Watershed, Fisheries, and Roads Analysis

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Introduction

This portion of Chapter 3 discusses existing conditions after the 2002 fires and the potential effects on watersheds, fisheries and roads as a result of the proposed management activities.

Each alternative is first considered as a complete entity, in terms of direct and indirect effects within the project area boundary. This is followed by a cumulative watershed effects analysis that considers, by subwatershed, the overall effect of: past activities on all ownerships, the Toolbox Alternatives on a subwatershed basis, and reasonably foreseeable future activities on all ownerships. Subwatersheds correspond to 6th field Hydrologic Unit Codes (HUC). A hydrologic unit code (HUC) is defines as an area of land upstream from a specific point on a stream (designated as the mouth) that defines a hydrologic boundary and includes all of the source areas that could contribute surface water runoff directly and indirectly to the designated outlet point.

The fisheries analysis focuses on the current condition and effects of the project on redband trout (*Oncorhynchus mykiss spp*.). Redband trout is the only native trout species found in the Toolbox Fire Recovery Project area. Bull trout (*Salvelinus confluentus*) a federally listed threatened species are not found in streams in the project area therefore, there are no priority watersheds in the project area. Other fish species that occur in the project area include non-native Eastern brook trout (*Salvelinus fontinallis*), sculpin (*Cottus spp*.), and speckled dace (*Rhinicythys osculus*.). The current aquatic condition information used in this analysis was obtained from the Silver Lake Watershed Assessment (SLWC, 2003), post-fire stream surveys for large woody debris and shade in fish bearing streams, and post-fire stream channel conditions surveys for major intermittent streams.

Because of the close relationship between watershed conditions and roads, this section also incorporates a discussion of the **Roads Analysis Process** that was used to generate road management strategies for each alternative. The Roads Analysis

Process resulted in recommendations regarding each road that ranged from leaving the road open at its current maintenance level, increasing the maintenance level, closing the road, or decommissioning the road. These recommendations were used to design the varying road management actions that are included in the alternatives.

Key Issue: Effects on Soils, Watersheds, and Aquatic Habitat

Issue Statement: The proposed salvage and connected actions, including temporary road construction, could potentially have adverse effects on water quality and timing of runoff, and cumulatively contribute to adverse effects on soils.

Measurement Indicators:

1. Watershed and Riparian Effects, by determining the effect (Restore; Maintain; Degrade) on the functionality of:
    - Uplands – Roads, Canopy, Soil
    - Riparian Vegetation and Bank Stability
    - Channel Condition - Pool frequency, Large Wood Frequency, Temperature, Fine Sediment and Fish Passage

2. Soils (See Geology, Geomorphology and Soils section of Chapter 3), including measures of:
    - Fertility
    - Sediment Risk (including the contribution of roads to sediment transport)
    - Compaction

3. Amount of Soil and Riparian Protection and Restoration Activity (miles or acres) and assessment of effects, including sediment reductions (tons/year) from Road Decommissioning

4. Attainment of INFISH Riparian Management Objectives – Yes or No

Purpose and Need

The purpose and need of this project includes six elements, one of which relates directly to Watershed and Fisheries:

- Restore riparian areas damaged by the Toolbox Fire Complex

Regulatory Framework

Watershed and Roads Analysis

The Fremont National Forest Land and Resource Management Plan (LRMP) (USDA 1989) provides direction regarding resource management activities and establishes management standards and guidelines. Direction pertaining to the water resources portion of the Toolbox Fire Recovery Project is discussed below.

The LRMP forest-wide standards for soils and watershed management are to:

- Maintain or improve soil productivity (p. 80).
- Keep soil erosion levels within tolerable limits (p.83).
- Monitor results and impacts of land management activities on soil productivity (p. 83).
- Protect water quality through implementation and enforcement, monitoring and evaluation, and modification of best management practices (BMPs). [Guidance regarding individual BMPs are described in General Water Quality Best Management Practices, Pacific Northwest Region, 1988] (p. 88)
- Assess the cumulative effects of activities on water quality or stream channels (p. 86).
- The Forest Plan sets the goal as “a safe and economical transportation system providing efficient access for the movement of people and materials” (p. 51).

LRMP Forest-wide standards that affect soil and watershed condition provide further detail:

- The transportation system will serve long-term multiple resource… (with)…the minimum system necessary to provide access for the activities authorized under management area direction” (p. 116).
- Overall density for roaded area of the Forest will not exceed 2.5 miles per square mile (p. 116).

- All system roads will be operated and maintained to protect the resources, perpetuate the intended road management objective, and promote safety (p. 116).
- Prescribed fire will be considered for use in meeting management objectives in areas where ecological studies show that fire has played a significant role in ecosystem development (p. 118).

The following LRMP Management Areas have further management goals and standards that pertain to water resources:

- MA 15 – Fish and wildlife habitat and water quality (p. 199) (Goal): Water bodies and courses, their riparian vegetation, and the immediately adjacent upland areas will be managed to maintain or improve water quality, fish habitat, recreation opportunities, and riparian habitat for dependent wildlife species. All project actions must be in compliance with the Inland Native Fish Strategy (INFISH). The Forest Plan amendment for INFISH (1995) amended the standards and guides by creating Riparian Habitat Conservation Areas (RHCAs) (See Chapter 1 of this EIS, "Forest Plan Management Areas"). Standards and guidelines:
    - Applicable state and federal water quality standards will be met.
    - Site-specific prescriptions will be required for all project activities that affect aquatic/riparian systems.
    - In cases of irresolvable conflict, soil, fish, water, and wildlife will receive preferential consideration.
    - Watershed, wildlife, and fisheries habitat rehabilitation and improvements will be required to meet goals for aquatic/riparian systems.
    -

Soil Productivity Guide (SPG) (Fremont National Forest 2000). Goal: Consider soil impacts when planning all ground-disturbing management activities, implement sound soil conservation and management practices, monitor impacts of those practices, and maintain the productive potential of the lands. Standards and guidelines: see Geology, Geomorphology and Soils Section; (See Appendix C for complete text of Soil Productivity Guide).

Forest Service Manual 2500 – Watershed and Air Management (Chapter 2520 – Watershed Protection and Management). Objective: To meet direction in the National Forest Management Act of 1976 and other legal mandates. To manage National Forest System lands under ecosystem management principles without permanent impairment of land productivity and to maintain or improve soil and water quality.

Forest Service Manual 7700 - Transportation Analysis (7712.1 - Roads Analysis). If road management activities are planned, decisions are required to be informed by an interdisciplinary science-based roads analysis, if those activities would result in new road construction, changes in access, such as changes in current use, traffic patterns, and road standards, or where there may be adverse effects on soil and water resources, ecological processes, or biological communities.

Other regulatory or legal requirements that direct watershed management are:

- Section 208 of the Federal Water Pollution Control Act of 1972 specifically mandates identification and control of silvicultural related non-point sources of pollution.
- Clean Water Act, Section 303, 319, 404.
- Federal law required that streams, rivers, lakes and estuaries that appear on the 303(d) list be managed to meet water quality standards. A comprehensive watershed approach for protecting water quality includes developing TMDLs (total maximum daily loads) for both point and nonpoint sources. Department of Environmental Quality (DEQ) is committed to having federally approved TMDLs on all waterbodies listed on the 1998 303(d) list by the end of the year 2007. Two waterbodies within the project area are currently on the 303(d) list for temperature: West Fork Silver Creek (from mouth to Silver Creek Marsh) and Silver Creek (from mouth to Thompson Valley Reservoir).
- Section 319 of the Clean Water Act directs states to develop programs to control non-point source pollution and includes federal funding of assessment, planning and implementation phases.
- Section 404 of the Clean Water Act (CWA) established a program that regulates the discharge of dredged and fill material into water of the United States, including wetlands. Activities regulated under this program include fills for development, water resource projects (e.g., dams and levees), infrastructure development (e.g., highways and airports), and conversion of wetlands to uplands for farming and forestry.
- Best Management practices (BMPs) are the primary mechanism to enable the achievement of water quality standards. The Forest Service Nonpoint Source Management System consists of: Selection and design of BMPs based on site-specific conditions, technical, economic and institutional feasibility, and the water quality standards of those waters potentially impacted, the implementation and enforcement, monitoring to ensure compliance and

effectiveness, evaluation of monitoring, and adjustment of BMP standards and application. A complete list of BMPs refined for the Fremont National Forest can be found in Appendix C.

Fisheries

Forest-wide fisheries standards that apply to the project are contained within the Fremont National Forest Land and Resource Management Plan (LRMP) (USDA Forest Service, 1989) as amended by The Inland Native Fish Strategy (USDA Forest Service, 1995: A-6 to A-13).

There are two Forest-wide fisheries/riparian standards in the Fremont National Forest LRMP that apply to this project:

1. Redband trout populations will be used as an indicator of fisheries habitat changes (USDA Forest Service, 1989: Appendix 1, pg. 77)

2. Protection and enhancement of riparian areas, Management Area 15, which emphasizes fish and wildlife habitat and water quality (USDA Forest Service, 1989: pg. 199-204). The INFISH amendment substantially modified the way in which MA 15 direction is implemented (See Chapter 1, "Forest Plan Management Areas").

Inland Native Fish Strategy

The Inland Native Fish Strategy (INFISH) was developed in 1995 as a response to the need for a management strategy that would protect inland native fish that were not already covered within the geographic scope of the Northwest Forest Plan or the Interim Strategies for Managing Anadromous Fish Producing Watersheds on Federal Lands in Eastern Oregon, Washington, Idaho, and Portions of California (PACFISH). This includes such species as bull trout, westslope cutthroat trout, and interior redband trout. This strategy provides direction to maintain and restore native fish habitat and populations in those geographic regions outside the range of anadromous fish. INFISH was designed to provide interim protection for fish habitat and populations until longer-term management strategies such as the Interior Columbia Basin Ecosystem Management Project (ICBEMP) and other federal recovery plans were developed (e.g. bull trout). INFISH is still in effect today because long-term plans have not been implemented.

INFISH provides Riparian Goals and Riparian Management Objectives (RMO's) describing quality fish habitat. The goals described within INFISH "….establish an expectation of the characteristics of healthy, functioning watersheds, riparian areas and associated fish habitats." The RMO's are habitat parameters that provide a basis for determining the state of stream function, and the attainability of riparian goals. Objectives for six environmental features are identified: pool frequency, water temperature, large woody debris, bank stability, lower bank angle, and width to depth ratio. These features are good indicators of ecosystem health, and quantifiable, and are subject to accurate repeatable measurements. INFISH specifies default numeric values for each of the RMOs (USDA Forest Service 1995: A-2 to A-4). The default RMOs for pool frequency, large woody debris, water temperature, and width to depth ratio would apply to all of the streams in the project area. The default RMOs for bank stability and lower bank angle do not apply to the project area because they are to be used in non-forested stream systems and there are no non-forested stream systems within the project area.

INFISH establishes Riparian Habitat Conservation Areas (RHCAs) around all streams, wetlands, water bodies, and landslide prone areas on the Fremont-Winema National Forests (USDA Forest Service, 1995: A-4 to A-6). RHCAs are portions of watersheds where riparian-dependent resources receive primary emphasis, and management activities are subject to specific standards and guidelines. Standard widths defining RHCA appear in the following table:

Table 3.xx. RHCA Standard Widths, per Stream Side

Type of RHCA	Width, Each side of Stream
Category 1 - Fish bearing stream reaches	300
Category 2 - Perennial, non-fish bearing streams	Not found in project area
Category 3 - Ponds, lakes, wetlands, >1 acre	150
Category 4 - Seasonally flowing/ intermittent stream reaches	50

INFISH directs that site-specific widths may be increased where necessary to achieve riparian management goals and objectives, or decreased where interim widths are not needed to attain RMOs or avoid adverse effects.

Fourteen standards in the INFISH Decision Notice apply to this project. These include: TM-1 (a), RF-1, RF-2 (a-f), RF-3 (a-c), RF-4, RF-5, GM-1, FM-1, FM-4, RA-2, RA-4, RA-5, WR-1, and FW-1. The other INFISH standards and guidelines are outside the scope of this project. TM-1 prohibits timber harvest within RHCAs, except as follows TM-1 (a):

> Where catastrophic events such as fire, flooding, volcanic, wind, or insect damage result in degraded riparian conditions, allow salvage and fuelwood cutting in RHCAs only where present and future large woody debris needs are met and where cutting would not retard or prevent attainment of other Riparian Management Objectives and where adverse effects can be avoided to inland native fish.

Project specific salvage designs within RHCAs, under TM-1a, were developed for the Toolbox Fire Recovery Project proposed action and then modified or applied in a varying fashion during the development of the action alternatives.

Interior Columbia Basin Ecosystem Management Project

The Interior Columbia Basin Ecosystem Management Project (ICBEMP) was initiated by the USDA Forest Service and USDI Bureau of Land Management to develop and implement a coordinated, scientifically sound, broad-scale, ecosystem-based management strategy for lands they administer across parts of Idaho, Oregon, Montana, and Washington. This project was designed to replace existing management plans such as PACFISH, INFISH and the Eastside Screens.

The theme of ICBEMP is on restoring and maintaining ecosystems across the project area and providing for the social and economic needs of people, while reducing short- and long-term risks to natural resources from human and natural disturbances. The science that was used to develop the ICBEMP criteria for evaluating functionality of aquatic habitats will be used in this document, as it is considered the best available.

Endangered Species Act/Sensitive Fish Species

There are no fish species listed as either threatened or endangered under the Endangered Species Act of 1973 within the project area. Therefore, a biological assessment for affected fish species will not be required with this project.

In 1997, several groups petitioned the U.S. Fish and Wildlife Service to list redband trout in the Great Basin under the Endangered Species Act. On March 15, 2000, the U.S. Fish and Wildlife Service found Great Basin redband trout not warranted for listing at this time (USDI 2000). Reasons given for not listing included moderate to high numbers of redband trout as compared to state-wide averages, an improving trend in habitat conditions, the return of adfluvial populations in Goose Lake and Chewaucan River systems, and strong conservation efforts through various working groups and watershed councils.

Interior redband trout are a sensitive species on the Regional Foresters Sensitive Animal list (November 28, 2000). A Biological Evaluation has been prepared for this project and is available in the project files located at the Silver Lake Ranger District. The Biological Evaluation for fisheries addresses the direct, indirect, and cumulative effects of all alternatives on interior redband trout habitat, individuals, and populations.

Analysis Area and Methods

Watershed

Map 2 displays the analysis area, the hydrologic units and the streams discussed in this analysis.

The existing condition of the two fifth field watersheds was completed on two levels: the project area alone and for each of the eight 6th field subwatersheds involved in the analysis area. Several sources of information were used to arrive at the existing conditions: Geographical Information Systems (GIS), field inventories after the fire occurred, Burn Area Emergency Rehabilitation (BAER) report, and existing field inventories.

Field inventories were completed after the fire burned to measure the condition of soil compaction, stream channels, and roads. Soil compaction was inventoried using the methodology outlined in the Geology, Geomorphology and Soils section.

Ochoco Bottomline surveys for intermittent streams were completed on nine intermittent streams (Benny Creek, Hawk Creek, Graham Creek, Duncan Creek, East Duncan Creek, McCall Creek, Willow Creek, Indian Creek, and Strawberry Creek) within the project area. Information from these surveys includes: photographs of the stream, dominant and

subdominant substrate material, slope, shade, large wood frequency and pool frequency. An assessment of the stream condition was completed in 2000 on the perennial streams of Silver Creek, the 5th field watershed. This inventory was the basis for the Silver Lake Watershed Assessment (Friedrichsen, 2003) and included all perennial streams within the analysis area: Silver Creek, West Fork Silver Creek, North Fork Silver Creek and Guyer Creek. Field inventories, after the fires burned, were completed on sections of these streams affected by the fire.

The Burn Area Emergency Rehab (BAER) team analyzed the Toolbox and Silver Fires after the fires were contained on August 5, 2002. Results are detailed in the Geology, Geomorphology and Soils section.

Two documents that analyzed portions of the project area are available: Silver Lake Watershed Assessment (Friedrichsen, 2003) and Silver Creek Watershed Ecosystem Analysis at the Watershed Scale (USFS, 1997). However, both analyses are based on data collected before the Toolbox fire complex burned and more recent data has been collected. Both analyses utilize methodology that has since been improved or altered and neither analysis covers the entire project area. Several areas of concern cited in both analyses are consistent. For example, both documents cite roads as the highest producer of soil loss and both recommend the closure or decommissioning of roads as the most effective method for decreasing high road densities. Both documents suggest the [obliteration] decommissioning of roads within 300 feet of streams be the emphasis. Any specific road recommendations from the analyses were replaced by the recent Roads Analysis completed specifically for this project. Compacted soil in timber harvest units was identified as the largest soil impact (USFS, 1997) and recommendations to increased infiltration through subsoiling are expressed. Friedrichsen (2003) suggests there is a data gap with respect to the level of soil impacts that have occurred within each subwatershed and suggests further site-specific data collection is needed. The USFS (1997) analysis concluded that most subwatersheds have high disturbance levels on greater than 40% and as high as 73% of the subwatershed. The 1997 analysis used aerial photo interpretation to determine detrimental soil conditions and field verified these findings with four field transects. The data gathered to determine soil condition for the this analysis was all field generated data that was collected post fire, covered the entire project area, and consisted of 91 transects.

Existing information from field inventories was also used for the analysis. A culvert inventory was completed between 1999 and 2002. Culvert and stream channel information in the vicinity of road crossings at three hundred and ninety-nine culverts across the Fremont National Forest were inventoried. The inventory information was used to determine if a given culvert was an impediment to fish passage or not. On some occasions, the information gathered was not enough to make a determination regarding fish passage. Temperature has been monitored on several perennial streams across the forest and seven-day average maximum temperatures are calculated for each year of record. Sediment was monitored at several perennial stream sites within the analysis area in 1996 and 2000. The Soil Resources Inventory (SRI) (Wenzel, 1979) was used to characterize soils found in the analysis area.

Water Erosion Prediction Program (WEPP) was used to determine a background erosion rate of 0.01 to 0.05 tons/acre. Directly after the fire, an erosion rate for Toolbox was calculated at 0.09 tons/acre and 0.06 tons/acre for Silver. Site soil erosion and sediment transport scenarios were run for various scenarios, based on eco-class, soil type, and slope patterns. The estimates provide context for the effect of skid trails two years into ground cover recovery or the sedimentation as a result of the commercial salvage operation.

In order to estimate the amount of sediment generated off of the roads within the analysis area, WEPP (Waters Erosion Prediction Project, 1999) Cross Drain Spacing and Sediment Yield Program (version 2.000) was used. A typical 2 percent grade on native or graveled roads with 400 to 800 feet cross drain increments with an eastside climate from Wallowa, Oregon was used to run the model. Roads away from streams yield 0.0025 tons per year per mile of native road and 0.00 tons per year per mile of gravel road. Roads near streams yield 0.47 tons per year per mile of native surfaced road and 0.35 tons per year per mile of gravel road. These values were used to generate relative differences between alternatives with respect to sediment generation from roads.

The Roads GIS layer was used as the basis of the Roads Analysis process. It was used to calculate the number and location of road crossings, the boundary and acres of each subwatershed, the capability area for the analysis of the soils, ownership of the land base, and several other factors.

Fisheries

The fisheries analysis focuses primarily on the Silver Fire portion of the project area. The Silver Fire portion contains all four fish bearing streams in the entirety of the Toolbox Fire Recovery project area. These streams are Silver Creek, West Fork Silver Creek, North Fork Silver Creek, and Guyer Creek. There are no fish bearing streams within the Toolbox fire area. Streams within the Toolbox Fire portion are intermittent in nature and flow in the early spring and drain into Thompson and Duncan Reservoirs. These streams may provide limited spawning habitat for redband trout during early spring runoff. Spawning may occur in these streams, particularly the lower mile of Benny and Duncan Creeks, however, stream flows last for roughly 4 weeks and recede quickly thus exposing spawning gravels and killing any potentially incubating eggs.

Data Collection Methods

During the summer of 2000 stream survey crews and resource professionals gathered and summarized current condition information on fish bearing streams on a stream reach basis in support of the Silver Lake Watershed Assessment (SLWC 2003). The following was assessed:

- Dominant vegetation type
- Available shade
- Bank stability
- Large woody debris
- Pools
- Substrate composition
- Stream channel characteristics such as gradient, wetted width, bankfull width, bankfull depth, floodprone width were measured which aides in the delineation of Rosgen Channel Types.

Data collection on fish bearing streams in the post-fire period (fall of 2002) consisted of recounts of large woody debris in the affected stream reaches and measurements of shade using a solar pathfinder. Data collection on intermittent stream channels used the Ochoco Bottom Line survey method (Grover et. al. 1992).

Management Indicator Species

These are species identified in the Fremont National Forest LRMP to represent the welfare of other species using the same habitat. The habitat requirements of the selected indicator species are presumed to represent those of a larger group of species. The Fremont National Forest LRMP designates redband trout as the management indicator species for assessing changes to fish habitat on the Fremont National Forest (USDA Forest Service 1989).

Key Parameters Used to Analyze Effects to Aquatic/Stream Channel Conditions

Redband trout production, growth, survival, and long-term population persistence depends on several key habitat characteristics. These characteristics include:

- Riparian Vegetation and Bank Stability
- Large Woody Debris
- Large Pools
- Spawning Gravel Fines/Substrate Composition
- Rosgen Channel Type
- Stream Temperature and Shade

Roads and Roads Analysis

Recommendations from the Roads Analysis Process were used to generate road management strategies for each alternative. Road analysis consists of six steps: Setting up the analysis, describing the situation, identifying issues, assessing benefits, problems, and risks, describing opportunities and setting priorities, and reporting. The information used to determine recommendations for Roads Analysis was augmented with field inventories of the roads within the project area. The field inventories noted several characteristics of the road. Most notably, the condition of the road and any unclassified roads that were encountered were inventoried. The recommendations regarding road management were made with a full compliment of resource specialists, including: soils, hydrology, fisheries, wildlife, cultural, silviculture, recreation, engineering, timber

and fire. Each road was reviewed in a systematic manner by the roads analysis team. The engineer shared pertinent information found during the field inventory and a discussion ensued regarding the necessity of each road as it pertained to each resource. The recommendations from the roads analysis were based on resource needs and benefits and the calculated road density was a result of those recommendations. The recommendations regarding each road ranged from leaving the road open at its current maintenance level, increasing the maintenance level, closing the road, or decommissioning the road. The situation where the current maintenance level was recommended to increase occurred only when the current maintenance level was not reflective of the condition or need for the road. A recommendation for closure of a road reflected the foreseeable need for intermittent use of that road. A recommendation to decommission a road reflected the road should be removed for resource needs and the road was not necessary for other resource needs. The recommendations that came out of the roads analysis were then incorporated and/or modified into the action alternatives, consistent with the overall theme of a given alternative. See Appendix E for a complete listing of proposed road management actions by road and by alternative.

Since no new specified road construction was identified during timber sale planning, the analysis area for potential road reconstruction includes the existing transportation system that would be needed for the timber haul associated with the action alternatives. This includes consideration of roads both within the project area and outside of the area. In addition, potential material sources for surfacing materials are included in the analysis area. This includes three cinder pits that are currently developed:

- Rim Cinder Pit: NW, SE, Sec.34, T.29S., R.16E
- Thompson Cinder Pit: NW, Sec.24, T.30S., R.13E.
- 3004 Cinder Pit: NE, NE, Sec.5, T.31S., R.16E.

Short-term vs. long-term

In the environmental consequences section, the terms “short-term” and “long-term” are used to predict the duration of effects. “Short-term” refers to any effects that would occur between the present time and the end of the year 2007. “Long-term” refers to any effects that would occur starting in the year 2008.

Existing Condition

The project area is located on the Silver Lake Ranger District of the Fremont-Winema National Forests. Local weather is largely influenced by the Cascade Mountains. The higher peaks of the subwatersheds of the analysis area lie to the east of the Cascade Mountain Range within view of Crater Lake National Park and Mount McLoughlin. This mountain range lifts and blocks the maritime air masses that move eastward from the Pacific Ocean, inducing rain and snow to fall on its slopes. The watershed stands in the shadow of the Cascade Range and receives leftover rain and snow and averages about 15-40 inches each year depending on elevation. The majority of precipitation falls as snow from October through March, with the highest elevations receiving the greatest depths. Winter temperatures typically drop below 0°F. Even during the summer, frost and snow may occur at these elevations. Convective thunderstorms provide rain in the spring and summer, although the summer months are relatively dry. Higher elevation areas have a progressively shorter growing season, being significantly shorter above 6,500 feet elevation where ponderosa pine becomes less common. Rain and snow are captured by juniper and sagebrush along the lower scabland plateaus, by ponderosa pine in the lower to middle elevations, and by white fir, Shasta red fir, mountain hemlock and lodgepole forests in the upper elevations. Some of this intercepted water evaporates, while the remainder soaks into the soil. The best infiltration occurs when needles and leaves cover the soil, slowing surface runoff and allowing the moisture to enter the ground.

The analysis area is comprised of eight 6th field watersheds or subwatersheds, which are part of two 5th field watersheds—Silver Creek (HUC 1712000502) and Silver Lake (HUC 1712000503). Ninety-three percent of the analysis area has a slope between 0 and 20%, while 7% of the analysis area has a slope greater than 20%. The few areas with steeper slopes occur along canyons of Silver, West Fork Silver, Duncan, and East Duncan and along peaks and ridges such as Foster Butte, etc. The elevation within the project area ranges from approximately 4500 ft to 5800 ft in the Silver Fire area and 5300 ft to 6700 ft in the Toolbox Fire area. The elevation within the eight subwatersheds ranges from 7680 at Yamsay Mountain to 4315 at Paulina Marsh.

The wildfires of 2002 burned approximately 110,000 acres on the Fremont National Forest. Eighty thousand acres burned within the Toolbox Fire Recovery project area and will be referred to as the Silver Fire and Toolbox Fire. The severity of

both fires varied from unburned to high severity. Eight 6th field HUC subwatersheds that were affected by the fires will be analyzed for this project. They are shown in Table 3-XX. A minor portion of the 6th field HUC 171200050208 (Bridge Creek) burned in the Silver Fire and HUC 171200051003 (Ana River) burned in the Toolbox Fire but these subwatersheds are not part of the project area and are not analyzed for this project.
In order to understand the common measurements used in this analysis, a discussion of the terms "mortality" (or level of mortality), "intensity" and severity" is useful. These terms, particularly severity and intensity have often been are used in different ways in different arenas. They are even sometimes used interchangeably; they are often confused. For example, the Toolbox Complex BAER Report (for the entire Toolbox Complex) indicated that 74,673 acres burned with low severity, 11,311 acres with moderate severity and 810 acres with high severity. However the maps that accompanied the BAER Report instead displayed "burn intensity" and showed a very small area of high intensity (corresponding to the 810 acres of "high severity"). In all cases, the terms used in the BAER are related to the effect of the fire on the soils, specifically the water absorbency/repellency of the soils (correctly termed "severity"). Burn intensity describes the nature of a fire in terms of its rate of energy release. These are physical descriptions of the fires, rather than ecological effects.

Silver Lake Ranger District and North Zone specialists in several disciplines worked to develop, update and ground-verify vegetative mortality maps of the burned areas. Any reference to "severity" of burn in any background documentation in the Toolbox Fire Recovery analysis file that is drawn from these maps should not be considered to be the same use of the term "severity" in the Toolbox Complex BAER Report.

Very high vegetative mortality was documented along 7.4 miles of fish bearing streams, moderate and high mortality along 9.8 miles, and low mortality along 5.7 miles.

Burn severity was determined by the BAER (Burn Area Emergency Rehabilitation) team and was based on soil condition and degree of hydrophobicity. Burn severity across the project area is dominated (85% of the project area) by low severity burn, approximately 14% was classified as moderate severity, and 1% classified as high severity. The majority of the high severity burned areas are located in West Fork Silver Creek (approximately 196 acres) and Lower Duncan Creek (approximately 402 acres).

Table 3-XX – Hydrologic Unit Code and Associated Fire

FIRE NAME	6TH FIELD HUC NAME	6TH FIELD HUC NUMBER	Area (acres)
Toolbox	Benny Creek	171200050204	26,813
Toolbox	East Duncan Creek	171200050302	11,601
Toolbox	Lower Duncan Creek	171200050303	25,012
Silver/Toolbox	Middle Silver Creek	171200050209	38,828
Silver/Toolbox	Thompson Reservoir	171200050205	41,166
Toolbox	Upper Duncan Creek	171200050301	22,146
Silver/Toolbox	Upper Silver Creek	171200050206	16,276
Silver	West Fork Silver Creek	171200050207	24,001

The fires (Silver fire and Toolbox fire) make up approximately 44% of the eight subwatersheds included in this analysis. The fire burned greater than 50% of the subwatershed in East Duncan Creek, Lower Duncan Creek, and Upper Duncan Creek. Fortunately, the majority of the fires burned at low to moderate severity.

Table 3-XX Percent of each Subwatershed Burned and associated burn severity

SUBWATERSHEDS	HIGH SEVERITY	MODERATE SEVERITY	LOW SEVERITY	PERCENT OF SUBWATERSHED-BURNED
Benny Creek	0.2%	8.8%	38.9%	48%
East Duncan Creek	0.3%	12.9%	83.1%	96%
Lower Duncan Creek	1.6%	5.2%	48.9%	56%
Middle Silver Creek	0.0%	0.2%	4.1%	4%
Thompson Reservoir	0.1%	3.7%	16.2%	20%
Upper Duncan Creek	0.1%	12.4%	67.5%	80%
Upper Silver Creek	0.4%	1.9%	31.4%	34%
West Fork Silver Creek	0.8%	5.8%	33.8%	40%

Land ownership for each of the subwatersheds is a matrix of Forest Service owned land, UST (United States Timberland), and other private holdings. The Forest Service owns approximately 58% of the project area, UST owns approximately 29%, and 13% is owned by other private holdings.

The table below summarizes the miles of riparian area burned, by vegetative mortality level, along fish bearing and surveyed intermittent streams within the project area.

Table 3.xx. Miles of Riparian Area Burned on National Forest System Lands within the Silver Fire Portion

Stream	Miles in Area	Low Mortality	Moderate and High Mortality	Very High Mortality	Percent of Stream Miles Burned at Moderate to Very High Mortality
Silver Creek	9.3	3.8	3.3	2.2	59
WFK Silver Creek	9.4	1.9	2.5	5.0	80
NFK Silver Creek	2.3	0.0	2.1	0.2	100
Guyer Creek	1.9	0.0	1.9	0.0	100
Strawberry Creek	3.4	0.6	1.8	1.0	82
Indian Creek	1.7	0.5	0.0	1.2	71
Totals	**28.0**	**6.8**	**11.6**	**9.6**	

Data used to describe the current stream channel conditions on the four fish bearing streams was collected in the summer of 2000 and fall of 2002. Stream functionality calls are made based on whether habitat objectives are being met. Habitat is compared to INFISH Riparian Management Objectives (USDA 1995). Other habitat elements such as water temperature, riparian vegetation, bank stability, and fine sediment were established by examination of the scientific literature and/or obtained through monitoring of natural or near natural streams on the Fremont National Forest.

Designated Beneficial Water Uses

The waters associated with this project area are for the beneficial use of fisheries, terrestrial wildlife, livestock and road watering. Downstream uses are similar with the addition of agricultural irrigation. There are no surface water supply sources within the project area.

Water quality is currently maintained through the application of Best Management Practices (BMPs) for controlling nonpoint sources of pollution to surface water.

303(d) Listed Waters

Forest Service temperature monitoring data was provided to the Oregon Department of Environmental Quality (DEQ). Streams that did not meet State of Oregon water quality standards were submitted by DEQ to the Environmental Protection Agency (EPA) for inclusion in the EPA 303(d) list. Stream temperatures are out of compliance with the State standards for rearing habitat when any maximum 7-day temperature average exceeds 17.8°C. There are two locations that are on the 303(d) list that are part of the analysis area. Silver Creek from the mouth to Thompson Valley Reservoir (Record ID 665, Segment ID 42A-SILV0) and West Fork Silver Creek from the mouth to Silver Creek Marsh (Record ID 666, Segment ID 42A-SIWF0) were found to have 7-day average daily maximum temperatures that exceed the temperature standard. Silver Creek is monitored with a temperature sensor at an elevation of 4530 and West Fork Silver Creek has two monitoring sites at elevations of 4460 and 4740, respectively.

Silver Creek and West Fork Silver Creek
Segments on 303d List
Middle Silver Creek
Lower Duncan Creek
West Fork
Silver Creek
Upper Silver
Creek
East Duncan
Creek
Upper Duncan
Creek
Thompson Reservoir
Benny Creek

Table 3-XX. Recorded 7-day Average Daily Maximum Temperature at 303(d) Monitoring Sites.

STREAM	ELEVATION	7-DAY AVERAGE DAILY MAXIMUM TEMPERATURE (°C)									
		1992	1993	1994	1995	1996	1997	1998	1999	2000	2002
SILVER CREEK	4530		22.8				24.1	23.9		24.4	26.2
WEST FORK SILVER CREEK	4460			27.0	21.2	21.8	21.4	21.1		23.8	
WEST FORK SILVER CREEK	4740	27.0	21.0	27.0	22.6	22.6	22.0	21.6	21.0	27.6	

Temperature

The following table lists the maximum 7-day average temperatures that have been recorded in the streams within the analysis area. These sites are not official monitoring sites for the 303(d) list.

Table 3-XX. Temperature Monitoring Sites

SITE	ELEVATION	1993	1994	1995	1996	1997	1998	1999	2000	2002
INSIDE FIRE BOUNDARY										
NORTH FORK SILVER CREEK	5050	12.7	15.4	12.3	12.9	12.5	13.0	12.3	14.3	17.4
WEST FORK SILVER CREEK	5050	13.1	16.4	12.8	13.8	13.3	13.2	12.4	15.3	17.8
All temperatures give in degrees Celsius										

Sediment Monitoring

Several sites within the project area are long-term sampling sites for fine sediment in channel substrate. These sites were inventories last in 2001, before that in 1996 and sampled again after the fires in May 2003. Typically the fine sediment information is generated with bulk samples of spawning gravel. The sample is acquired through the insertion of a cylinder into the streambed and extracting the gravel from the cylinder. Five samples were taken at each site, at pool tail crests or other areas that provided suitable spawning gravels. The samples were then dried and passed through a series of nested sieves to determine the percent of fines less than 6.4 mm (Table 3-XX). In 2003, one sample at two of the four sites was taken of the percent fines on West Fork Silver Creek.

Table 3-XX. Percent Fines less than 6.4 mm within Project Area.

STREAM	ELEVATION	PERCENT FINES LESS THAN 6.4 mm		
		1996	2001	2003
WEST FORK SILVER CREEK	4850	41	35	32
WEST FORK SILVER CREEK	4740	26	25	NA
WEST FORK SILVER CREEK	4460	31	15	30
SILVER CREEK	4720	36	NA	NA

Road System

Historically, the Fremont National Forest emphasized timber management. A large road system was constructed to gain access to timber and other forest resources. Timber sale revenue paid for the majority of the road construction and maintenance. In the past decade however, timber harvest has declined. This change in forest management has reduced the operating budget and the ability to maintain an extensive road system. The Toolbox Fire Recovery Project proposes quantities of timber haul over the existing road system that far surpass levels that have occurred in the past decade, or more. The existing road system proposed for reconstruction includes Maintenance Level-2 roads consisting of native surfaces. Included in this road system are arterial haul roads with diminished cinder surfaces.

Environmental Consequences

Additional Background

Forest Canopy

Removal of forest cover can increase water yield and is generally proportional to the amount of live vegetation and tree canopy removed from a site. The removal of canopy reduces the amount of evapotranspirational draft and increases openings which enhances snowmelt (Troendle, 1982). Generally, 20 to 30 percent of a watershed must be harvested before a significant change in flow can be detected (Troendle and Leaf, 1981). However, the removal of the canopy from the analysis area has already occurred as a result of the wildfire. The action alternatives remove only dead trees (with the exception of noncommercial thinning), which are no longer functioning as canopy.

Fire Effects on Watershed Function and Aquatics

The effect fire has on watershed function is widely variable but generally predictable. The elements of watershed function that are affected by fire that are focused upon are soil and water. Changes in soil and water regimes are most significant where fire has a large-scale impact on the vegetation and soil properties of the ecosystem (Swanson, 1981 in Agee, 1993). On the other hand, with fires of low severity or those that affect a small part of a large watershed (Bethlalmy, 1974 in Agee, 1993), it is difficult to detect changes in soil and water regimes (Beschta, 1990; McNabb and Swanson, 1990).

Swanson (1981 in Agee, 1993) utilizes a flow chart that considers vegetation, soil properties, hillslope hydrology, hillslope geomorphic processes and channel response. The degree to which the effect on each of the elements occurs is a function of the scale of the fire impact. After a fire occurs the vegetation typically results in reduced root strength, reduced ground cover, reduced leaf area and evapotranspiration, reduces standing biomass, and increased blowdown. Evapotranspiration is the collective term for evaporation from soils, plant surfaces, and water bodies, together with water losses through plant leaves. Depending on the severity of the fire the soil typically illustrates an increase in hydrophobicity (water repellency of the soil caused by the coating of soil particles by hydrophobic organic substances from plant decomposition or fungi (Agee, 1993)), which may result in increased overland flow. The reduction in ground cover and reduced root strength may increase surface erosion. The reduction of litter layer and soil organic matter may increase overland flow and increase surface erosion. An increase in surface erosion may result in aggradation of the channel. The reduction in ground cover and reduced litter layer may result in reduced thermal insulation that may result in an increased depth of freeze-thaw cycles that may ultimately increase freeze-thaw soil movement. The reduction in evapotranspiration and the reduction in standing biomass may increase the amount of water available to the soil that could result in more frequent shallow, rapid soil mass movement.

Wildfires can also have an affect on the nutrient cycle in aquatic systems. Usually there is an initial nutrient pulse after a wildfire. This is followed by a gradual decrease in nutrient loss from the watershed because of the high recovery of net photosynthetic rates of terrestrial vegetation. Low nutrient concentrations in the stream 5-10 years after the fire are expected to contribute to the decline in autochthonous production (Minshall, Brock, and Varley 1989). Enhanced light levels will increase primary production for 10-20 years. There are two major factors affecting the pattern of dissolved nutrient concentrations in streams: 1) water borne transport, and 2) biotic uptake and release. Nutrient increases are usually small or of a short duration after a fire and their effects on fish populations and food resources are negligible in most cases. Robichaud et. al. (1993) observed relatively little sediment transport and minimal nutrient losses following a low intensity burn in northern Idaho, however, nutrient spikes following fire are most common during storm events in the autumn and after the summer period of maximum algal production and fish growth.

The response of aquatic macroinvertebrates to fire depends on the degree of sedimentation, streambed movement, and changes in riparian and upland vegetation. The first year following a fire, increased stream flows, streambed erosion, and/or high-suspended sediment concentrations, could cause significant invertebrate drift from streams draining the burned area. Deposition of fine sediments has the potential to alter habitat thus influencing species density and composition. Rinne (1996) states that aquatic macroinvertebrate densities did not change immediately following a fire, however after runoff events population densities decreased. Rinne (1996) also observed that in the year following a fire aquatic macroinvertebrate diversity was reduced by 25% to 70%.

Fire can alter the quantity, quality, and use of salmonid habitat via the alteration of water temperatures, sedimentation rates, riparian vegetation, nutrient availability, food sources, and woody debris (McMahon and deCalesta 1990). The greatest

potential of fire to harm salmonid populations are those species which spawn and rear in small to medium sized streams draining forested watersheds. Thus, riparian zones and fish populations are strongly influenced by fire and associated forest management activities occurring in the watershed. Siltation of streambeds has been widely documented as adversely affecting salmonid populations in a variety of ways, including reducing embryo survival, fry emergence, and limiting the abundance of aquatic macroinvertebrates. Increased inputs of fine sediment were found to cause mortality in Yellowstone cutthroat trout two years after large wildfires occurred (Bozek and Young 1994). After large wildfires on the Boise National Forest, rainbow and bull trout densities were lower in some reaches and higher than pre-fire conditions in other reaches (Reiman et al 1997). The effects of fire on fish and aquatic resources may depend on multiple factors that include: the scale and severity of fire; existing watershed and riparian condition; the connectedness of habitats that provide for potential refugia and re-colonization; and the potential for the full range of life history expression (Reiman et al. 1997).

Water temperature is a major factor affecting salmonid survival, distribution, production, and species composition in the Pacific Northwest. The most direct effect of fire along streams is the potential to increase stream temperatures to lethal levels during burning. The loss of riparian and upland vegetation from a fire can cause and elevation in stream temperatures for several years following a fire. Stream temperatures will gradually return to normal as re-vegetation of the riparian area occurs thus providing shade to the stream. Summer water temperatures will increase as a loss of shade from a fire, which results in an increase in primary and secondary production (McMahon and deCalesta 1990). Salmonid use in burned areas during the summer will be elevated as a result. Warmer stream temperatures will usually occur in the winter and spring, which can have a negative impact on salmonids such as altering the timing of fry emergence, smolt outmigration, and upstream migrations of adults.

The most significant, long-term impact to fish habitat following a fire is the loss of woody debris both in the stream channel and riparian areas. Because of this, stream channels become simpler and less stable and lose habitat complexity important for providing a diversity of stream velocities and cover types used as feeding and resting sites by salmonids and other aquatic organisms.

Water Quality and Quantity

Water quality criteria developed under section 304(a) of the Clean Water Act are based on data and scientific judgments on the relationship between pollutant concentrations and environmental and human health effects. The criteria are intended to "…accurately reflect the latest scientific knowledge…on the kind and extent of all identifiable effects on health and welfare including, but not limited to, plankton, fish, shellfish, wildlife, plant life…which may be expected from the presence of pollutants in any body of water…" (Environmental Protection Agency, 2002)

The reduction of forest vegetation from a wildfire or removal of trees reduces evapotranspiration and causes an increase in annual water yield. Initial increases in water yield on the east side of the Cascades are approximately 3 to 5 acre-inches. Overall the increases are generally proportional to the annual precipitation. For the action alternatives of this project, however, there would be no increase in water yield because the project would not remove green trees.

Snow dynamics are expected to be altered by the fire through the increase in the number of openings created by the fire and subsequently by salvage harvest. An increase in snow accumulation is expected as a result of increased openings. The openings created by the fire and salvage harvest will be mostly small and irregularly sized openings. Brooks et al. (1991, p. 277) reports that water yield increases are usually slight with small and irregularly sized openings.

Overland Flow and Runoff

Overland flow occurs rarely in a mature, unburned forest due to interception by the forest canopy, evapotranspiration, forest floor litter and decomposing organic matter. The factors that limit overland flow in a mature forest change after a moderate to severe wildland fire. More precipitation finds it way to the soil due to the reduction in standing biomass, leaf area, and evapotranspiration. Where fire severity is high and soils have become predominantly hydrophobic, water sheds off of the soil surface. The increase in hydrophobicity coupled with a decrease in ground cover affect the rate of overland flow and eventually becomes runoff and is delivered to streams.

A study of a 564-ha catchment located on the east slope of the Cascades in north central Washington burned in 1970 (Helvey, 1980). Runoff and sedimentation were measured from the catchment for 7 years after the fire. The author concluded that runoff from the burned catchment during subsequent years was much greater than the measured values

before the fire due to a much reduced transpiration loss from the burned watersheds and the change in vegetation characteristics.

The annual water yield coming off of subwatershed can be significantly increased after a fire due to reduced ground cover, reduced evapotranspiration, and increased hydrophobicity. This effect is proportional to the amount of watershed area burned and to annual precipitation (Beschta, 1990). Therefore a wildfire that burned at low to moderate severity in an area with limited annual precipitation will experience fewer changes in overland flow as a result of the fire.

Stream Flows and Channel Response

One must consider the impact of a precipitation event that follows a moderate to high severity fire. The impacts of such an event can be far-reaching (Minshall et. al., 1998). As discussed earlier, a severely burned forest can result in increased overland flow that can result in sheet, rill, and gully erosion of the burned area. In the extreme scenario, overland flow picks up sediment of varying sizes and eventually picks up debris. This debris torrent picks up velocity and cuts channels, at times scouring to bedrock, causing wide and deep gullies. The result is an increase in the amount of sediment in the channel that is eventually transported downstream or deposited in low gradient areas. Eventually the sediment will form new channels and stabilize.

Generally, in areas with limited topographical relief and minimal annual precipitation, like the Fremont National Forest, the effect of increased overland flow is seen in the form of increased sedimentation. The amount of sedimentation was estimated through the use of WEPP and found to be minor..

Direct and Indirect Effects-Watershed

The following table illustrates the alternatives and how they vary with respect to items of particular watershed concern. The open road density and open and closed road density are based on the project area. The open and closed road density includes not only those roads that will remain open but those that will be closed as well. Although the roads are not being used they still function differently than an unroaded space or a decommissioned road. The miles of road to be decommissioned under each alternative are shown along with the number of roads to be decommissioned within 300 feet of an intermittent or perennial stream (as recommended in USFS, 1997 and Friedrichsen, 2003).

Table 3.XX Activities by Alternative within Project Area.

PROJECT AREA	ALT. A	ALT. C	ALT. D	ALT. E	ALT. G	ALT. H
TOTAL COMMERCIAL SALVAGE (acres)	0	14,441	6,367	11,490	14,419	13,031
GROUND BASED COMMERCIAL SALVAGE (acres)	0	13,971	6,007	11,183	13,970	13,031
AERIAL COMMERCIAL SALVAGE (acres)	0	470	360	307	449	0
OPEN ROAD DENSITY (mi/mi^2)	3.68	1.76	1.68	2.57	2.57	1.72
OPEN & CLOSED ROAD DENSITY (mi/mi^2)	3.68	2.75	2.71	3.48	2.71	2.71
CLOSE ROADS (mi)	0.0	72.9	75.5	67.4	10.4	72.9
DECOMMISSION ROADS (mi)	0.0	69.0	71.6	14.6	71.6	71.6
DECOMMISSION ROADS WITHIN 300' of STREAMS (mi)	0.0	9.94	10.28	5.89	10.28	10.28
OPEN ROADS (mi)	271.0	129.1	123.9	189.0	189.0	126.5
SEDIMENT SAVINGS from ROAD ACTIONS (ton/yr)	0.0	0.7	0.7	0.6	0.6	0.7
SEDIMENT LOSS from ROAD ACTIONS (ton/yr)	1.4	0.6	0.6	0.8	0.8	0.6

Alternative A

The no action alternative serves as a baseline for comparison of the expected effects of all of the other alternatives. There would be no commercial salvage, no acres of fuels treatment or fuels reduction, no prescribed fire, no active closure or decommissioning of any portion of the road system, no active soil or riparian improvement projects, and no reforestation.

This alternative incorporates some of the recommendations of Beschta et. al., (1995). There would be no "immediate intervention on the post-fire landscape" and species would be allowed to naturally regenerate. There would be no salvage logging under this alternative and therefore no salvage logging in sensitive areas. The logging of sensitive areas is often associated with accelerated erosion and soil compaction (Beschta et. al., 1995).

There would be fewer opportunities to actively reduce sediment yields through improvement of drainage on roads and closure and decommissioning of roads. Within the eight subwatersheds there are 1,012 miles of road within the eight subwatersheds that are affected by this project. Within the project area there are 440 miles of road, of which 271 are located on Forest Service land. Currently the road density within the project area and on Forest Service land is 3.68 miles of road per square mile of land base. The direction in the Forest Plan is to "not exceed 2.5 miles per square mile of open road". Recommendations developed during the USFWS (1998) analysis for watersheds functioning appropriately are road densities below 1.0 mi/mi^2. Road closure and/or decommission within subwatersheds is the recommended action in which to reduce road densities that exceed this value. Under the no action alternative there would be no miles of new temporary road or any re-opening of unclassified roads. The lack of temporary roads and the lack of re-opening unclassified roads would reduce the temporary increase in road miles, road density, and potential sediment production from the additional miles of road. However, the long-term impact from the high road density would be a chronic problem for the analysis area. The WEPP derived model, Cross Drain Spacing and Sediment Yield Program, yielded a sediment loss due to the road system within the analysis area of 1.4 tons/yr.

The ground disturbing activities associated with commercial salvage logging, road reconstruction and fuels treatment would not take place under this alternative. The minimal ground disturbance associated with planting and a low-severity prescribed burn would also not take place under this alternative.

The no action alternative would have little to no affect on stream temperature in the planning area.

The riparian improvement projects that are aimed at rehabilitating key areas of the analysis area would not be implemented under this alternative and a passive approach to protection and restoration would be implemented. Under this alternative, several streams would continue to lack large wood material and cover the material provides. Areas within the riparian zones that do not revegetate would be left bare. This type of mineral soil exposure would add to sedimentation problems within the stream system. Aspen enhancement projects would not be implemented and conifer encroachment into meadows and riparian areas would continue to plague the landscape. The drainage improvement at road 2917413, located within the riparian habitat conservation area, would not be implemented and excessive sedimentation from this recreational access road would continue.

Common Information All Action Alternatives

Commercial salvage harvest would occur to some degree in all action alternatives. Any harvest activity would strictly follow the Best Management Practices set forth in Appendix C. Surface erosion from a logging operation is associated with the disturbance associated with the operation and not simply the cutting of the timber. In this case, the effect of the loss of the timber as canopy has already occurred as a result of the fire. The effects of disrupted soil structure, removal of protective cover, increased raindrop impact, and reduces soil infiltration rates are all associated with the ground disturbance associated with the harvest of timber (Megahan, 1980) or in this case the commercial salvage of timber and reduction of fuels. The impact from traditional logging systems is understood to cause more severe soil surface disturbance and consequent erosion than helicopter and skyline operations (Klock, 1975). Excessive fine sediment alters aquatic habitats by decreasing stream stability. Stream stability is defined as “allowing the stream to develop a stable dimension, pattern, and profile such that, over time, channel features are maintained and the stream system neither aggrades nor degrades. For a stream to be stable it must be able to consistently transport its sediment load, both in size and type, associated with local deposition and scour” (Rosgen 1996). Increased sediment fills pool habitats and spawning gravel interstices, and increases streambank erosion, and stream channel width/depth ratios. These factors combined, result in less habitat complexity and a reduction in fish and other aquatic species production capacity of a given watershed.

In the event of significant increases in sediment yields to stream channels, streams may exceed their natural ability to carry the sediment load. This may result in sediment depositions, especially in lower gradient reaches of a stream as point and mid-channel bars, which will lead to wider, shallower and less stable channels. This can result in bank erosion and bed scour, which further increases the sediment load in the stream. These events can be activated by initial direct introduction of sediment from outside the channel and/or increases in water yields that result in channel erosion.

In order to better understand the probability of sedimentation and sediment transport as a function of the removal of the material, Water Erosion Prediction Project (WEPP) was used to determine a background erosion rates. Directly after the fire took place, an erosion rate for Toolbox was calculated at 0.09 tons/acre and for Silver an erosion rate of 0.06 tons/acre. A background erosion rate of 0.01 to 0.05 tons/acre was calculated. Site soil erosion and sediment transport scenarios were run for various cases, based on eco-class, soil type, and slope patterns and cases that track the post-fire conditions. More specifically, the estimates provide context for the effect of skid trails two years into ground cover recovery. Six of the seven cases showed no sediment estimated with WEPP technology as a result of skid trails two years into ground cover recovery. One case shows 14% probability of treatment sediment from four specific units. The amount of sediment predicted from these units is within background erosion rates. Overall, the modeling exercise concluded that soil erosion generated from salvage harvest is apt to be minor in all action alternatives. However, the number of roads within the analysis area makes it a key issue when considering effects of treatment.

The number of roads within the analysis area after treatment would have an effect on the sediment loss. The information generated from Cross Drain (WEPP, 1999) was used to compare the level of roading in each alternative. The sediment estimate from the miles of road that are planned for closure or decommissioning is considered sediment savings while the miles of road planned to remain open is considered sediment loss. The actions associated with closure or decommission would be short-term increases in sediment but provide for a long-term sediment savings.

Compaction is not expected to increase as a result of the activity beyond pre-activity levels. Compaction is directly related to soil type, soil moisture at the time of operation, the type of equipment used, the number of passes made and ground cover. Obviously, the soil type will not be altered as a function of land management and ground cover is expected to substantially recover before any harvest activity takes place. All commercial activity on the landscape would strictly follow BMPs and the Soil Productivity Guide (SPG), both can be found in Appendix C. There will be short-term effects from some of the best management practices but the long-term benefits will outweigh the short-term effects. The short-term effects from BMPs include but are not limited to sedimentation from the closure and/or decommissioning of temporary and re-opened unclassified roads and landings and the construction of drainage precautions on skid trails. Research on the Foothills Fire Salvage concluded that when BMPs and soil and water protection measures were correctly implement, no accelerated soil erosion and sediment delivery to stream channels was identified over a three year period (Maloney and Thornton, 1995). Maloney and Thornton (1995) go on to warn that potential for adverse effects is possible if there is not strict adherence to BMPs and soil and water protection measures.

Salvage logging within RHCAs occurs in every action alternative by varying degrees. Alternatives with more acres of RHCA harvest represent a higher risk of sedimentation than those with fewer acres of RHCA harvest. The number of acres is given under each alternative description. Alternative D and H include salvage harvest only in roadside hazard areas. Roadside hazard corridors within RHCAs would have the following mitigating measures. Individual tree marking would occur where necessary, line-pulling distances would be minimized, no mechanized ground-based skidding equipment would be allowed in the first 150 feet of the stream channel on RHCA 1 and within 50 feet of the stream channel on RHCA 3 and RHCA 4. Alternatives C, E and G include roadside hazard areas in addition to more acres within RHCAs. Typically, RHCA 1 widths are 300 feet slope distance on each side of the active stream channel. Harvest of this area would occur in the outer 100 feet of the RHCA. No mechanized ground-based equipment would be allowed within the entire width of RHCAs except at existing classified road crossings. It is expected that the harvest in the outer 100 feet of the RHCA would be far enough away from the stream to allow for limited amounts of sediment that would reach the stream channel and would have little to no affect on the amount of stream-side shade and therefore is not expected to affect stream temperature. RHCA 3 (ponds, lakes, reservoirs, and wetlands greater than 1 acre) widths are typically 150 feet slope distance on each side of the active stream channel. Salvage harvest would occur in the outer 75 feet of the RHCA 3 and is expected to be far enough away from the stream to allow for limited amounts of sediment that would reach the stream channel or aquatic habitat. RHCA 3 harvest would have some affect on the amount of stream-side shade but is not expected to affect stream temperature. RHCA 4 (seasonally flowing or intermittent streams) widths are typically 50 feet slope distance on each side of the active stream channel. Salvage harvest would be allowed within RHCA 4 and may allow for the recovery of riparian vegetation with conifer uplands versus the conifer dominated riparian vegetation on several intermittent streams within the project area. RHCA 4 harvest would affect the amount of stream-side shade and may cause short term increases in temperature. In some instances, it has been found that once conifer overstory communities are replaced with scrub-shrub or riparian vegetation dominated communities with conifer uplands, the stream have slightly lower summer water temperatures, lower width-to-depth ratios and more undercut banks (Liquori and Jackson, 2001). Overall, salvage harvest is expected to generate minor amounts of sedimentation. However, the harvest within the RHCAs has the most likely probability of having adverse affects on stream condition of any of the salvage harvest because of the proximity of the ground-disturbing event to the stream channel or aquatic habitat.

The reconstruction of roads would consist of surfacing or resurfacing of several miles of road. This activity would include ground disturbance of pre-existing rock sources. Short-term increases in sediment from surfacing or resurfacing sections of road that contribute sediment to streams would occur. Culvert backfill at Road 2800505 would mitigate a chronic sediment source into Graham Creek with short-term increases of sediment at the creek but long-term savings of sedimentation at this site. All action alternatives except Alternative E incorporate a drainage improvement project on Road 2917413.

Small diameter coarse woody debris would be left onsite after commercial salvage, and fuel treatment and reduction. This material helps to capture and hold eroded materials. Monitoring on the Boise National Forest on units harvested following high severity fire showed that fire salvage logging could help reduce surface soil erosion and sediment delivery by increasing ground cover and storage areas with logging slash (Maloney and Thornton, 1995). All ground disturbing activities would follow the Best Management Practices, found in Appendix C.

Low-severity burns, where much of the organic matter comprising the forest floor may remain following burning, are generally insignificant with regard to hydrologic and water quality variables. The severity of the burn, the proportion of the watershed burned, and the relative proximity of the burned area to the stream channel all strongly influence the hydrologic

response to burning. Measurable hydrologic responses that occur after burning are typically greatest within the first year or two and decay toward pre-fire levels (Beschta, 1990).

Reforestation should shorten the length of time to hydrologic recovery compared to natural regeneration. It is expected that planted trees would reach maturity sooner and may reduce the amount of time for root systems to effectively stabilize soil. Conifer planting within portions of the RHCAs associated with the Toolbox Fire Recovery Project would help to accelerate the recovery of shade producing vegetation within RHCAs. This is a key element in accelerating restoration of aquatic habitat conditions within the burned area.

Aquatic habitat conditions within all potentially affected fish bearing stream reaches would see improvements in large wood, number of pools and number of deep pools from both natural recruitment of dead and dying trees and proposed aquatic habitat restoration projects. In headwater areas above the fire, instream habitat is expected to remain static or improve over time.

In-channel habitat conditions, particularly fine sediment levels within spawning substrates, within Silver Creek and West Fork Silver Creek, North Fork Silver Creek, and Guyer Creek would remain static or decline over the next few years as problem roads within the project area continue to deliver sediment to these streams. After project completion, improvements for sediment in these streams should improve as roads are improved and/or decommissioned.

Grazing standards implemented on the Yamsay Mt., Foster Butte, and Winter Rim Allotments are designed to maintain healthy range conditions while achieving full utilization of allocated forage (USDA Forest Service 1989). Management of these allotments in 2003 would include deferment of grazing until vegetation seed-set. Implementation of these standards is a key element in improving in upland vegetative condition. This would aid in the maintenance of stream channel conditions across the affected sub-watersheds.

Alternative C

Alternative C places an emphasis on providing wood products while contributing to the long-term development of LOS. This alternative is a modified version of the proposal that was presented to the public in November 2002 during scoping as the Proposed Action. Alternative C would result in a road density of 1.76 mi/mi^2, 14,441 acres of commercial salvage and fuels treatment and reduction, 16 miles of temporary road development, re-opening of 21.4 miles of unclassified roads and reforestation of 34,000 acres that experienced loss of stocking due to fire and includes soil and riparian restoration projects.

After implementation of the activities associated with this alternative is complete, there would be 129 miles of open road. These roads were calculated to erode 0.6 tons of sediment per year. Sediment savings from the closure and decommissioning of classified roads of 72.9 miles and 69.0 miles, respectively, would be 0.7 tons/yr. Alternative C would close 6 miles and decommission 9.94 miles of road segments within 300 feet of an intermittent or perennial stream. Of the six miles that would be closed, approximately 0.4 miles are within 50 feet of an intermittent or perennial stream. Of the 9.94 miles to be decommissioned, approximately 2.53 miles are within 50 feet of an intermittent or perennial stream. The level of closure and decommissioning planned under this alternative would generate short-term pulse of sediment, especially at roads near streams. However, the long-term savings of sedimentation outweighs the initial losses expected during the active closure and decommissioning. The resultant open road density would be 1.76 mi/mi^2. The density of open roads, plus roads that would be closed (but not decommissioned), would be 2.75 mi/mi^2. Under this alternative all roads within the former reservation would remain open and all other recommendations from the Roads Analysis would be followed.

The number of acres of commercial salvage under this alternative is the largest of all of the alternatives. More than 90% of the salvage harvest would be done with ground-based equipment on sideslopes less than 30 percent. The modeling of salvage harvest illustrated there would be minor soil erosion and sediment transport under all Alternatives. The only units with slight probability of sedimentation are Units 130, 131, 133, and 134 and equal a total of 781 acres.

Alternative C calls for the largest number of acres of harvest within riparian habitat conservation areas (RHCA). RHCA 1, RHCA 3 and RHCA 4 have 37 acres, 448 acres and 147 acres, respectively under this alternative. There are 15 acres, 186 acres, and 132 acres of RHCA 1, RHCA 3 and RHCA 4, respectively, within roadside hazard corridors. Harvest operation effects include disrupting soil structure, removal of protective cover and increased raindrop impact (Megahan, 1980). Salvage harvest would be allowed within RHCA 4 and may allow for the recovery of riparian vegetation with conifer

uplands versus the conifer dominated riparian vegetation on several intermittent streams within the project area. In some instances, it has been found that once conifer overstory communities are replaced with scrub-shrub or riparian vegetation dominated communities with conifer uplands, the stream have slightly lower summer water temperatures, lower width-to-depth ratios and more undercut banks (Liquori and Jackson, 2001). Overall, salvage harvest is expected to generate minor amounts of sedimentation. However, the harvest within the RHCAs has the most likely probability of having adverse affect on stream condition of any of the salvage harvest in this project because of the proximity of the ground-disturbing event to the stream channel or aquatic habitat. This alternative includes the highest number of acres of RHCA harvest and represents the highest risk of sedimentation compared to the other alternatives with respect to RHCA harvest.

Roads needed to commercially salvage the units under this alternative are 16.0 miles of temporary roads and 21.4 miles of re-opened unclassified roads. The addition of 37.4 miles of road to the current 270.1 miles of road would result in a temporary open road density of 4.2 mi/mi^2 or a functioning at unacceptable risk for road density (USFWS, 1998). This road density would be short lived and all road construction may not occur at the same time. The BMPs state that any temporary road will be used for only one season, they will be obliterated [decommissioned] with subsoiling and drainage structures will be installed. Newly re-opened unclassified roads will be treated in the same fashion after use associated with salvage harvest. Therefore, the additional roads associated with the salvage harvest operation would increase the road density but it would be short-term.

Fuels reduction would occur via underburning, broadcast burning, jackpot burning, low ground pressure machine piling and burning, grapple or hand piling and burning, thinning of dead trees, slash buster, or other methods. All of the fuels treatment would occur within salvage units along with some additional whole tree yarding and yarding with tops attached. Again, these activities are apt to generate minor soil erosion but would reduce the fuel loading in an area that is expected to exceed 20 tons of fuel per acre within 15 years if no action is taken. This reduction in fuels would allow for a higher probability of a low-severity fire in the future which has generally insignificant affects with regard to hydrologic and water-quality variables (Beschta, 1990). Prescribed fire would occur primarily outside of the harvest units and is expected to be a low-severity burn.

Planting and site preparation for reforestation should allow for accelerated watershed recovery.

The riparian improvement projects are aimed at rehabilitating key areas of the analysis area. Under this alternative, 9.6 miles of stream would have additional large wood placed and the resultant cover the material provides. Areas within the riparian zones that do not revegetate on their own would be planted with native species. This action would allow for natural recovery before immediate intervention (Beschta et. al., 1995). Aspen enhancement projects would be implemented and conifer encroachment into meadows and riparian areas would begin to be controlled. The drainage improvement at road 2917413, located within the riparian habitat conservation area, would be implemented and excessive sedimentation from this recreation access road would be mitigated.

Alternative D

Alternative D emphasizes the maintenance of water quality through the limitation of several activities. Alternative D would result in a road density of 1.68 mi/mi^2, 6,367 acres of commercial salvage and fuels treatment and reduction, no new temporary road development, re-opening 5.7 miles of unclassified roads and reforestation of 34,000 acres that experienced loss of stocking due to fire and includes soil and riparian restoration projects.

After implementation of the activities associated with this alternative is complete, there would be 123.9 miles of open road. These roads were calculated to erode 0.6 tons of sediment per year. Sediment savings from the closure and decommissioning of classified roads of 75.5 miles and 71.6 miles, respectively, would be 0.7 tons/yr. Alternative D would close 6 miles and decommission 10.28 miles of road segments within 300 feet of an intermittent or perennial stream. Of the six miles that would be closed, approximately 0.4 miles are within 50 feet of an intermittent or perennial stream. Of the 9.94 miles to be decommissioned, approximately 2.53 miles are within 50 feet of an intermittent or perennial stream. The level of closure and decommissioning planned under this alternative would generate a short-term pulse of sediment, especially at roads near streams. However, the long-term savings of sedimentation outweighs the initial losses expected during the active closure and decommissioning. The resultant open road density would be 1.68 mi/mi^2 and is the lowest road density among all alternatives. The density of open roads, plus roads that would be closed (but not decommissioned), would be 2.71 mi/mi^2. This alternative follows all recommendations taken from the Roads Analysis.

The number of acres of commercial salvage under this alternative is the smallest of all of the alternatives. More than 90% of the salvage harvest would be done with ground-based equipment on mild slopes. The modeling of salvage harvest illustrated there would be minor soil erosion and sediment transport under all alternatives. The only units with slight probability of sedimentation are Units 131and 134. These units equal a total of 31 acres compared to over 700 acres for the other action alternatives. Alternative D calls for the smallest number of acres of harvest within riparian habitat conservation areas (RHCA). RHCA 1, RHCA 3 and RHCA 4 have 15 acres, 186 acres and 15 acres, respectively under this alternative. All of these acres are within a roadside hazard corridor that crosses the RHCA. Roadside hazard corridors within RHCAs would have the following mitigating measures. Individual tree marking would occur where necessary, line-pulling distances would be minimized, no mechanized ground-based skidding equipment would be allowed in the first 150 feet of the stream channel on RHCA 1 and within 50 feet of the stream channel on RHCA 3 and RHCA 4. Harvest operation effects include disrupting soil structure, removal of protective cover and increased raindrop impact (Megahan, 1980). The most potential for sedimentation from salvage harvest exists with RHCA salvage harvest. However, the roadside hazard must be mitigated and the operating constraints for the harvest would mitigate adverse impacts from the harvest operation within RHCAs.

Roads needed to commercially salvage the units under this alternative are 5.7 miles of re-opened unclassified roads. There would be no new temporary road construction under this alternative. The addition of 5.7 miles of road to the current 270.1 miles of road would result in a temporary open road density of 3.7 mi/mi^2 or a functioning at unacceptable risk for road density (USFWS, 1998). This road density would be short lived and all road construction may not occur at the same time. Newly re-opened unclassified roads would be decommissioned after use associated with salvage harvest in accordance with BMPs. Therefore, the additional roads associated with the salvage harvest operation would increase the road density slightly but it would be short-term.

Fuels reduction methods would be the same as Alternative C (see Alternative C.)

Planting and site preparation for reforestation should allow for accelerated watershed recovery.

The riparian improvement projects would be the same as Alternative C (see Alternative C).

Alternative E

Alternative E emphasizes economic efficiency with regard to commercial salvage and limits the reduction of road density. The implementation of Alternative E would result in a road density of 2.57 mi/mi^2, 11,490 acres of commercial salvage and fuels treatment and reduction, 15.8 miles of temporary road development, re-opening 13.3 miles of unclassified roads and reforestation of 34,000 acres that experienced loss of stocking due to fire and does not include soil and riparian restoration projects.

After implementation of the activities associated with this alternative is complete, there would be 189 miles of open road. These roads were calculated to erode 0.8 tons of sediment per year. Sediment savings from the closure and decommissioning of classified roads of 67.4 miles and 14.6 miles, respectively, would be 0.6 tons/yr. Alternative E would close 8 miles and decommission 5.89 miles of road segments within 300 feet of an intermittent or perennial stream. Of the eight miles that would be closed, approximately 1.22 miles are within 50 feet of an intermittent or perennial stream. Of the 5.89 miles to be decommissioned, approximately 1.62 miles are within 50 feet of an intermittent or perennial stream. The level of closure and decommissioning planned under this alternative would generate short-term pulse of sediment, especially at roads near streams. However, the long-term savings of sedimentation outweighs the initial losses expected during the active closure and decommissioning. The resultant open road density would be 2.57 mi/mi^2. The density of open roads, plus roads that would be closed (but not decommissioned), would be 3.48 mi/mi^2. This alternative has the highest open and closed road density of all alternatives because there is very little road decommissioning under this alternative. The only road decommissioning that would occur under this alternative are those roads which have riparian health as the primary beneficiary of the road action. Roads within the former reservation will remain open except any roads within the former reservation that were recommended for decommissioning would be decommissioned under this alternative. Roads outside of the former reservation would follow the Road analysis recommendations when the benefiting resource was riparian health. Any roads outside of the former reservation that were recommended for decommissioning under the Roads Analysis would now be closed and those recommended for closure would remain open.

The number of acres of commercial salvage under this alternative is the third largest of all of the alternatives. More than 90% of the salvage harvest would be done with ground-based equipment on sideslopes less than 30 percent. The modeling of salvage harvest illustrated there would be minor soil erosion and sediment transport under all Alternatives. The only units with slight probability of sedimentation are Units 130, 131, 133, and 134 and equal a total of 781 acres. Alternative E calls for the second highest number of acres of harvest within riparian habitat conservation areas (RHCA). RHCA 1, RHCA 3 and RHCA 4 have 4 acres, 204 acres and 108 acres, respectively under this alternative. There are 15 acres, 186 acres, and 15 acres of RHCA 1, RHCA 2 and RHCA 3, respectively, within roadside hazard corridors. Harvest operation effects include disrupting soil structure, removal of protective cover and increased raindrop impact (Megahan, 1980). Salvage harvest would be allowed within RHCA 4 and may allow for the recovery of riparian vegetation with conifer uplands versus the conifer dominated riparian vegetation on several intermittent streams within the project area. In some instances, it has been found that once conifer overstory communities are replaced with scrub-shrub or riparian vegetation dominated communities with conifer uplands, the stream have slightly lower summer water temperatures, lower width-to-depth ratios and more undercut banks (Liquori and Jackson, 2001). However, this would occur to a lesser extent than Alternative C due to fewer acres being treated within RHCA. Overall, salvage harvest is expected to generate minor amounts of sedimentation. However, the harvest within the RHCAs has the most likely probability of having adverse affect on stream condition of any of the salvage harvest in this project because of the proximity of the ground-disturbing event to the stream channel or aquatic habitat. This alternative includes the second highest number of acres of RHCA harvest. The number of acres is reduced from Alternative C. The number of RHCA 1 salvage harvest outside of roadside hazard removal is reduced to 4 acres compared to 37 acres in Alternative C. For this alternative, RHCA 3 salvage harvest outside of roadside hazard removal is at 204 acres compared to 448 acres in Alternatives C and G. The reduction in the minimum number of acres in all RHCA categories reduces the risk compared to Alternative C but is high compared to all other alternatives.

Roads needed to commercially salvage the units under this alternative are 13.3 miles of temporary roads and 15.8 miles of re-opened unclassified roads. The addition of 29.1 miles of road to the current 270.1 miles of road would result in a temporary open road density of 4.07 mi/mi^2 or a functioning at unacceptable risk for road density (USFWS, 1998). This road density would be short lived and all road construction may not occur at the same time. The BMPs state that any temporary road will be used for only one season, they will be obliterated [decommissioned] with subsoiling and drainage structures will be installed. Newly re-opened unclassified roads will be treated in the same fashion after use associated with salvage harvest. Therefore, the additional roads associated with the salvage harvest operation would increase the road density but it would be short-term.

Fuels reduction would occur via underburning, broadcast burning, jackpot burning, low ground pressure machine piling and burning, grapple or hand piling and burning, thinning of dead trees, slash buster, or other methods. All of the fuels treatment would occur within salvage units along with some additional whole tree yarding and yarding with tops attached. Again, these activities are apt to generate minor soil erosion but would reduce the fuel loading in an area that is expected to exceed 20 tons of fuel per acre within 15 years if no action is taken. This reduction in fuels would allow for a higher probability of a low-severity fire in the future which has generally insignificant affects with regard to hydrologic and water-quality variables (Beschta, 1990).

Planting and site preparation for reforestation should allow for accelerated watershed recovery.

The riparian improvement projects that are aimed at rehabilitating key areas of the analysis area would not be implemented under this alternative and a passive approach to protection and restoration would be implemented. Under this alternative, several streams would continue to lack large wood material and the cover the material provides. Areas within the riparian zones that do not revegetate would be left bare and allowed to naturally recovery at the temporal scale involved with ecosystem evolution (Beschta et. al., 1995). This type of mineral soil exposure would add to sedimentation problems within the stream system. Aspen enhancement projects would not be implemented and conifer encroachment into meadows and riparian areas would continue to plague the landscape. The drainage improvement at road 2917413, located within the riparian habitat conservation area, would not be implemented and excessive sedimentation from this recreational access road would continue.

Alternative G

Alternative G places an emphasis on using active management to achieve post-fire recovery, particularly in response to the purpose and need to develop a long-term sustainable forest that is maintainable by re-introduction of fire, while providing

recovery of some merchantable. It focuses on fuels reduction and long-term fire suppression effectiveness, partially through a limit to the reduction of road density. The implementation of Alternative G would result in a road density of 2.57 mi/mi^2, 14,419 acres of commercial salvage and fuels treatment and reduction, 21.4 miles of temporary road development, re-opening 16.0 miles of unclassified roads and reforestation of 34,000 acres that experienced loss of stocking due to fire and does include soil and riparian restoration projects.

After implementation of the activities associated with this alternative is complete, there would be 189 miles of open road. These roads were calculated to erode 0.8 tons of sediment per year. Sediment savings from the closure and decommissioning of classified roads of 10.4 miles and 71.6 miles, respectively, would be 0.6 tons/yr. Alternative G would close 3.6 miles and decommission 10.28 miles of road segments within 300 feet of an intermittent or perennial stream. Of the 3.6 miles that would be closed, approximately 0.3 miles are within 50 feet of an intermittent or perennial stream. Of the 10.28 miles to be decommissioned, approximately 2.53 miles are within 50 feet of an intermittent or perennial stream. The level of closure and decommissioning planned under this alternative would generate short-term pulse of sediment, especially at roads near streams. However, the long-term savings of sedimentation outweighs the initial losses expected during active closure and decommissioning. The resultant open road density would be 2.57 mi/mi^2. The density of open roads, plus roads that would be closed (but not decommissioned), would be 2.71 mi/mi^2. Roads within the former reservation will remain open with the exception of any roads within the former reservation that were recommended for decommissioning would be decommissioned under this alternative. Roads outside of the former reservation would follow the Road analysis recommendations when the benefiting resource was riparian health or the recommendation was to decommission a road. The remaining roads that are outside of the former reservation would remain open.

The number of acres of commercial salvage under this alternative is the second largest of all of the alternatives. More than 90% of the salvage harvest would be done with ground-based equipment on sideslopes less than 30 percent. The modeling of salvage harvest illustrated there would be minor soil erosion and sediment transport under all Alternatives. The only units with slight probability of sedimentation are Units 130, 131, 133, and 134 and equal 781 acres.

Alternative G calls for the third highest number of acres of harvest within riparian habitat conservation areas (RHCA). RHCA 1, RHCA 3 and RHCA 4 have 15 acres, 448 acres and 147 acres, respectively under this alternative. There are 15 acres, 186 acres, and 15 acres of RHCA 1, RHCA 2 and RHCA 3, respectively, within roadside hazard corridors. Harvest operation effects include disrupting soil structure, removal of protective cover and increased raindrop impact (Megahan, 1980). Salvage harvest would be allowed within RHCA 4 and may allow for the recovery of riparian vegetation with conifer uplands versus the conifer dominated riparian vegetation on several intermittent streams within the project area. In some instances, it has been found that once conifer overstory communities are replaced with scrub-shrub or riparian vegetation dominated communities with conifer uplands, the stream have slightly lower summer water temperatures, lower width-to-depth ratios and more undercut banks (Liquori and Jackson, 2001). Overall, salvage harvest is expected to generate minor amounts of sedimentation. However, the harvest within the RHCAs has the most likely probability of having adverse affect on stream condition of any of the salvage harvest in this project because of the proximity of the ground-disturbing event to the stream channel or aquatic habitat. This alternative includes the second highest number of acres of RHCA harvest. This alternative is similar to Alternative C for RHCA harvest except it has no acres outside of roadside hazard within RHCA 1. Overall, this alternative represents the third highest risk of sedimentation from RHCA salvage harvest compared to the other alternatives. The minimum number of acres in RHCA 1 salvage reduces the risk to perennial streams for sedimentation from RHCA harvest compared to Alternative C and E.

Roads needed to commercially salvage the units under this alternative are 16.0 miles of temporary roads and 21.4 miles of re-opened unclassified roads. The addition of 37.4 miles of road to the current 270.1 miles of road would result in a temporary open road density of 4.18 mi/mi^2 or a functioning at unacceptable risk for road density (USFWS, 1998). This road density would be short lived and all road construction may not occur at the same time. The BMPs state that any temporary road will be used for only one season, they will be obliterated [decommissioned] with subsoiling and drainage structures will be installed. Newly re-opened unclassified roads will be treated in the same fashion after use associated with salvage harvest. Therefore, the additional roads associated with the salvage harvest operation would increase the road density but it would be short-term.

Fuels reduction would occur via underburning, broadcast burning, jackpot burning, low ground pressure machine piling and burning, grapple or hand piling and burning, thinning of dead trees, slash buster, or other methods. The majority of the fuels treatment would occur within salvage units along with some additional whole tree yarding and yarding with tops attached. Additional treatment outside of salvage units would occur in this alternative only. Treatment within a quarter

mile of private land would take place for a total of 5,596 acres. The total amount of acres planned for fuels treatment are apt to generate minor soil erosion but would reduce the fuel loading in an area that is expected to exceed 20 tons of fuel per acre within 15 years if no action is taken. This reduction in fuels would allow for a higher probability of a low-severity fire in the future which has generally insignificant affects with regard to hydrologic and water-quality variables (Beschta, 1990). Prescribed fire would occur primarily outside of the harvest units and is expected to be a low-severity burn.

Planting and site preparation for reforestation should allow for accelerated watershed recovery.

The riparian improvement projects would be the same as Alternative C (see Alternative C).

Alternative H

Alternative H focuses on wildlife habitats and on contributing to the long-term development of LOS while providing recovery of some merchantable. It was developed through the modification of Alternative C in response to several key issues. The implementation of Alternative H would result in a road density of 1.72 mi/mi^2, 13,031 acres of commercial salvage and fuels treatment and reduction, 14.9 miles of temporary road development, re-opening 19.7 miles of unclassified roads and reforestation of 34,000 acres that experienced loss of stocking due to fire and does include soil and riparian restoration projects.

After implementation of the activities associated with this alternative is complete, there would be 126.5 miles of open road. These roads were calculated to erode 0.7 tons of sediment per year. Sediment savings from the closure and decommissioning of classified roads of 72.9 miles and 71.6 miles, respectively, would be 0.6 tons/yr. Alternative H would close 6.0 miles and decommission 10.28 miles of road segments within 300 feet of an intermittent or perennial stream. Of the 6.0 miles that would be closed, approximately 0.4 miles are within 50 feet of an intermittent or perennial stream. Of the 10.28 miles to be decommissioned, approximately 2.53 miles are within 50 feet of an intermittent or perennial stream. The level of closure and decommissioning planned under this alternative would generate short-term pulse of sediment, especially at roads near streams. However, the long-term savings of sedimentation outweighs the initial losses expected during active closure and decommissioning. The resultant open road density would be 1.72 mi/mi^2. The density of open roads, plus roads that would be closed (but not decommissioned), would be 2.71 mi/mi^2. Roads within the former reservation will remain open with the exception of any roads within the former reservation that were recommended for decommissioning would be decommissioned under this alternative. All other recommendations from the Road Analysis would be followed under this alternative.

The number of acres of commercial salvage under this alternative is the third largest of all of the alternatives. More than 90% of the salvage harvest would be done with ground-based equipment on sideslopes less than 30 percent. The modeling of salvage harvest illustrated there would be minor soil erosion and sediment transport under all Alternatives. The only units with slight probability of sedimentation are Units 130, 131, 133, and 134 and equals 741 acres. Alternative H calls for the minimum number of acres of harvest within riparian habitat conservation areas (RHCA), only those within roadside hazard corridors. There are 15 acres, 186 acres, and 15 acres of RHCA 1, RHCA 2 and RHCA 3, respectively, within roadside hazard corridors. Within roadside hazard corridors individual tree marking would occur where necessary, line-pulling distances would be minimized, no mechanized ground-based skidding equipment would be allowed in the first 150 feet of the stream channel on RHCA 1 and within 50 feet of the stream channel on RHCA 3 and RHCA 4. Harvest operation effects include disrupting soil structure, removal of protective cover and increased raindrop impact (Megahan, 1980). The most potential for sedimentation from salvage harvest exists with RHCA salvage harvest. However, the roadside hazard must be mitigated and the operating constraints for the harvest would mitigate adverse impacts from the harvest operation within RHCAs.

Roads needed to commercially salvage the units under this alternative are 14.9 miles of temporary roads and 19.7 miles of re-opened unclassified roads. The addition of 34.6 miles of road to the current 270.1 miles of road would result in a temporary open road density of 4.14 mi/mi^2 or a functioning at unacceptable risk for road density (USFWS, 1998). This road density would be short lived and all road construction may not occur at the same time. The BMPs state that any temporary road will be used for only one season, they will be obliterated [decommissioned] with subsoiling and drainage structures will be installed. Newly re-opened unclassified roads will be treated in the same fashion after use associated with salvage harvest. Therefore, the additional roads associated with the salvage harvest operation would increase the road density but it would be short-term.

Fuels reduction methods would be the same as Alternative C (see Alternative C.)

Planting and site preparation for reforestation should allow for accelerated watershed recovery.

The riparian improvement projects would be the same as Alternative C (see Alternative C).

Action Alternative Summary-Watershed

The primary concern with any salvage activity from a watershed perspective is water quality and sedimentation. The elements of primary consideration therefore are the number of acres salvaged and the road management activity for each alternative. The salvage activity for each alternative are apt to generate short-term minor amounts of transportable sediment (See Geology, Geomorphology and Soils section of Chapter 3). The units of concern fro sedimentation total approximately 750 acres for Alternatives C, E, G, and H, 31 acres for Alternative D and zero acres of concern in Alternative A.

The amount of road within the analysis area is excessive to proper watershed function and would continue to cause problems within the watershed if not managed properly. Under Alternative A no road management activity is planned and the road density remains high. Alternative E and G would each reduce road densities to 2.57 mi/mi^2 and Alternatives C, D, and H would result in the lowest densities, approximately 1.7 mi/mi^2. The differences between the alternatives become clearer when one considers the open road density for each alternative, when combined with the closed (but . Alternative E has an open and closed road density of 3.48 mi/mi^2 while the other action alternatives (C, D, G, and H) have densities of approximately 2.7 mi/mi^2. Further investigation of the miles of road to be closed and decommissioned illustrates that Alternatives C, D, and H close approximately 70 miles and decommission approximately 70 miles. Alternative E decommissions only 14.6 miles and closes 67.4 miles while Alternative G closes 10.4 miles and decommissions 71.6 miles. Overall, Alternative D, H, and C are the most aggressive with the road treatments they call for and will have more of a long-term benefit than Alternatives G and E. Alternative G decommissions nearly the same number of roads as Alternative D, H, and C but closes only 10 miles of road. Alternative E uses road closure as its primary tool for road treatment and includes the decommissioning of only 14.6 miles of road.

Direct and Indirect Effects-Fisheries

Effects of the 2002 fires, followed by the proposed activities in relation to soils and watershed hydrology (amount of flow, timing of flow, and water quality) have been discussed elsewhere in Chapter 3. This section will discuss the effects of each alternative on aquatic habitat in potentially affected stream channels and will document compliance with the INFISH riparian management objectives. Effects to sensitive fish will also be discussed. Differences between the five action alternatives on aquatic habitat are expected to be none or minimal, so the following disclosure of effects is common to all action alternatives.

Quantitative indicators have been identified and are the primary basis to evaluate the effects of the different alternatives on fisheries resources and aquatic habitats. These indicators include: Sediment yield from roads and proposed harvest (tons per year), road density (miles per square mile), road miles within 300 feet of stream channels, and the amount of harvest within RHCAs (acres).

Although not a habitat characteristic, the affect of road location and densities on aquatic habitat, in particular sediment delivery to streams is well documented. The effects analysis will consider how the alternatives change road densities within the affected watersheds and RHCAs and how those changes could affect interior redband trout production, growth, recruitment, and survival. The estimated sediment yield for each alternative provides a varying degree of long-term benefits from road sediment reduction when compared to baseline conditions. Because these differences are relative, it is difficult to state to what degree the greater percentage reductions in road sediment would benefit aquatic habitat. However, it is expected that over the long-term, sediment reduction from road closures and decommissioning would help improve spawning habitat and pool quality for each alternative. These reductions in combination with proposed aquatic habitat restoration, should contribute to a gradual improvement in redband trout production capability in fish bearing streams within the project.

Riparian timber harvest removes shade-providing vegetation on streams, which increases maximum water temperatures in summer and changes the year-round temperature regime of a stream (Beschta et al 1987). Riparian timber harvest also

reduces large woody debris recruitment to the stream channel, which reduces hiding cover, habitat complexity, pool formation, and substrate trapping. Redband trout prefer complex habitats associated with accumulations of large woody debris.

Alternatives have been grouped based on similarity of proposed harvest within RHCA, proposed Soil and Riparian Protection/Restoration projects, and to a lesser degree Road Management characteristics.

Past Activities (see also Appendix A)

Timber Management

The eight-subwatersheds in which the Silver and Toolbox Fires occurred have been extensively harvested and roaded for timber access over the past 50 years, on both National Forest and private lands (Appendix A, Tables A-2, A-6 and A-13). No monitoring has occurred to document the affect of timber harvest operation on redband trout on the Fremont National Forest. However, the effects of timber harvest operations on aquatic habitats and fisheries resources are well documented (Meehan 1991). It is assumed that effects on redband trout from timber harvest and road construction operations has been substantial because riparian areas have had some level of harvest, the amount of road construction has resulted in elevated sediment in spawning substrates and culverts have been installed that did not allow fish passage.

Road and Trail Maintenance

Sediment produced by road and trail maintenance in the Silver and Toolbox Fire portions is likely insignificant. Annual maintenance has long-term benefits for fisheries resources and aquatic habitats by preventing larger inputs of sediment to stream channels in the event of culvert failures and other events.

Developed Recreation Sites – Maintenance and Use

Campgrounds and trailheads concentrate anglers and cause increased impacts to riparian vegetation thus potentially increasing inputs of sediment to stream channels. These sites include: Bunyard Crossing, Silver Creek Marsh Campground, and the Fremont National Recreation Trail.

Dispersed Recreation- Hunting and Fishing

Angling activity is moderate on Silver Creek at Bunyard Crossing and at Auger Valley (on Silver Creek) and light elsewhere in the drainage. Moderate amounts of angling occur on West Fork Silver Creek at the Road 2917 crossing and at Silver Creek Marsh Campground, with light amounts occurring throughout the rest of the drainage. Both of these locations have large dispersed camping sites within the riparian area. Light amounts of angling occur throughout the North Fork Silver Creek and Guyer Creek drainages. Impacts to riparian vegetation and vegetative ground cover are occurring at dispersed campsites with potential inputs of sediment into stream channels.

Diversions and Reservoirs

There are three reservoirs in or downstream of the project area: Thompson Reservoir (Silver Creek), Diversion Reservoir (West Fork Silver & Silver Creek) and Duncan Reservoir (Duncan Creek). These reservoirs are for irrigation and recreation, with irrigation water having the priority. The main diversion point, which is unscreened, for the stored water occurs on Silver Creek just downstream of the Silver Fire boundary. The majority of the stream flow for Silver Creek is the result of water releases from Thompson Reservoir during irrigation season. During non-irrigation season, Silver Creek has a minimal volume of stream flow. Redband trout either becoming trapped in residual pools and die, or they migrate downstream to the Diversion Reservoir and winter over until irrigation flows are released the following spring.

Fish Stocking

Past stocking of streams by the Oregon Department of Fish and Wildlife has allowed hatchery rainbow trout and non-native Eastern brook trout to invade and out-compete native trout in some reaches, especially in areas that have less than optimum aquatic habitat conditions. In addition, introgression of native redband trout and hatchery rainbow trout has likely occurred. In about 1998, the Oregon Department of Fish and Wildlife discontinued stocking of streams in the Silver Lake watershed.

Livestock Grazing

Three grazing allotments were active in the project area on the Fremont National Forest prior to the fires in the Toolbox and Silver Fire portions: Yamsay, Foster Butte, Winter Rim. None of these allotments have had a significant impact on fisheries resources and aquatic habitats in the burned area. This is due to adjustments in management plans, which resulted in reducing impacts to riparian vegetation, streambank stability, or sediment inputs to fish-bearing streams. Grazing histories on National Forest, as well as on BLM and private lands are summarized in Appendix A, Table A-8. On the Forest, the 2002 fires are unlikely to alter future grazing patterns to the extent that significant, new damage to aquatic habitats would occur. None of the active allotments (Yamsay, Foster Butte, Winter Rim) were having a significant negative effect on fisheries resources or aquatic habitats prior to the fire.

Fire Suppression and Prescribed Fire

As evidenced by the 2002 fire, 50 plus years of successful fire suppression has allowed the subwatersheds in the Silver and Toolbox Fire portions to become more vulnerable to high mortality fire as fuels continued to accumulate. This is evidenced by the high percentage of moderate and high mortality burning that occurred along streams and riparian areas within the project area. In recent years, prescribed fire has been applied to several areas throughout the Silver and Toolbox Fire portions (See Appendix A, Table A-3). No monitoring has occurred to document the affect of prescribed fire on redband trout on the Fremont National Forest. However, it is assumed that effects are insignificant because riparian areas have generally been unburned and the low intensity nature of the fires on the upland slopes has not generated any observed erosion or sediment input into fish bearing streams.

2002 Fires – Retardant Drops

Approximately 120,000 gallons of retardant were used during suppression of the Toolbox Complex. The primary area that received retardant was the Indian Mountain communications site within the Toolbox Fire area, in the Lower Duncan Creek subwatershed. Retardant was also used on the Silver Fire in and around Silver Creek, West Fork Silver Creek and Thompson Reservoir.

Overall, the majority of the drops were concentrated on the communications site, with other drops occurring along ridgelines, upper slopes, and adjacent to other natural fire barriers such as meadows, roads, and rock outcrops that were considerable distances away from RHCAs. Two instances occurred where retardant entered RHCAs and fish bearing streams. One location was on Silver Creek downstream from Bunyard Crossing and the other was on West Fork Silver Creek upstream from the Diversion Reservoir. No fish kill was observed in either occurrence, as it appeared that only a minor amount of retardant entered the streams. Accidental releases of retardant into streams have caused fish kills (see several authors in Gresswell 1999). Norris et al. (1991) demonstrated that direct application of retardant onto the stream surface was the primary source of retardant contamination in streams. They also found that only minor amounts of retardant entered streams from riparian areas and that relatively narrow, untreated riparian strips as small as three meters wide virtually eliminated retardant from entering streams (Norris et al. 1991). It is unlikely that the retardant drops had a significant effect on redband trout.

2002 Fire – Firelines (Dozer and Hand)

Approximately 203 miles of dozer line and 3 miles of hand line were constructed during the Toolbox Complex Fire. With few exceptions, dozer line was not constructed within RHCAs. Only one dozer line crossed a fish-bearing stream (West Fork Silver Creek) while another dozer line was put in along an intermittent stream (Indian Creek). Dozer lines on the Fremont National Forest were re-contoured, water-barred, and covered with slash in the fall of 2002. The majority of the dozer lines were rehabilitated with an excavator under the direction of a Forest Service resource advisor. The 3 miles of hand line had the soil raked back into the prism, were water-barred, and covered with slash if available. There was one instance where a dozer line is known to have contributed direct sediment inputs to a fish-bearing stream. This occurred on West Fork Silver Creek, near the crossing of the 3038 Road, on the west boundary of the Silver Fire.

2002 Fire – BAER Projects

One relief culvert was installed on West Fork Silver Creek at Road 27. These culverts were installed because several areas upstream of Road 27 experienced high and very high burn severities, which created the potential for increased water yield and debris flows. The relief culverts were installed at the high flow elevation of the existing culvert to alleviate any potential increased stream flows. The sediment into West Fork Silver Creek from these installations occurred as short pulses during and immediately following the installation process. Another relief culvert was constructed at the 2914 Road

crossing of Duncan Creek, an intermittent stream, to alleviate likely increased stream flows during spring runoff. Over 15 miles of road within the project area had drainage ditches cleaned out for proper drainage of water during periods of increased water yields. Log erosion barriers and/or rice wattle treatments were used on 13 acres within the project area. It is unlikely that BAER treatments had a significant effect on redband trout or aquatic habitats in the project area.

2002 Fire – Natural Effects

The natural effects of the Toolbox Complex fires on watersheds and aquatics are described elsewhere in the Fisheries Section and in the Watershed section.

Personal Use Firewood and Christmas Tree Cutting

Firewood and Christmas tree cutting and are not currently causing any known problems for fisheries, aquatic habitat, or stream channel conditions in the Silver or Toolbox Fire portions.

Culvert Replacements and Road Decommissioning

Three culverts on fish bearing streams have been replaced in recent years in order to provide improved fish passage (See Appendix A, Table A-9). These culverts are on West Fork Silver Creek, North Fork Silver Creek, and Guyer Creek. Approximately 60 miles of road have been decommissioned in the West Fork Silver Creek, Upper Silver Creek, Thompson Reservoir and Upper Silver Creek subwatersheds between 1995 and 2001. These actions have improved aquatic habitat conditions for fisheries resources and overall hydrologic function of these watersheds. Any sediment input to these streams because of these projects is considered to have an insignificant effect on redband trout because of the short duration, minimal quantities and low risk of entering fish habitat because of mitigation measures and Forest BMP's.

Present Activities

Private Timber Management

On private lands, the "present" is defined in this section as being the time from the control of the fires in 2002 until reforestation activities are complete, which is estimated to be in 2005. The reason this time frame was chosen was that it includes activities primarily precipitated by the Tool Box and Silver Fires. United States Timberlands (UST), the owner of the largest areas of private land, primarily within the Toolbox Fire portion, began salvage logging operations as soon as the fires were controlled (See Appendix A, Table A-13). They plan to salvage approximately 16,000 acres as long as there is a market for small timber. Both dead and alive timber is being harvested to make the logging operations economically viable. The majority of the salvage acreage was logged in 2002 and the remainder will be logged in 2003 depending on markets. Approximately 2,000 acres of plantation burned sufficiently to require replanting. UST plans to plant approximately 18,000 acres (10,000 from salvage, 6,000 from logging prior to the fires, and 2,000 from burned plantations) of clear-cut and partial cut units to meet or exceed State stocking density requirements.

Livestock Grazing

In three pastures of the Foster Butte Allotment, numbers have been reduced and dates have been adjusted for the upcoming grazing season as a response to the Toolbox fire. The one pasture in the Buck Creek Allotment that has burned acreage will be rested, as scheduled prior to the fire. The Guyer Riparian pasture fence was completed this past fall and a two pasture system will incorporate deferment and early season use. Numbers will stay at 100 head. Grazing in the other allotments and/or pastures will not change in 2003. None of the active allotments (Yamsay, Foster Butte, Winter Rim) were having a significant negative effect on fisheries resources or aquatic habitats prior to the fire, and the most likely scenario following the fire is that riparian impacts would remain relatively constant. On BLM allotments grazing in 2003 and beyond will continue as permitted in all but the Dead Indian-Duncan Allotment. Pastures within the fire-affected subwatersheds will be rested in 2003 and 2004. These BLM Allotments are scheduled for Rangeland Health Assessments and any changes identified will be determined at that time.

Personal Use Firewood and Christmas Tree Cutting

These activities generally occur at least 300 feet from live streams, springs, or seeps. Firewood and Christmas tree cutting and are currently not causing problems for fisheries, aquatic habitat, or stream channel conditions in the Silver or Toolbox Fire portions.

Reasonably Foreseeable Future Activities

517 East Forest Recovery Project/Triad Restoration Project

This project proposes a variety of treatments to restore the landscape to more historic conditions. These treatments include reintroduction of fire where fire historically played a role, commercial and pre-commercial thinnings, aspen enhancements, and large woody debris additions to Silver Creek, Benny Creek, and Squaw Creek. Any sediment input to these streams because of this project is predicted to have an insignificant effect on redband trout because of the minimal quantities and low risk of entering fish habitat because of riparian buffers, mitigation measures, and Forest BMP's.

West Fork Silver Creek Watershed Restoration/Enhancement Project

This project proposes a variety of treatments to restore the landscape to more historic conditions. These treatments include reintroduction of fire where fire historically played a role, commercial and pre-commercial thinnings, aspen enhancements, and large woody debris additions to West Fork Silver Creek, riparian vegetation enhancement, various aspen treatments, and beaver reintroductions. Any sediment input to these streams because of this project is predicted to have an insignificant effect on redband trout because of the minimal quantities and low risk of entering fish habitat because of riparian buffers, mitigation measures, and Forest BMP's.

Windmill Restoration Project

This project proposes a variety of non-commercial treatments to restore the landscape to more historic conditions. These treatments include reintroduction of fire where fire historically played a role, pre-commercial thinnings, aspen enhancements, and large woody debris additions to Duncan Creek and East Duncan Creek. Any sediment input to these streams because of this project is predicted to have no effect on redband trout because this species does not occur in these streams, which are intermittent.

Private Timber Management

The reasonably foreseeable future is defined, for the purposes of this report, as being the time period following the completion of reforestation to about 30 years into the future. On industrial forestland, once reforestation is complete no additional investments or harvests are planned in the foreseeable future. The stands will be free to grow naturally. Advanced regeneration may grow to the minimum merchantable size for saw logs before the majority of the trees in the even aged plantations attain saw log size. On non-industrial forestland it's expected the landowners would occasionally conduct light partial harvests. Harvests are not scheduled.

Livestock Grazing

Beyond this grazing season, numbers, systems and seasons of use in the Foster Butte, Sycan and Winter Rim Allotments will be considered under a NEPA process. The Yamsay Mt and Buck Creek allotment will continue to be managed within the terms and conditions of the grazing permits currently issued. They are scheduled to be part of NEPA analysis in 2007. BLM Allotments are scheduled for Rangeland Health Assessments and any changes identified will be determined at that time. Decisions on grazing beyond 2004 will be made based on monitoring of the pastures in the next couple of years.

Road and Trail Maintenance

Sediment produced by road and trail maintenance in the Silver and Toolbox Fire portions is insignificant. Annual maintenance benefits fisheries resources by preventing larger inputs of sediment to stream channels.

Personal Use Firewood and Christmas Tree Cutting

These activities generally occur at least 300 feet from live streams, springs, or seeps. Firewood and Christmas tree cutting and are currently not causing problems for fisheries, aquatic habitat, or stream channel conditions in the Silver or Toolbox Fire portions.

Alternative A

Sediment Yield

Under Alternative A, sediment inputs from roads would continue to occur in streams within the Silver Fire portion. Fire-derived sediment increases in Silver Creek, West Fork Silver Creek, North Fork Silver Creek, and Guyer Creek are likely to

be small because only 1.3 percent of the Silver Fire area burned at a high severity (BAER Report) and 14.5 percent at moderate severity. The majority of fire-derived sediments are expected in the West Fork Silver Creek drainage, which experienced a higher percentage of moderate to very high mortality burn. Fire derived sediment inputs would be highest in 2003-2005 and should return to near pre-fire levels by 2006 as natural vegetation returns. Sediment produced by road maintenance would be minor because of existing Forest mitigation measures and BMP's. Sediment delivery predictions from roads were estimated to be 4.1 tons per year under Alternative A for the Silver Fire portion.

Road Density/Locations

Under Alternative A, existing road densities and miles of open roads within Category 1 and Category 4 RHCAs would remain unchanged as no road closures or decommissions would occur. Current road maintenance activities would continue. Therefore, road conditions on the landscape would continue to exert stress on drainages within the project and their native trout populations by delivering fine sediment to instream habitats and by increasing the drainage network.

RHCA Harvest

No harvest in Riparian Habitat Conservation Areas would occur under this alternative. No commercial salvage would occur with RHCAs within roadside hazard corridors.

Aquatic Habitat Condition

Wildfire has eliminated the protective vegetation on slopes and along stream channels and can alter surface soil layers, increasing water yield and surface erosion. In the case of the Silver Fire portion of the Toolbox Complex, 84.2 percent of the area experienced low severity fire, 14.5 percent was moderate, and 1.3 percent high (USDA Forest Service 2002-BAER Report). Approximately 800 acres in the entire Toolbox Fire Complex exhibited hydrophobic conditions. Storm events up to 50 years were modeled using the Watershed Erosion Prediction Project (WEPP) model. There were only slight increases in water yield predicted under any storm event.

Numerous roads within the analysis area have been identified as having minimal cross drainage with the sediment routed to the streams in several locations. Under Alternative A, minimal maintenance of the road system would occur, no decommissioning would take place and reconstruction activities, including drainage improvements would likely not take place. Fine sediment levels would increase in affected stream channels.

Silver Creek and West Fork Silver Creek have exhibited late summer water temperatures that exceed State of Oregon standards. Other perennial streams within the analysis area (North Fork Silver Creek and Guyer Creek) fall within the acceptable limits for water temperature. Portions of all perennial streams were burned and mortality of shade producing shrubs and trees did occur. The loss of shade, while minimal overall, will increase solar radiation and some increase in stream temperature will occur. Given the limited extent and magnitude of overstory loss adjacent to perennial streams, changes in stream temperature will be negligible. All alternatives will have identical effects to stream temperature, which is immeasurable increases in the short-term, followed by decreases in the long-term as overstory vegetation within the RHCA's is regenerated.

Fire can also affect nutrient availability and subsequent nutrient loading of streams. Nutrients from the forest floor can be redistributed by leaching of the ash layer and soil, and transported to the stream by surface erosion, soil mass movement, or solution transport (Swanson 1991). Increased nutrient loading (primarily nitrate-nitrogen and phosphorous) to streams is usually seen following burns where fire induced changes in soils results in increased flows. The cause of this increase is believed to be from increased flows that displace volatized material or organic detritus from upslope areas adjacent to the channel. No measurable increase in water yield and minimal increases of fine sediment are predicted from the Silver Fire within the Toolbox Complex. Fire induced loading to all potentially affected streams is expected to be minimal.

Large woody debris is lacking throughout several reaches of the streams in the analysis area. Within the burned area, recruitment of large wood to the channel over several decades is anticipated as burned overstory trees die and fall in the floodplain and active stream channel. Overall, within the burned area all streams will see an increase in large woody debris under Alternative A.

Alternatives C and E

Sediment Yield

Alternatives C and E are predicted to deliver (respectively) 3.7 and 3.8 tons of sediment per year to streams in the Silver Fire portion. This delivery is sediment produced by roads within the project area. The amount of sediment yield due to harvest activities is expected to be minimal, as documented within the Geology, Geomorphology and Soils section of this EIS. Sediment inputs from roads are likely to occur over a 2-4 year period with the largest pulses of sediment occurring during storms, runoff, and high flow periods in 2003-04 and to a lesser degree in 2005-06.

Table 3.xx. Estimates of Sediment Yield from Roads for the Silver Fire portion

Alternative	Baseline Condition Sediment Yield (Tons/yr)	Road Decommission/Closure Reductions in Sediment Yield (Tons/yr)	Open Road Sediment Yield (tons/yr)	Percent Reduction from Baseline Condition
C	4.1	0.4	3.7	9.8
E	4.1	0.4	3.8	7.3

Significant increases in sediment yield, that exceed the streams natural ability to carry the sediment load, resulting in sediment depositions, wider, shallower and less stable channels, bank erosion and bed scour, are not expected with Alternatives C and E due to riparian protection measures and adherence to Forest BMP's.

Road Density/Location

Road density, miles of new temporary road, and miles of re-opened road were calculated both for the entire Toolbox Fire Recovery Project area and for each of the subwatersheds (See Watershed section of Chapter 3 for discussions). Road data for Category 1 RHCAs applies only to the Silver Fire portion, as there are no Category 1 RHCAs in the Toolbox Fire portion.

Road miles in the Silver Fire portion within 300 feet of fish bearing stream channels currently total 3.05 miles; and 16.38 miles within 300 feet of intermittent streams. The following table displays proposed closure and decommissioning, within Category 1 and 4 RHCAs, by alternative, with the resulting miles of open road. Maintaining a buffer between the road and stream channel provides a filter that minimizes the introduction of fine sediment into the stream channel. Studies have shown a buffer distance of roughly one site-potential tree would effectively remove sediment in most situations (FEMAT 1993). The number of road miles within 300 feet of perennial and intermittent stream channels were identified from GIS road and stream layers for the project area.

Table 3.xx. Road Management within RHCAs for the Silver Fire Portion

Alternative	Miles of Road within 300 feet of Streams		Miles of Proposed Closed Road		Miles of Proposed Decommissioned Road		Miles of Open Road	
	C1	C4	C1	C4	C1	C4	C1	C4
C	3.05	16.38	0.02	2.60	1.90	4.11	1.15	12.27
E	3.05	16.38	0.07	2.83	1.21	3.31	1.84	13.07

Alternatives C and E would be considered to be **functioning appropriately but at risk** for road densities within the project area. The open road reductions within 300 feet of fish bearing streams and intermittent streams are displayed in the above table. Sediment inputs from roads into stream channels are expected to be minor given the low number of road miles within 300 feet of stream channels and the implementation of riparian protection measures and BMP's.

RHCA Harvest

Other than roadside hazard corridor harvest (which is included in all action alternatives), in the Silver Fire portion, 22 acres of Category 1 RHCA harvest are proposed in Alternative C; 4 acres are proposed in Alternative E. Harvest in roadside hazard corridor, within RHCAs, would add 15 acres of Category 1 RHCA harvest to both alternatives.

The following table displays RHCA harvest for all categories in the Silver Fire portion:

Table 3.xx. Proposed RHCA for Alternative C and E for the Silver Fire portion

Alternative	RHCA Harvest in Units by Category (Acres)			
	C1	C1 Roadside Hazard	C3*	C4*
C	22	15	127	45
E	4	15	99	45

*Roadside Hazard in C3 and C4 were not calculated by fire portion. For the project area as a whole there would be an additional 186 acres of harvest in C3 and 15 acres in C4, in roadside hazard corridors, with all action alternatives.

In these two alternatives, harvest units within Category 1 RHCA are either reserved for helicopter yarding (with exceptions that would allow "line-pulling" from equipment outside the RHCA) and placed in the outer 100 foot of a typical 300-foot RHCA; or in the case of roadside hazard corridors are equipment-restricted. See Chapter 2 for a complete description of resource protection and mitigation measures that apply to RHCA harvest. Specifically, see "Alternative Descriptions; Actions Common to All Fully Analyzed Action Alternatives" for the design of harvest within all category of RHCAs *outside of* roadside hazard corridors; see Chapter 2 "Mitigation and Resource Protection Measures; Aquatics and Soils; Roadside Hazard RHCA Units" for measures that would apply to harvest *within* roadside hazard corridors.

With Alternatives C and E, harvest would occur within Categories 1, 3, and 4 RHCAs. Under the alternative designs some harvest would occur as near as 200 feet from fish bearing streams. Studies show that non-channelized sediment flow rarely travels more than 300 feet and that riparian buffers of 200-300 feet are generally effective at protecting streams from sediment from non-channelized flow (Ketcheson and Megahan 1990, Burroughs and King, 1989). Therefore, the potential for sedimentation into these streams would be greater with harvest occurring at 200 feet of fish bearing streams as opposed to 300 feet.

Harvest would also occur within the entire 50-foot RHCA width along intermittent streams (though no mechanized ground based equipment would be permitted within the entire RHCA width), thus increasing the potential for sediment transport to downstream fish bearing streams. In addition, the harvest would decrease future large wood recruitment to riparian areas, though between 20 and 80 trees per mile of stream would be retained, including all green trees and sufficient dead trees to provide long-term attainment of INFISH Riparian Management Objectives. Large down woody material in riparian areas provides several functions including trapping of sediment transported by rill or sheet erosion, microclimates for the establishment of deciduous and coniferous tree species, and protection and stabilization of streambanks and riparian areas during high flow events.

Riparian vegetation and bank stability

Silver Creek, West Fork Silver Creek (except Reach 5), North Fork Silver Creek, and Guyer Creek are all **functioning appropriately** for riparian vegetation and bank stability. Reach 5 of West Fork Silver Creek is **functioning appropriately but at risk** due to a high abundance of grass and the lack of willow in the older age classes and its slightly low bank stability values. Strawberry and Indian Creeks are **functioning appropriately** for bank stability.

When streams are lined with riparian vegetation such as sedges, willows, and dogwood, streambanks are typically highly stable, resulting in a stream channel that is less susceptible to alteration during high flow events. Under Alternatives C and E, no significant increases in water yield or sedimentation are predicted. Riparian vegetation and bank stability will improve as natural vegetation recovers over time in areas that experienced moderate and high burn intensities.

Large woody debris

Silver Creek, in all reaches in the project area, is **functioning appropriately but at risk** for meeting INFISH standards for large wood. However, only Reaches 5 and 6 are considered to have this rating using ICBEMP numbers for natural and near natural streams while Reaches 7 and 8 are considered to be **functioning appropriately**. West Fork Silver Creek is

functioning appropriately for meeting INFISH standards and natural and near natural conditions as described in ICBEMP. Only Reach 6 of West Fork Silver Creek is considered to be **functioning appropriately but at risk**. North Fork Silver Creek and Guyer Creek are both **functioning appropriately** for large wood while Strawberry Creek is **functioning appropriately but at risk** and Indian Creek is **functioning at unacceptable risk** using ICBEMP criteria.

Under Alternatives C and E, some harvest would occur within RHCAs (in the area between 200 feet and 300 feet from the stream along fish bearing streams). As fire affected trees within the RHCAs die they will provide an important source of wood to the affected stream channels, riparian areas, and adjacent slopes. Large woody debris within affected stream reaches is expected to continue trending toward attainment of desired future condition objectives. The amount of large wood entering fish bearing streams in the Silver Fire portion is expected to increase by an estimated 50 pieces over the next 20 years, which will be sufficient to move to a functional condition. Implementation of the aquatic habitat restoration projects (9.6 miles of large woody debris placement in the Silver Fire portion) would improve the number of pieces of large woody debris in fish bearing streams and therefore improve aquatic habitat conditions for redband trout and other aquatic species.

Pools

The numbers of pools in all potentially affected stream reaches meet objectives and are considered to be **functioning appropriately**. However, the number of large pools, those greater than 2.6 feet in depth, were found to be deficient in all surveyed stream reaches, with the exception of Reaches 4, 5, and 6 of West Fork Silver Creek, and are considered to be **functioning appropriately but at risk** for Silver and West Fork Silver Creeks. North Fork Silver Creek and Guyer Creek are considered to be **functioning at unacceptable risk** for large pools. Factors believed to be affecting formation of large, deep pools are the low numbers of large woody debris and the filling of pools from upstream sediment sources.

Under Alternatives C and E, RHCAs have been established on all streams with some harvest occurring in the outer edges and with specific guidelines (see RHCA Harvest above). No change is expected in the number of pools or large pools, as a result of salvage, with either of these alternatives. Implementation of the aquatic habitat restoration projects would improve the number of large pools in fish bearing streams and therefore improve aquatic habitat conditions for redband trout and other aquatic species.

Spawning gravel fines/substrate composition

The major cause of sedimentation to streams is from roads in most watersheds. No new specified road construction will occur with this project. Project area wide, approximately 16.0 miles (Alternative C) and 13.3 miles (Alternative E) of temporary road would be constructed using the Forest Road Best Management Practices (BMPs). No temporary road would be constructed within RHCAs. Given the physical separation of temporary road construction from spawning areas (greater than 300 feet in all cases) and the BMPs in place, the amount of fine sediment in spawning gravels is not expected to change as a result of temporary road construction. Under Alternatives C and E, improvements (cross drainage, rolling dips etc.) would be made to the roads within the project area, which is expected to slightly decrease the amount of fine sediment in spawning gravels.

Salvage activities proposed under Alternatives C and E are not expected to add significantly to fine sediment entering fish bearing streams. In addition, salvage in Category 1 RHCAs would be via helicopter to minimize soil disturbance and compaction. If any project-generated sediment were to reach fish bearing streams, it is expected that it would be short-term in nature, and at an immeasurable, negligible level. The use of timber BMPs, close adherence to the Soil Productivity Guide, and protective measures in RHCAs would prevent most sediment from reaching stream channels. Road related activities (road maintenance and construction of temporary road) would also have minimal effect as long as road BMPs are followed.

Rosgen channel types

Silver Creek, West Fork Silver Creek (except Reach 5), North Fork Silver Creek, and Guyer Creek are all **functioning appropriately** for predicted Rosgen Channel Types. Although Reach 5 of West Fork Silver Creek has stream channels that are similar to the stream type expected, segments of the reach have bankfull width-to-depth ratios that are slightly greater than expected, therefore the reach is considered to be **functioning appropriately but at risk**. Wildfire, followed by commercial salvage and associated road building, can increase water yield and accelerated erosion. These changes can have a dramatic effect to channels downstream depending on the magnitude of the change and the condition and type of

stream channels affected. Under Alternatives C and E, little increase in water yield or sediment yield is predicted and therefore no changes in channel types are expected to occur.

Stream temperature and shade

Under Alternatives C and E, water temperature will continue to exceed state water quality standards in Silver Creek and West Fork Silver Creek and temperatures may increase with the loss of overstory vegetation from fire-induced mortality. Water temperatures for North Fork Silver Creek and Guyer Creek are expected to remain unchanged.

Alternative D, G, and H

Sediment Yield

Alternatives D, G, and H are predicted to deliver (respectively) 3.7, 3.8, and 3.7 tons of sediment per year to streams in the Silver Fire portion. This delivery is sediment produced by roads within the project area. The amount of sediment yield because of harvest activities is expected to be minimal, as documented within the Geology, Geomorphology and Soils section of this EIS. Sediment inputs from roads are likely to occur over a 2-4 year period with the largest pulses of sediment occurring during storms, runoff, and high flow periods in 2003-04 and to a lesser degree in 2005-06.

Table 3.xx. Estimates of Sediment Yield from Roads for the Silver Fire portion

Alternative	Baseline Condition Sediment Yield (Tons/yr)	Road Decommission/Closure Reductions in Sediment Yield (Tons/yr)	Open Road Sediment Yield (tons/yr)	Percent Reduction from Baseline Condition
D	4.1	0.4	3.7	9.8
G	4.1	0.4	3.8	7.3
H	4.1	0.4	3.7	9.8

Significant increases in sediment yield, that exceed the streams natural ability to carry the sediment load, resulting in sediment depositions, wider, shallower and less stable channels, bank erosion and bed scour, are not expected with Alternatives D, G, and H due to riparian protection measures and adherence to Forest BMP's.

Road Density/Location

Road density, miles of new temporary road, and miles of re-opened road were calculated both for the entire Toolbox Fire Recovery Project area and for each of the subwatersheds (See Watershed section of Chapter 3 for discussions). Road data for Category 1 RHCAs applies only to the Silver Fire portion, as there are no Category 1 RHCAs in the Toolbox Fire portion.

Road miles within 300 feet of fish bearing stream channels currently total 3.05 miles; and 16.38 miles within 300 feet of intermittent streams. The following table displays proposed closure and decommissioning, within Category 1 and 4 RHCAs, by alternative, with the resulting miles of open road. Maintaining a buffer between the road and stream channel provides a filter that minimizes the introduction of fine sediment into the stream channel. Studies have shown a buffer distance of roughly one site-potential tree would effectively remove sediment in most situations (FEMAT 1993). The number of road miles within 300 feet of perennial and intermittent stream channels were identified from GIS road and stream layers for the project area.

Table 3.xx. Road Management within RHCAs for the Silver Fire Portion

Alternative	Miles of Road within 300 feet of Streams		Miles of Proposed Closed Road		Miles of Proposed Decommissioned Road		Miles of Open Road	
	C1	C4	C1	C4	C1	C4	C1	C4
D	3.05	16.38	0.02	2.35	1.90	4.45	1.15	11.93
G	3.05	16.38	0.00	1.69	1.90	4.45	1.15	11.93
H	3.05	16.38	0.02	2.35	1.90	4.45	1.15	11.93

Alternatives D and H would be considered to be **functioning appropriately** for road densities within the project area while Alternative G would be **functioning appropriately but at risk for road densities**. The open road reductions within 300 feet of fish bearing streams and intermittent streams are displayed in the above table. Sediment inputs from roads into stream channels are expected to be minor given the low number of road miles within 300 feet of stream channels and the implementation of riparian protection measures and BMP's.

RHCA Harvest

Other than roadside hazard corridors (which are included in all action alternatives), in the Silver Fire portion, no Category 1 RHCA harvest is proposed in Alternatives D, G and H. Harvest in roadside hazard corridor, within RHCAs, would add 15 acres of Category 1 RHCA harvest to each of the alternatives.

The following table displays RHCA harvest for all categories in the Silver Fire portion

Table 3.xx. Proposed RHCA for Alternative C and E for the Silver Fire portion

Alternative	RHCA Harvest in Units by Category (Acres)			
	C1	C1 Roadside Hazard	C3*	C4*
D	0	15	0	0
G	0	15	132	45
H	0	15	0	0

*Roadside Hazard in C3 and C4 were not calculated by fire portion. For the project area as a whole there would be an additional 186 acres of harvest in C3 and 15 acres in C4, in roadside hazard corridors, with all action alternatives.

In these alternatives, harvest units within Category 1 RHCA are all in roadside hazard corridors and are equipment-restricted. See Chapter 2 for a complete description of resource protection and mitigation measures that apply to RHCA harvest. Specifically, see "Alternative Descriptions; Actions Common to All Fully Analyzed Action Alternatives" for the design of harvest within all category of RHCAs *outside of* roadside hazard corridors; see Chapter 2 "Mitigation and Resource Protection Measures; Aquatics and Soils; Roadside Hazard RHCA Units" for measures that would apply to harvest *within* roadside hazard corridors.

With Alternative G harvest would occur within Categories 3 and 4 RHCAs. Harvest would occur within the entire 50-foot RHCA width along intermittent streams (though no mechanized ground based equipment would be permitted within the entire RHCA width), thus increasing the potential for sediment transport to downstream fish bearing streams. In addition, the harvest would decrease future large wood recruitment to riparian areas, though between 20 and 80 trees per mile of stream would be retained, including all green trees and sufficient dead trees to provide long-term attainment of INFISH Riparian Management Objectives. Large down woody material in riparian areas provides several functions including trapping of sediment transported by rill or sheet erosion, microclimates for the establishment of deciduous and coniferous tree species, and protection and stabilization of streambanks and riparian areas during high flow events.

Under Alternatives D and H, limited harvest within roadside hazard corridors within RHCAs would still occur (as it would with all action alternatives). Any harvest within RHCAs increases the potential for sediment transport to downstream fish bearing streams. In addition, the harvest would decrease future large wood recruitment to riparian areas, though between 20 and 80 trees per mile of stream would be retained, including all green trees and sufficient dead trees to provide long-term attainment of INFISH Riparian Management Objectives.

Riparian vegetation and bank stability

Same effects as Alternatives C and G (see previous section)

Large woody debris

Silver Creek, in all reaches in the project area, is **functioning appropriately but at risk** for meeting INFISH standards for large wood. However, only Reaches 5 and 6 are considered to have this rating using ICBEMP numbers for natural and near natural streams while Reaches 7 and 8 are considered to be **functioning appropriately**. West Fork Silver Creek is **functioning appropriately** for meeting INFISH standards and natural and near natural conditions as described in ICBEMP. Only Reach 6 of West Fork Silver Creek is considered to be **functioning appropriately but at risk**. North Fork Silver Creek and Guyer Creek are both **functioning appropriately** for large wood while Strawberry Creek is **functioning appropriately but at risk** and Indian Creek is **functioning at unacceptable risk** using ICBEMP criteria.

Under Alternatives D, G, and H, harvest would not occur within Category 1 RHCAs, but would occur in (Alternative G) Category 3 and 4 RHCAs. All action alternatives include limited roadside hazard corridor RHCA harvest. As fire affected trees within the RHCAs die they will provide an important source of wood to the affected stream channels, riparian areas, and adjacent slopes. Large woody debris within affected stream reaches is expected to continue trending toward attainment of desired future condition objectives. The amount of large wood entering fish bearing streams in the Silver Fire portion is expected to increase by an estimated 50 pieces over the next 20 years, which will be sufficient to move to a functional condition. Implementation of the aquatic habitat restoration projects (9.6 miles of large woody debris placement in the Silver Fire portion) would improve the number of pieces of large woody debris in fish bearing streams and therefore improve aquatic habitat conditions for redband trout and other aquatic species.

Pools

The numbers of pools in all potentially affected stream reaches meet objectives and are considered to be **functioning appropriately**. However, the number of large pools, those greater than 2.6 feet in depth, were found to be deficient in all surveyed stream reaches, with the exception of Reaches 4, 5, and 6 of West Fork Silver Creek, and are considered to be **functioning appropriately but at risk** for Silver and West Fork Silver Creeks. North Fork Silver Creek and Guyer Creek are considered to be **functioning at unacceptable risk** for large pools. Factors believed to be affecting formation of large, deep pools are the low numbers of large woody debris and the filling of pools from upstream sediment sources.

Under Alternatives D, G, and H, RHCAs have been established on all streams with some harvest occurring in the outer edges of Category 3 (Alternative G) and within Category 4 RHCAs (Alternative G) and in roadside hazard corridors (all action alternatives), within specific guidelines (see RHCA Harvest above). No change is expected in the number of pools or large pools, as a result of salvage, with these alternatives. Implementation of the aquatic habitat restoration projects would improve the number of large pools in fish bearing streams and therefore improve aquatic habitat conditions for redband trout and other aquatic species.

Spawning gravel fines/substrate composition

The major cause of sedimentation to streams is from roads in most watersheds. No new specified road construction will occur with this project. Project area wide, approximately 16.0 miles (Alternative G) and 14.9 miles (Alternative H) of temporary road would be constructed using the Forest Road Best Management Practices (BMPs). Alternative D has no temporary road construction. No temporary road would be constructed within RHCAs. Given the physical separation of temporary road construction from spawning areas (greater than 300 feet in all cases) and the BMPs in place, the amount of fine sediment in spawning gravels is not expected to change as a result of temporary road construction. Under Alternatives D, G and H, improvements (cross drainage, rolling dips etc.) would be made to the roads within the project area, which is expected to slightly decrease the amount of fine sediment in spawning gravels.

Salvage activities proposed under Alternatives D, G, and H are not expected to add significantly to fine sediment entering fish bearing streams. In addition, no salvage would occur in Category 1 RHCAs. If any project-generated sediment were to reach fish bearing streams, it is expected that it would be short-term in nature, and at an immeasurable, negligible level. The use of timber BMPs, close adherence to the Soil Productivity Guide, and protective measures in RHCAs would prevent most sediment from reaching stream channels. Road related activities (road maintenance and construction of temporary road) would also have minimal effect as long as road BMPs are followed.

Rosgen channel types

Silver Creek, West Fork Silver Creek (except Reach 5), North Fork Silver Creek, and Guyer Creek are all **functioning appropriately** for predicted Rosgen Channel Types. Although Reach 5 of West Fork Silver Creek has stream channels that

are similar to the stream type expected, segments of the reach have bankfull width-to-depth ratios that are slightly greater than expected, therefore the reach is considered to be **functioning appropriately but at risk**. Wildfire, followed by commercial salvage and associated road building, can increase water yield and accelerated erosion. These changes can have a dramatic effect to channels downstream depending on the magnitude of the change and the condition and type of stream channels affected. Under Alternatives D, G and H, little increase in water yield or sediment yield is predicted and therefore no changes in channel types are expected to occur.

Stream temperature and shade

Under Alternatives D, G, and H, water temperature will continue to exceed state water quality standards in Silver Creek and West Fork Silver Creek and temperatures may increase with the loss of overstory vegetation from fire-induced mortality. Water temperatures for North Fork Silver Creek and Guyer Creek are expected to remain unchanged.

Direct, Indirect, and Cumulative Effects-Road Reconstruction

Alternative A

There would be no known adverse short term or long-term effects from not implementing road reconstruction.

Effects Common to the Action Alternatives

Road reconstruction would place a surface course layer of cinders on the Maintenance Level-2 roads to provide a durable aggregate surface for timber haul and prevent subgrade deformation while reducing possible roadway soil erosion. The arterial haul roads would be resurfaced with additional cinders to increase the overall roadway surface depth to accommodate timber haul.

Road reconstruction would increase the level of safety for the Public and Forest Service when using these roads during timber sale haul. Reconstruction would use cinders from Forest Service pits, which would utilize and decrease the future availability of the minerals.

Cumulative Watershed Effects

Cumulative watershed effects (CWEs) are defined in the Code of Federal Regulations 40 Section 1508.7 as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. CWEs in watersheds are measurable impacts on physical watershed conditions resulting from the combined effects of a variety of forest management activities. These activities include timber, range, recreations, road management, and all other forest uses. Each forest use or management activity has an individual impact on watershed systems, that when collectively evaluated with other impacts, may have an unanticipated impact larger than the individual impact. The elements that are considered in the cumulative watershed effects analysis are roads, soils, canopy, riparian vegetation, channel, pools, large wood, temperature, sediment, and fish passage. Each of these elements is assigned a functionality rating. These elements are combined with the overall condition of the uplands, riparian area, and stream channels. The findings from this information are tempered with the subwatershed sensitivity, uncertainty, and risk and result in an overall functionality of each subwatershed.

Analysis Methods

An overall rating of each subwatershed in the project area will be made using a synthesis of the uplands, riparian, and channel condition information. The uplands information consists of the roads, canopy, and soils. The riparian information consists of the bank stability values and riparian vegetation. The channel condition information consists of pool frequency, large wood frequency, temperature, fine sediment, and fish passage. The uplands, riparian and channel information for each subwatershed will then be considered for each alternative. Consideration of each alternative as it pertains to each subwatershed will then be explored. The information regarding each alternative coupled with past, present and future activity, the inherent subwatershed sensitivity and the degree of uncertainty or risk involved with the project alternatives will be evaluated.

Subwatershed Sensitivity – Analysis Methods

The degree to which a watershed or subwatershed responds to a management activity or a natural disaster is considered when determining the inherent watershed or watershed sensitivity. Existing conditions and the inherent sensitivity allow one to more clearly understand how a subwatershed may react to any proposed activity on the subwatershed. For the purposes of this analysis, the inherent sensitivity of each 6th field watershed or subwatershed in the planning area will be analyzed. The sensitivity of each subwatershed was determined through the analysis of several elements. These elements are the hydrologic soil group, mass wasting hazard, precipitation amounts, rain-on-snow potential zones, drainage density, watershed relief ratio, and mean basin elevation.

Subwatershed Sensitivity – Hydrologic Soil Group

The soils that make up each subwatershed were broken into hydrologic soil groups that indicate the general infiltration and water movement ability of the soil and bedrock materials. Generally, hydrologic soil groups C and D are rather likely to generate stream flow. Hydrologic soil group A is made up of soils having high infiltration rates, when thoroughly wetted, these soils consists chiefly of deep, well to excessively drained sands and/or gravel. These soils have a high rate of water transmission and would result in a low runoff potential. Hydrologic soil group B is characterized by soils with moderate infiltration rates when thoroughly wetted, these soils consist chiefly of moderately deep to deep, moderately well to well-drained soils, with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission. The soils in hydrologic group C have a slow rate of water transmission and are characterized by slow infiltration rates when thoroughly wetted. Group C consists of (1) soils with a layer that impedes the downward movement of water or (2) soils with moderately fine to fine texture and a slow infiltration rate. Hydrologic soil group D is characterized by soils with a very slow rate of water transmission and very slow infiltration rates when thoroughly wetted. Group D consists of (1) clay soils with high swelling potential, (2) soils with a high permanent water table, (3) soils with clay pan or clay layer at or near the surface, and (4) shallow soils over nearly impervious materials. The percent of the subwatershed area that consists of soil group C and D were reported, as they are streamflow generation areas.

The different soil groups are given an index factor that weighs their relative contribution to surface runoff and sediment delivery within the subwatershed. The total number of acres for hydrologic soil group D and C is multiplied by an index factor of 0.8 and 0.4, respectively in order to generate an index total. The index total was then converted to a percent of the subwatershed area and rated for overall sensitivity with respect to hydrologic group. Subwatersheds were rated high, moderate and low for greater than 40%, greater than 15% and less than or equal to 40%, and less than or equal to 15%, respectively.

Table 3-XX. Index Total for Hydrologic Soil Group C and D

SUBWATERSHED	HYDROLOGIC SOIL GROUP C (acres)	INDEX TOTAL FOR HYDROLOGIC SOIL GROUP C	HYDROLOGIC SOIL GROUP D (acres)	INDEX TOTAL FOR HYDROLOGIC SOIL GROUP D	INDEX TOTAL (Acres)
Benny Creek	5007	2003	4417	3534	5536
East Duncan Creek	927	371	931	745	1116
Lower Duncan Creek	5221	2088	12267	9814	11902
Middle Silver Creek	7881	3152	15968	12774	15927
Thompson Reservoir	5202	2081	4820	3856	5937
Upper Duncan Creek	2040	816	2899	2319	3135
Upper Silver Creek	1487	595	2050	1640	2235
West Fork Silver Creek	2192	877	4466	3573	4450

Table 3-XX. Percent of Subwatershed in Hydrologic Soil Group C and D

SUBWATERSHED	INDEX PERCENT OF SUBWATERSHED	HYDROLOGIC GROUP INDEX
Benny Creek	21%	MODERATE
East Duncan Creek	10%	LOW
Lower Duncan Creek	48%	HIGH
Middle Silver Creek	41%	HIGH
Thompson Reservoir	14%	LOW
Upper Duncan Creek	14%	LOW
Upper Silver Creek	14%	LOW
West Fork Silver Creek	19%	MODERATE

Subwatershed Sensitivity – Mass Wasting Hazard

Mass wasting information was derived from the Soil Resources Inventory (SRI) for the Fremont National Forest. The rating is based on the relative stability of the mapping units as they occur in the natural state. Types of movement include slumps, slides, rockfall, landflows, and landslips. Soil mapping units where no evidence of failure exists were rated as very stable. Occasional failures that were observed were rates as stable. The analysis area yielded four categories of information with regard to mass wasting—very stable, stable with rotational slumps as the mass movement type, stable with debris slides as the mass movement type, and not applicable.

The mass wasting information for the portion of the subwatersheds north of the Forest Service boundary, approximately 46,500 acres, has not yet been completed. However, the area is characterized by low relief and little to no history of mass wasting.

Table 3-XX. Mass Wasting Characteristics of each Subwatershed

SUBWATERSHED	VERY STABLE	STABLE (rotational slumps)	STABLE (debris slides)	Not Applicable
Benny Creek	86%	6%	0%	8%
East Duncan Creek	50%	0%	0%	50%
Lower Duncan Creek	55%	12%	0%	33%
Middle Silver Creek	98%	0%	0%	2%
Thompson Reservoir	72%	3%	0%	25%
Upper Duncan Creek	72%	3%	0%	25%
Upper Silver Creek	83%	1%	1%	15%
West Fork Silver Creek	79%	13%	0%	8%

The index for mass wasting characteristics for the analysis was rated as follows. Greater than 85% of the subwatershed that was very stable was rated as low sensitivity, greater than 70% and less than 85% of the subwatershed that was very stable was rated as moderate and less than 70% was rated as high sensitivity. If any subwatershed had greater than 10% of the area in rotational slumps the category was raised to the next level of sensitivity.

Table 3-XX. Index for Mass Wasting Characteristics

SUBWATERSHED	INDEX
Benny Creek	LOW
East Duncan Creek	HIGH
Lower Duncan Creek	VERY HIGH
Middle Silver Creek	LOW
Thompson Reservoir	MODERATE
Upper Duncan Creek	MODERATE
Upper Silver Creek	MODERATE
West Fork Silver Creek	HIGH

Subwatershed Sensitivity – Precipitation and Rain on Snow Potential

Precipitation amounts were taken from the Silver Creek SNOTEL station that is located at 5740 ft elevation and was installed in 1981. The average accumulated precipitation by September 30 for the water years (October 1 through September 30) of record (1981-2002) is 27.5 inches. The majority of the precipitation falls by June 1. The average accumulated precipitation by June 1 for the water years of record is 24.4 inches. Due to the limited number of precipitation gages located within or near the analysis area the precipitation value of 24.4 inches will be used for each subwatershed. Overall the limited amount of precipitation experienced in the area yields less sensitive watersheds on the whole.

The amount within the rain-on-snow zone for each subwatershed was not readily calculated. A clear picture of the elevation bands that are located within rain-on-snow potential zones is not available due to the limited number of gauging stations throughout the subwatersheds. The available gauging stations in the general area illustrate a typical rain-on-snow signature seen during several years of the gauging record. These sites are located at approximately 4400 ft elevation. One of the gauging stations is located with the Silver Creek 5th field watershed. For this reason, it would be accurate to estimate the lower boundary of the rain-on-snow zone to be 4500 feet for the Silver Creek 5th field watershed. The upper boundary of the rain-on-snow zone for Silver Creek could be estimated at approximately 6,000 feet. This elevation range places approximately 65% of the Silver Creek 5th field watershed within the approximated rain-on-snow area. The Silver Lake 5th field watershed does not have a gauging station within the watershed and therefore the same elevation range will be used.

However, the concern over rain-on-snow events is a very real concern in any area that experiences substantial snow pack. A significant snowmelt could be produced if a rain-on-snow event with very high winds, temperatures, humidity and precipitation were to occur at a time (Marks et. al., 1998). The resultant snowmelt would enhance runoff and increase the potential for flooding. If conditions are ripe, a rain-on-snow flood event can be very damaging to the subwatershed. Each subwatershed will be discussed separately regarding the estimated risk of a rain-on-snow event and how that relates to risk in relation to subwatershed sensitivity.

The index rating for rain-on-snow area for each subwatershed will be rated separately for the 5th field watersheds. For the subwatersheds in the project area: any subwatershed with greater than or equal to 70% of the subwatershed in the rain-on-snow elevation range will be rated as high and any subwatershed with less than 70% and greater than 50% will be rated as moderate, and less than 50% will be rated as low.

Table 3-XX. Rain-on-Snow Index Rating for each Subwatershed

SUBWATERSHED	% OF SUBWATERSHED WITHIN RAIN-ON-SNOW RANGE	RAIN-ON-SNOW SENSITIVITY INDEX
Benny Creek	60%	MODERATE
East Duncan Creek	45%	MODERATE
Lower Duncan Creek	85%	HIGH
Middle Silver Creek	65%	MODERATE
Thompson Reservoir	65%	MODERATE
Upper Duncan Creek	60%	MODERATE
Upper Silver Creek	95%	HIGH
West Fork Silver Creek	70%	HIGH

Subwatershed Sensitivity – Drainage Density

The drainage density for each subwatershed was determined by taking the miles of stream divided by the subwatershed area. Drainage density affects the rapidity by which water can flow to the outlet. A larger drainage density value, will yield a quicker flow response and higher the peak (Brooks et al. p. 78, 1991). This value was further divided into the drainage density values for perennial and intermittent streams. The low class of drainage density is considered between 3 to 4 mi/mi^2 (Strahler, 1964). None of the subwatersheds have drainage densities above 1.3 mi/mi^2. The index for the drainage density was rated relative to the eight subwatersheds and was separated into high (greater than or equal to 1.2 mi/mi^2), moderate (greater than or equal to 1.0 mi/mi^2 and less than 1.2 mi/mi^2) and low (less than 1.0 mi/mi^2).

Table 3-XX. Drainage Density for each Subwatershed

SUBWATERSHED	PERENNIAL AND INTERMITTENT DRAINAGE DENSITY (mi/mi^2)	DRAINAGE DENSITY SENSITIVITY INDEX
Benny Creek	1.18	MODERATE
East Duncan Creek	0.64	LOW
Lower Duncan Creek	1.13	MODERATE
Middle Silver Creek	1.03	MODERATE
Thompson Reservoir	1.10	MODERATE
Upper Duncan Creek	0.84	LOW
Upper Silver Creek	1.24	HIGH
West Fork Silver Creek	1.27	HIGH

Subwatershed Sensitivity – Watershed Relief Ratio

The subwatershed relief ratio was generated by subtracting the outlet elevation from the subwatershed crest elevation divided by the length of the subwatershed. Upper Silver Creek and Lower Duncan Creek have the largest watershed relief ratio due to the shortest distances between the high and low point. West Fork Silver Creek loses the most elevation between high and low points but does so over the longest distance which yields an average watershed relief ratio. The index used for watershed relief was separated into high (greater than or equal to 0.75 ft/ft), moderate (greater than or equal to 0.5 ft/ft and less than 0.75 ft/ft) and low (less than 0.5 ft/ft).

Table 3-XX. Watershed Relief Ratio for each Subwatershed

SUBWATERSHED	HIGH PT (ft)	LOW PT (ft)	DIFFERENCE IN ELEVATION (ft)	DISTANCE (ft), HIGH TO LOW PT	WATERSHED RELIEF RATIO	WATERSHED RELIEF SENSITIVITY INDEX
Benny Creek	7135	4956	2179	66,181	0.03	LOW
East Duncan Creek	6800	5200	1600	42,148	0.04	LOW
Lower Duncan Creek	7066	4320	2746	29,662	0.09	HIGH
Middle Silver Creek	7140	4315	2825	53,858	0.05	MODERATE
Thompson Reservoir	7560	4956	2604	51,007	0.05	MODERATE
Upper Duncan Creek	6820	5200	1620	57,204	0.03	LOW
Upper Silver Creek	7195	4435	2760	27,497	0.10	HIGH
West Fork Silver Creek	7680	4435	3245	79,888	0.04	LOW

Subwatershed Sensitivity – Mean Basin Elevation

Mean basin elevation was estimated by the elevation of the centroid of each subwatershed. Higher elevation subwatersheds have more inherent sensitivity. The index used for the centroid elevation information was high (greater than 5500 ft), moderate (greater than or equal to 5000 ft and less than 5500 ft) and low (less than 5000 ft).

Table 3-XX. Centroid Elevation of each Subwatershed and Associated Rank

SUBWATERSHED	CENTROID ELEVATION (ft)	SENSITIVITY INDEX
Benny Creek	5789	HIGH
East Duncan Creek	6131	HIGH
Lower Duncan Creek	5100	MODERATE
Middle Silver Creek	4600	LOW
Thompson Reservoir	5000	MODERATE
Upper Duncan Creek	5930	HIGH
Upper Silver Creek	5300	MODERATE
West Fork Silver Creek	5060	MODERATE

Summary of Subwatershed Sensitivity

The following table is a synopsis of the overall subwatershed sensitivity for the subwatersheds within the analysis area.

Table 3-XX. Overall Subwatershed Sensitivity

SUBWATERSHED	INDEX
Benny Creek	MODERATE
East Duncan Creek	MODERATE
Lower Duncan Creek	HIGH
Middle Silver Creek	MODERATE
Thompson Reservoir	MODERATE
Upper Duncan Creek	MODERATE
Upper Silver Creek	HIGH
West Fork Silver Creek	HIGH

The conditions of each subwatershed begins with the current condition and does not use this current condition as the baseline or desired condition of the subwatershed (Beschta et. al., 1995). The desired conditions are taken from ICBEMP (1997), USFWS (1998), Clean Water Act guidance and historic ranges of canopy variability.

Cumulative Watershed Effects – Analysis Methods

The elements that are considered in the cumulative watershed effects analysis are roads, soils, canopy, riparian vegetation, channel, pools, large wood, temperature, sediment, and fish passage. Each of these elements is assigned a functionality rating. These elements are combined with the overall condition of the uplands, riparian area, and stream channels.

Cumulative Watershed Effects – Roads

Roads account for most of the sediment problems in a watershed because they are a link between sediment source areas (skid trails, landings, and cutslopes, etc.) and stream channels. They directly affect the channel morphology of streams by accelerating erosion and sediment delivery and by increasing the magnitude of peak flow (Furniss et. al., 1991). A study of eroded material travel distances below fill slopes shows that more than 95% of relief culverts can be prevented from contributing sediment to streams if the travel distance is 300 feet or more. Roads with broad-based dips have nearly 100% of the contributing eroded material stopped within a travel distance of 100 feet (Burroughs and King 1989). As a result, INFISH (1995) recommends buffer strips of 300 feet between riparian areas and roads. In addition, maintaining a buffer between the road and stream channel provides a filter that minimizes the introduction of fine sediment into the stream channel. Road density (both open road density and closed road density), road impact index, the number of road crossings, roads within riparian areas, and the drainage network efficiency will all be used to determine the impact of roads at the subwatershed level.

Road densities vary widely within the project area by land ownership and within each subwatershed. Rosgen (1991) developed a Road Impact Index (RII), which is a qualitative indicator of sediment delivery risk. The RII will be used on a subwatershed basis and is calculated using the following formula: Road Impact Index = (miles of road within the subwatershed/area of the subwatershed in square miles) * the number of stream crossings. This method is based on the following assumptions: 1) higher road density allow for a higher potential of an increase in sediment yield due to the larger acreage of exposed surfaces and 2) the more drainage ways that are crossed the higher the probability that direct sediment introduction will occur. The number of roads within riparian areas, as defined by the Inland Native Fish Strategy (INFISH, 1995), will be presented for perennial fish bearing streams and intermittent streams. Also, the number of roads within 300 feet of any perennial or intermittent streams will be reported. INFISH (1995) recommends strips of 300 feet between riparian areas and roads. This buffer between roads and streams provides a filter that minimizes the introduction of fine sediment into the stream channel.

Drainage network efficiency will be calculated based on Wemple (1994). Generally speaking, an undisturbed watershed should move water through the system slowly. Therefore, a significant increase in drainage network efficiency signals a point of concern for watershed health. Wemple (1994) concluded that roads extend the stream network by as much as 40% during storm events by altering timing of water delivery to stream. An estimate of the percent increase in drainage network efficiency for each subwatershed will be calculated based on the 40% figure. Closed roads are considered to contribute to the overall drainage efficiency and are therefore included.

To reduce the adverse effects of roads on aquatic resources, road miles should be decreased through closure and decommissioning in subwatersheds with high road densities. The functionality rating of roads within each subwatershed will be based on the following list but adjustments will be made when considering road impact index, stream crossings, the number of roads within riparian areas, and drainage efficiency.

Functioning Appropriately – Subwatershed road density less than 1.0 mi/mi^2 and no valley bottom roads
Functioning at Risk – Subwatershed road density of 1.0 – 2.4 mi/mi^2 and some valley bottom roads
Functioning at unacceptable risk – Subwatershed road density greater than 2.4 mi/mi^2 and many valley bottom roads

Cumulative Watershed Effects – Canopy

Leaf area index indicates the amount of snow interception and shade generated from that canopy, both of which affect the amount and timing of runoff. Canopy cover is used as a surrogate for leaf area index because of available remote sensing tools. The canopy information was developed from the ISAT information available and then modified to reflect the current

vegetation condition as a result of the fires. The assumption is made that forested stands, which are above or below the historic range of variability (HRV) may affect timing of runoff, amount of runoff and total yield of runoff from the subwatershed. It is further assumed that forested stands that are within the historic range of variability for canopy do not contribute to cumulative effects. Canopies outside of the historic range of variability, increased canopy densities indicate a build up of understory trees. This build up heightens the risk of catastrophic fire, causes conifers to become stressed and susceptible to insects and disease and may also cause a reduction of water available for stream flow during summer months. The historic structural stages and ranges of canopy cover for the primary forest ecosystems on the Fremont National Forest are understood to be 26-40% for Ponderosa Pine and 25-55% for Lodgepole Pine and White Fir. The type of forest ecosystem was derived from the eco-class layer in GIS and the mortality expected from the fire. The percent of the forested acres of each eco-class that is above and below HRV was calculated and combined to determine the percent above and below HRV for each subwatershed.

Functioning Appropriately – Less than 20% of subwatershed above or below HRV
Functioning at Risk – 20-40% of subwatershed above or below HRV
Functioning Unacceptable Risk – 40-60% of subwatershed above or below HRV

The utility of this analysis allows one to better understand HRV after the fires of 2002. However, the action analyzed for this project is the removal of dead and dying trees (with the exception of noncommercial thinning) and will not affect the HRV of the stands as analyzed here.

Cumulative Watershed Effects – Soils

Soil condition was characterized through a field assessment of soil compaction. Soil compaction commonly occurs in high use areas such as roads, skid trails, and landings. The Fremont National Forest Soil Productivity Guide (SPG) addresses methods to plan and operate timber sales in order to minimize detrimental soil impacts. The goals states within the SPG are:

- For initial entries, Districts should plan for and design new activities that do not exceed detrimental soil conditions on more than 20% of a project area (includes the permanent and temporary transportation system, landings, and post sale activities.)

- In areas where less than 20% detrimental soil conditions exist from prior activities, the cumulative detrimental effect of the current activity (includes the permanent transportation system and post sale activities) following project implementation and restoration must not exceed 20%.

- In areas where more than 20% detrimental soil conditions exist from prior activities, the cumulative detrimental effects from project implementation and restoration must, at a minimum, not exceed the conditions prior to the planned activity and the goal is to move toward a net improvement in soil quality and to achieve less than 20% detrimental soil conditions in the long term.

An inventory of the soil compaction on Forest Service land was completed after the fires took place. The analysis area was divided into capability areas. Capability areas are groups of soil map units that have similar potential for erosion, compaction, displacement, and mass movement. Transects to determine soil compaction within the fire boundary were located within the primary capability areas in areas where salvage units were originally planned and inventoried in the field (91 transects were completed for the fire area). The results from the field inventory were recorded and an overall value for each transect was determined by the number of hits within each category. For more details see Geology, Geomorphology and Soils section.

The area of each subwatershed outside of the fire boundary was not tested for compaction. General characteristics of the soils potential for erosion, compaction, displacement, and mass wasting within the subwatershed will be reported. The potential for soil erosion is based on expected soil losses by rill and gully erosion when all vegetation cover is removed. The potential for compaction refers to the relative ease with which the soil can be compacted when wet or moist.

Compaction is used here as the point at which the soil macroscopic pore space is reduced by one-half or more or when the bulk density is increased by twenty percent, or more, above the natural state. The displacement potential rates the ease with which the soil can be loosened or moved. Displacement can be done by hoof, foot, vehicular or log traffic.

In order determine the functionality of each subwatershed with respect to soil condition the following rating system was used.

Functioning Appropriately – Less than 20% of subwatershed with detrimental soil compaction
Functioning at Risk – Greater than 20% of subwatershed with detrimental soil compaction

Cumulative Watershed Effects – Riparian Vegetation

Riparian areas occupy a small percentage of the area, but are an extremely vital component of the landscape, especially in arid eastern Oregon (Elmore and Beschta 1987). Riparian vegetation found in these areas buffers the fluvial system from potential impacts and disturbances caused by land management activities and natural events. Found in riparian areas within the area are a variety of sedges (*Carex* spp.), shrubs such as thinleaf alder (*Alnus incana*) and willow (*Salix* spp.), and deciduous trees such as aspen (*Populus tremuloides*) and black cottonwood (*Populus trichocarpa*). The stems of these plants provide roughness to dissipate floodwater energy and act as sediment filter. The strong root systems of these plants also provide resistance to a stream's erosive power. By collecting sediment and stabilizing stream banks, riparian plant species act to maintain the integrity of riparian areas and elevate or maintain water tables.

The condition of the riparian vegetation can have a pronounced impact on stream stability. The condition of riparian vegetation can be completed through the use of riparian scorecards. However, the implementation of the use of riparian score cards for the area is not yet completed. Bank stability is often used as surrogate to determine proper function of riparian vegetation when detailed information regarding riparian vegetation is not available. Streambank was inventoried as unstable if it lacked vegetation above the bankfull width stage. The total length of unstable bank (on either side of the stream) was totaled for a stream segment and divided by twice the length of the stream segment.

The information for the riparian vegetation and streambank stability was generated from a watershed analysis inventory completed in 2000 and Ochoco Bottomline surveys for intermittent streams completed after the fires in the fall of 2002. The riparian vegetation was inventoried as the three dominant riparian vegetation species found within the flood prone width. The dominance of late-seral species, like willow, dogwood, sedge, and grass, promotes high bank stability values.

The effects analysis will consider how the alternatives affect riparian vegetation and stream bank stability and how those changes could affect interior redband trout production, growth, recruitment, and survival.

Functioning Appropriately – Streambank stability greater than 90%
Functioning at Risk – Streambank stability between 80%-90%
Functioning at Unacceptable Risk – Streambank stability less than 80%

The effects analysis will consider how the alternatives affect riparian vegetation and stream bank stability and how those changes could affect interior redband trout production, growth, recruitment, and survival.

Cumulative Watershed Effects – Channel Condition Rating

Channel condition integrates past climatic, physiographic and management influences and is an essential indicator of overall subwatershed condition. Concerns have been raised regarding the effects of domestic grazing on channel condition and subsequently subwatershed condition. Intense, uncontrolled grazing can affect hydrologic function of an area through decreased infiltration, increased surface erosion and direct effects on streambank stability. The greatest effects occur when grazing within riparian areas creates trampled, bare conditions. Uncontrolled domestic livestock has a natural tendency to concentrate in riparian areas, thereby increasing the potential for damage to these sensitive sites. Since there is a lesser chance of significant damage to upslope areas than there is to the riparian areas, it is assumed that the effects of grazing will be integrated into the channel condition index.

The information for the channel condition was generated from a watershed analysis inventory completed in 2000 with additional data was collected after the fires burned. The additional data was focused on the amount of large wood per mile

and the amount of shade along the creek. Ochoco Bottomline surveys for intermittent streams completed after the fires in the fall of 2002.

The key instream habitat features that will be analyzed for stream channel for this project are pool frequency, large wood frequency, water temperature, sediment, fish passage, and channel morphology. Data for every instream habitat features is not available on all streams.

Pool Frequency

Pools are considered one of the most important fish habitat features, and for most fish, pools are the preferred habitat type (Beschta and Platts 1986). Reeves et al. (1991) describes some of the reasons why trout use this habitat type: pools offer low velocity refuges, cooler stream temperatures during the summer months, and overwintering habitat. Streams that lack large, deep pools have been documented to freeze during the winter months on the Fremont National Forest (Fremont National Forest, Unpublished Data). Decker and Erman (1992) found that rainbow trout numbers were more abundant with an increase in pool habitat. An increase in pool numbers and complexity produces conditions for increased fish numbers and biomass (Fausch and Northcote 1992). Pool frequency is typically reported as pools per mile and is a key feature in the determination of channel condition. The number of pools is evaluated against the weighted average of the 50th and 75th percentiles for natural and near natural streams in the northern Great Basin, Blue Mountains, and Central Idaho Mountains (USDA & USDI 1997). The natural or near natural frequency are determined using the table below, and the formula: desired numbers per mile = table value x 5280/average riffle width in feet. For example, a stream 10 feet wide with a slope of <2% would be expected to have 51 pools/mile of at the 75th percentile.

Table xx. Natural or Near Natural Frequency of Pools in Northern Great Basin Stream*

Slope Class	Pools/Mile	
	50th Percentile	75th Percentile
All	0.046	0.083
<2%	0.056	0.096
2-4%	0.060	0.101
>4%	0.030	0.058

*Also, includes data from Blue Mountain and Central Idaho Mountain Streams

Example:
0.096 x 5280/10 = 51 pools per mile

Table xx. Natural or Near Natural Frequency for Large Pools in Northern Great Basin Streams

Slope Class	Pools/Mile	
	50th Percentile	75th Percentile
All	0.000	0.003
<2%	0.000	0.005
2-4%	0.001	0.004
>4%	0.000	0.000

Large Pools are Pools that are greater than 2.6 feet deep

Functioning Appropriately – Pool numbers are greater than 75th percentile
Functioning at Risk – Pool numbers are greater than 50th and less than 75th percentile
Functioning at Unacceptable Risk – Pool numbers are less than 50th percentile

The effects analysis will consider how the alternatives affect pool frequency and large pools and how changes in those types of hiding and rearing cover alter the growth and survival of redband trout.

Large Wood Frequency

Large woody debris in streams is an important roughness element influencing channel morphology, sediment distribution, and water routing (Swanson and Lienkaemper 1978, Bisson et al. 1987). Large wood forms a step gradient, a stair-step effect along the channel. As a result, stream velocity is reduced (Zimmerman et al. 1967). Wood also serves as an important agent in pool formation. Large wood frequency is typically reported as pieces of wood per mile and is another key feature in the determination of channel condition. For this analysis, large wood is defined as being 20 inches in diameter on the small end and greater than 35 feet long in ponderosa and mixed conifer sites. The large wood must be within bankfull stage and can be live or dead.

Large woody debris is evaluated against the 50th and 75th percentiles for natural and near natural streams in the Northern Great Basin (USDA & USDI 1997). The natural or near natural frequency are determined using the table below, and the formula: desired numbers per mile = table value x 5280/average riffle width in feet. For example, a stream 10 feet wide with a slope of 2-4% would be expected to have 11 pieces of LWD/mile at the 50th percentile.

Table xx. Natural or Near Natural Frequency of LWD in Northern Great Basin Streams

Slope Class	Large Woody Debris/Mile	
	50th Percentile	75th Percentile
All	0.019	0.062
<2%	0.006	0.025
2-4%	0.020	0.085
>4%	0.020	0.067

Example:
0.020 x 5280/10 = 11 pieces per mile

Functioning Appropriately – Large wood numbers are greater than 75th percentile
Functioning at Risk – Large wood numbers are greater than 50th and less than 75th percentile
Functioning at Unacceptable Risk – Large wood numbers are less than 50th percentile

The effects analysis will consider how the alternatives affect large woody debris recruitment, undercut banks, and large pools, and how changes in those types of hiding and rearing cover alter the growth and survival of redband trout.

Temperature

Stream temperature is an important factor regulating aquatic life. Fish are cold blooded, and thus, assume the temperature of the water in which they live. For this reason, a fish's metabolism, and consequently their growth and development, are directly controlled by their thermal environment (Brown 1983). Therefore, the growth and survival of fish can be greatly affected by temperature extremes (Beschta et al. 1987). Because stream temperature affects fish habitat, the Oregon Department of Environmental Quality (DEQ) has established a state water quality temperature criteria (seven-consecutive average daily maximum temperature) to be at or below 17.8°C (64°F) with fish being the primary benefiting resource. Generally, water temperatures in excess of 21°C (70°F) are unfavorable and may cause stress to all age classes (Sigler and Sigler 1991). However, Behnke (1992) states that redband trout possess a hereditary basis to persist at higher water temperatures than other species of trout. Further, Sonski (1985) noted that redband trout raised in a hatchery increased growth until 24°C (75°F) and recommended temperatures ranging from 18.3 to 23.8°C (65 to 75°F) to keep broodstock in good condition. Behnke (1992) has captured (fly fishing) live redband in streams with temperatures of 28.3°C (82.9°F). Water temperatures exceeding 29.4°C (84.9°F) can be fatal to rainbow trout (Bjornn and Reiser 1991). Recent studies in southeast Oregon streams (Little Blitzen River and Bridge Creek in the Blitzen River Basin, and North Fork Twelvemile Creek in the Warner Basin) found that redband trout prefer water temperatures of 12.8°C (55°F). At this temperature, metabolic power and swimming ability were some of the highest reported for wild fish (Rodnick et al. in press). Stream shade and proper width-to-depth ratios are the key factors influencing water temperatures within streams of south central Oregon.

Functioning Appropriately – Seven-day average maximum stream temperature are less than 17.8°C
Functioning at Risk–Seven-day average maximum stream temperature are between 17.8°C and 24°C
Functioning at Unacceptable Risk – Seven-day average maximum stream temperature are greater than 24.0°C

The effects analysis will consider how the alternatives affect water temperature levels and how those changes could affect redband trout production, growth, recruitment, and survival.

Fine Sediment

Willers (1991) found that mortality increases as spawning gravel size decreases because fine sediment impedes the flow of oxygenated water over the eggs or can trap the alevins in the gravel. Likewise, other studies show an inverse relationship between fine sediment and reproductive success (Everest et al. 1987). The reference level of fines for a particular geologic type has not been identified; however, analysis shows that a level of less than 30% fines is generally attainable in the top four inches of spawning substrate throughout the Fremont National Forest. The data also shows a high correlation to road density and the presence of valley bottom roads.

Sediment can influence fish populations in several ways and can be directly linked to individual fish species and life stages. Two measurements of sediment levels that put particular emphasis on fisheries concerns are: 1) percent surface fines and 2) percent fines in spawning substrate. Fines are considered particles that are less than 6.4 mm along the intermediate axis (not the longest axis nor the shortest axis). Surface fines are determined with a Wolman pebble count, a systematic sampling of surface particle sizes. A bulk sample of pool tails and low gradient riffles is used to measure percent fines in spawning substrate. The bulk sample is acquired through the insertion of a cylinder into the streambed and extracting the gravel from the cylinder. The samples are then dried and passed through a series of nested sieves to determine the percent of fines less than 6.4 mm.

Functioning Appropriately – Less than 20% fines for Rosgen stream types C and E, less than 25% fines for Rosgen stream types A and B
Functioning at Risk – 20%-30% fines for Rosgen stream types C and E, 25%-30% fines for Rosgen stream types A and B
Functioning at Unacceptable Risk – Greater than 30% fines for all stream types

Background erosion is 0.01 to 0.05 ton/acre. Post fire erosion is 0.09 ton/acre overall in Toolbox. Post fire erosion in the Silver fire area is 0.06 ton/acre overall yet select areas have anticipated erosion rates of 1.72 ton/acre.

The effects analysis will consider how the alternatives change sediment levels in spawning and rearing habitats and how those changes could affect redband trout production, growth, recruitment, and survival.

Fish Passage

Fish move up and down streams for a variety of reason, including refuge into smaller streams after a flood or precipitation event, spawning migration and to seek more suitable habitat as a result of competition or unfavorable stream temperatures. Radio telemetry studies conducted in 2000 and 2001 on the Fremont National forest indicate redband trout move a considerable amount during spring spawning and also during late summer as stream temperatures increase and flow decreases. Radio telemetry studies in the spring of 2000 and 2001 in the Chewaucan Basin, located south of the analysis area, quantified movement of several adult spawning redband trout. Average round trip, upstream and downstream, distances traveled by redband trout after tagging was 66 and 40 river kilometers in 2000 and 2001, respectively. The maximum upstream distance traveled by one fish in 2001 was 23 river kilometers while 44% of the radio-tagged fish moved upstream less than six river kilometers (Tenniswood 2001, p. 16 and Appendix B).

As fish move through a system they are faced with challenges to their movement at road crossings. Culverts, the typical road crossing structure on forested land, historically were designed with the efficient movement of water in mind. To facilitate efficient movement of water, the culverts were placed at steeper slopes than the stream, were smaller in diameter than the typical stream cross-section, and introduce less friction to the flowing water than the stream. The combination of these factors leads to the culvert being a barrier to fish movement through the system.

A culvert inventory was done on 399 culverts on the Fremont National Forest during 2000-2002. The inventory measured the characteristics of the culverts that influenced fish passage. Criteria were placed on several characteristics to determine if fish could pass through the culvert. It was determined that fish could either pass through the culvert (green), that further information was necessary to determine fish passage status (gray), or fish passage was impeded by the culvert (red). The inventory found that nearly 89% of the culverts inventoried impeded movement to fish.

The location of the culvert within the subwatershed is critical when considering the importance or effect of the passage blockage. The following functionality criteria consider both if a road crossing is an impediment to fish passage and also where the road crossing is located. Roads that cross perennial streams are a higher priority than those on intermittent streams.

Functioning Appropriately – All inventoried culverts on perennial or intermittent streams in the subwatershed are category green.
Functioning at Risk – Some inventoried culverts on a perennial or intermittent stream in the mid to upper stream reaches in the subwatershed are category red. All inventoried culverts on perennial streams are located low in the subwatershed are category green.

Functioning at Unacceptable Risk – Any inventoried culvert on a perennial stream in the lower reaches of the subwatershed is red.

Rosgen channel type
The effects analysis will consider how the alternatives affect Rosgen Channel types and how those changes could affect interior redband trout production, growth, recruitment, and survival. The Rosgen Classification system was selected because it aids in describing the natural potential of each stream, based on numerous measurements, such as entrenchment, bankfull width-to-depth ratio, sinuosity, gradient, and dominant channel substrate (Rosgen 1996). *Entrenchment* is the vertical containment of the stream channel and refers to the ability of a stream to access its floodplain. The stream is entrenched when floodwaters are confined to the channel and is not entrenched when floodwaters are able to access the floodplain. *Bankfull width-to-depth ratio* indicates the shape of the channel, and is the ratio of bankfull width to mean bankfull depth. Bankfull stage is the point at which the stream accesses its floodplain and is a required measurement in order to determine width-to-depth ratios. It is synonymous to the flood stage, with an average return interval of 1.5 years (Leopold 1964), and is considered the channel forming flow. Width-to-depth ratios indicate whether the stream is wide and shallow or narrow and deep. *Sinuosity* refers to the extent with which a stream meanders across the landscape. Highly sinuous streams have many meanders and curves, while streams with low sinuosity are straighter with few meanders and curves. Gradient is the slope or steepness of the stream while the *dominant channel substrate* refers to the size of particle or rock that covers the stream channel.

Cumulative Watershed Effects by Subwatershed

Benny Creek

Existing Condition

Sensitivity
Benny Creek 6th field watershed (subwatershed) (HUC 171200050204) is approximately 42 square miles and is part of the Silver Creek 5th field watershed. There are no perennial streams within the subwatershed but there are several intermittent streams. The primary intermittent streams that are located within Benny Creek subwatershed are Graham Creek, Benny Creek and Hawk Creek. Graham Creek is approximately 3.2 miles long and located on the far south and eastern portion of the subwatershed. Benny Creek is approximately 16.4 miles long and extends from Winter Rim to Thompson Reservoir. Hawk Creek is approximately 4.4 miles long and located in the northern portion of the subwatershed.

Hydrologic soil group C, which is characterized by slow rates of infiltration and water transmission, characterizes nineteen percent of the subwatershed. Hydrologic soil group D, which is characterized by very slow rates of infiltration and water transmission, characterizes sixteen percent of the subwatershed. Thirty-five percent of the subwatershed area is characterized by hydrologic soil group C and D. The total index percent of hydrologic group C and D was rated as **moderate** sensitivity for this subwatershed. The subwatershed is dominated by very stable mass wasting characteristics with 86% of the subwatershed being rated as very stable. Six percent of the area is at some risk for rotational slumps. The sensitivity index for mass wasting was **low** for this subwatershed. All subwatersheds receive limited amounts of precipitation on average, which yields a less sensitive watershed on the whole. A rain-on-snow event is of particular concern any area with substantial snow pack. Benny Creek is located high in the system and on average holds snow in the upper elevations well into the spring. According to the estimated rain-on-snow range for the Silver Creek 5th field watershed of 4500-6000 feet, approximately 60% of the subwatershed is within this range. The sensitivity index for this element was rated as **moderate**.

Benny Creek has a low drainage density of 1.18 mi/mi^2, which is well below the low class of 3 to 4 mi/mi^2 (Strahler, 1964). In comparison to the other subwatersheds in the analysis area Benny Creek was rated as **moderate**. Subwatershed relief for Benny Creek is the lowest value of the eight subwatersheds being analyzed and was rated as **low** sensitivity. Over approximately 12.5 miles, an elevation of 2179 feet is lost for a resultant subwatershed relief ratio of 0.03 ft/ft. The centroid elevation of Benny Creek is 5789 feet which is the third highest in the analysis area and rated **high** for the sensitivity index. A higher centroid elevation value tends toward a more sensitive subwatershed.

Overall, Benny Creek has limited precipitation, no perennial streams, moderate sensitivity for streamflow generation areas, low sensitivity for mass wasting, and moderate sensitivity for rain-on-snow potential. The channel information ranges from low to high for the three elements considered. This information leads one to conclude that Benny Creek subwatershed has **moderate** sensitivity when compared to the other subwatersheds within the analysis area.

Functionality

Benny Creek is dominated by low-severity burn. Approximately 48% of the subwatershed burned, with 0.2%, 8.8% and 38.9% of the subwatershed burned at high, moderate and low-severity, respectively.

The roads, canopy and soils within the subwatershed will be used to characterize the uplands of Benny Creek. According to the transportation layer in Geographical Information Systems (GIS) there are 137 miles of road within Benny Creek subwatershed equating to an open road density of 3.27 mi/mi^2, which places the subwatershed **functioning at unacceptable risk**. The Riparian Habitat Conservation Area (RHCA) for an intermittent stream is 50 feet on each side of the stream. Of the 137 miles of road approximately 2.0 miles are located within the RHCA for intermittent streams. There are 14.56 miles or 13% are located within 300 feet of intermittent streams. Roads cross channels at 49 locations, sites where direct sediment introduction occurs. The road impact index (RII) was calculated to be 0.54. Along with the 49 miles of stream channels, an estimated 82 of the 137 miles of road are hydrologically integrated with the stream network, thus increasing the drainage network by 167%—using study results from Wemple (1994).

The capability areas within Benny Creek were rated as having 64% of the area as low potential for erosion, 96% of the area as high potential for compaction, 98% of the area as low potential for displacement, and 99% as low potential for mass movement. Transects used to measure compaction were measured after the fire took place and were only measured on Forest Service land within the fire perimeter. Benny Creek was rated as having 87% and 13% of the subwatershed within the fire perimeter as low and moderate compaction, respectively. No transect within Benny Creek was found to have high compaction and therefore is rated as **functioning appropriately**.

The canopy analysis showed that approximately 73%, 33% and 74% of Lodgepole Pine, Ponderosa Pine and White Fir, respectively, were within the historic range of variability. The Ponderosa Pine stands have over 50% of the stands below HRV. Overall, the subwatershed has 43% below HRV and 12% above HRV and places the subwatershed at **functioning at unacceptable risk**.

Riparian vegetation and bank stability information for the Benny Creek subwatershed was generated from Ochoco Bottomline surveys for intermittent streams in fall of 2002. The streambank stability values will be used as a surrogate for the riparian vegetation rating. Inventories were completes on the main stem of Benny Creek, Graham Creek, and Hawk Creek. Benny Creek was broken into 6 reaches. All reaches except for one has recorded bank stability greater than 90% or functioning appropriately. The first reach was inventoried as having bank stability of 82% or functioning at risk. The average over all of the reaches is 91% stability. Both inventoried reaches of Graham Creek and the inventoried reach of Hawk Creek have bank stability values of greater than 97% or **functioning appropriately**.

Channel condition will be characterized and rated for functionality with respect to pool frequency, large wood frequency, temperature, fine sediment and fish passage. The pool frequency and large wood frequency is greater than the 75th percentile in all surveyed reaches of Benny Creek, Graham Creek, and Hawk Creek except for reach 2 of Hawk Creek. The current amount of large wood is between the 50th and 75th percentile in reach 2 of Hawk Creek. Overall, the rating for pools and large wood per mile is **functioning appropriately**. No known measures of sediment were made for any of the intermittent streams within the Benny Creek subwatershed. No temperature data is known to be available for any streams within this subwatershed. There were three inventoried culverts on intermittent streams within the subwatershed. Two, one at Benny Creek and the other at Graham Creek, were located within the fire boundary. The two located outside of the fire perimeter are on Benny Creek. All of culverts were found to impede the passage of fish but all culverts are on intermittent streams and therefore rated as **functioning at risk**.

Table 3-XX. Benny Creek Subwatershed Channel Condition

REACH	ROSGEN	POOLS PER MILE			LARGE WOOD PER MILE			SUBSTRATE		REACH LENGTH (mi)
	TYPE	50th	75th	Total	50th	75th	Total	DOM	SUB.	
BENNY CREEK										
1	F/C	6	9	85	4	18	12	SAND	COBBLE	1.3
2	B	6	9	71	4	18	74	COBBLE	BOULDER	2.3
4	C/B	6	11	52	1	5	36	COBBLE	COBBLE	1.7
6	B/C	6	9	12	4	18	47	COBBLE	COBBLE	0.3
8	C	6	9	30	4	18	121	GRAVEL	COBBLE	0.1
10	G/C	6	9	28	4	18	84	COBBLE	BOULDER	0.6
GRAHAM CREEK										
1	C	8	13	103	6	24	46	COBBLE	GRAVEL	2.4
2	C	13	20	42	9	38	13	COBBLE	GRAVEL	1.9
HAWK CREEK										
1	B	12	17	58	8	34	43	COBBLE	GRAVEL	1.5

The current condition of Benny Creek, with the functionality ratings for each element considered under Cumulative Watershed Effects is shown in the summary table under "Environmental Consequences – Cumulative Watershed Effects". Generally, Benny Creek was rated as having moderate subwatershed sensitivity when compared to the other subwatersheds analyzed. It was rated as high sensitivity with respect to centroid elevation. Roads and canopy were rated as functioning at risk. Soil condition, bank stability, pool frequency and large wood frequency were rated as functioning appropriately. Fish passage was rated as functioning at risk. Temperature and sediment information was not available.

Past Activities (see also Appendix A)

- Fuels reduction: Under-burning: 1990-1994: 1360 acres, 1995-1999: 1850 acres, 2000-2002: 950 acres. Pile burning: 1990-1994: 70 piles, 2000-2002: 60 piles. *Underburning is typically at low severity and had little impact on the subwatershed.*
- Silvicultural activities within the subwatershed have included timber stand improvement or the thinning of sub-merchantable trees and merchantable harvest of timber. Timber stand improvement within this subwatershed occurred on 1,668 acres. Timber harvest activities on forest service land have focused on modifying structure and composition of stand while generating merchantable products. This subwatershed has seen 3,244 acres of harvest varying from intermediate, regeneration of both even aged and uneven aged, and salvage harvest. *Past timber harvest activities have been the main reason for high road densities within the subwatershed and the problems associated with high road densities. Timber harvest can also caused compaction and other detrimental soil conditions, expose areas to increased surface erosion, and may modify streamflow regimes. General watershed effects of timber removal on watersheds are well documented (Meehan, 1991, Troendle and Leaf, 1981) though no specific studies have been completed on the Fremont National Forest* .
- Personal use firewood: Approximately 300 personal use firewood permits sold at district with 2.5% occurring in this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.* [Also a present and future activity]
- Grazing has occurred in the Winter Rim pasture on the subwatershed as early as 1966 with sheep then transitioned to cattle in 1981. Numbers of animals have drastically reduced from 1500-2500 in 1966 to 300 cattle in 1981 to a 2 pasture rotation with 282 cattle to early season use with 660 cattle to currently 282 cattle on a 2 pasture rotation. Thompson Valley Allotment was through the summer months of 1946-1955 by 220 cattle. Foster Butter Allotment was used in 1966 by 1602 cattle on a rest rotation, 1980-1992 by 6807 AUMS on rest rotation by pasture and 1993-2002 by 6297 AUMS early season. *Clearly the use in the past has been heavy, but current management of livestock has limited their impacts on the subwatershed.*
- Powerline and communications facilities consist of 3.5 miles of 500 KV BPA/PGE/PPL powerline. *No known problems with these facilities exist with respect to soil and water.* [Also a present and future activity]
- National Recreation Trail (NRT), dispersed recreational sites and Fremont Point Cabin. Activities associated with the trail and recreational areas at isolated or concentrated locations near streams may cause limited resource

damage in the form of compaction or trampling. *Heavy use near cabin by trampling and parking may have caused compaction of isolated areas.*

- Route marking on existing roads for Pole Butte Snowpark and Trail system. *Little to no problems associated with this activity exist with respect to soil and water.*
- Four water impoundments. *Concentrated use by vehicles, livestock and wildlife around pond may cause compaction problems and associated water ponding on the surface.* [Also a present and future activity]
- An estimated 3990 acres of timber were removed from private land within the subwatershed, which equates to 15% of the subwatershed in the fall of 2002. *The long 2003 rain and snow season extending from March into May provided soil moisture conditions for seedbed response and ground cover recovery. The removal of salvage timber directly after the fire occurred along with the response to the fire allowed for greater sedimentation directly after the fire occurred. However, the precipitation and the openings created by the salvage has allowed for good ground cover recovery on the private land and has therefore limited sedimentation transport opportunities.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. *The hand pulling of weeds would cause no detectable impact to soil and water. There are no knows problems associated with this activity.*
- Past fire activity shows there have been 106 fires since 1948, of which 97% of the acres burned were caused by lightning and the largest fire was 430 acres. *The intense fire suppression has resulted in more dense stands throughout the area and may help lead to more intense fires that would have historically occurred.*
- 2002 Fire Suppression. 31 miles of dozer line were constructed within the subwatershed and trees were fallen for safety or suppression objectives. *The additional compacted surface of dozer lines add to the road density and sedimentation problems associated with roads/trails. It is assumed that dozer lines were rehabilitated with waterbars and drainage according to BMPs and have reduced sediment production to background levels.*
- BAER projects. Drainage ditches were cleaned throughout subwatershed. *This activity facilitated proper movement of moisture off of roads.*
- Since 1970, numerous silvicultural activities have occurred on National Forest lands (See Appendix A, Table A-2). *The effect of this activity is reflected in the "Existing Condition" discussions of canopy, compaction and road densities at the start of this section.* This same past activity information applies to all eight subwatersheds.
- Industrial forest lands. Throughout the analysis area have logged extensively throughout the 20th century. By 2000, almost all stands were logged at least once. *The extensive use on private lands has increased ground disturbance and increased erosion.*
- Unclassified roads are roads on National Forest System lands that are not managed as part of the forest transportation system, such as unplanned roads, abandoned travelways, and off-road vehicle tracks that have not been designated and managed as a trail; and those roads that were once under permit or other authorization and were not decommissioned upon the termination of the authorization (36 CFR212.1). The number of unclassified roads was estimated within the project area through aerial photography and old maps. It was estimated that there are 0.93 mi/mi^2 using a sample of the analysis area. The unclassified roads are grown over through lack of use. They have not been properly closed or decommissioned, however and with the limited amount of precipitation in the area, the natural closure or decommissioning of the roads would be slow. *These roads are adding to an already high road density, they may be increasing drainage efficiency and decreasing infiltration on the subwatershed.* This same past activity information applies to all eight subwatersheds.

Toolbox Fire Recovery Project Activities (on a subwatershed basis)

Direct and indirect effects *on a project area basis* were discussed early in the Watershed section. This section concerns itself with how those direct and indirect effects apply to a cumulative effects finding, on a *subwatershed* basis.

Table 3-XX. Benny Creek Direct and Indirect Effects

BENNY CREEK	ALT. A	ALT. C	ALT. D	ALT. E	ALT. G	ALT. H
TOTAL COMMERCIAL SALVAGE (acres)	0	1,960	658	1,437	1,960	1,809
GROUND BASED COMMERCIAL SALVAGE (acres)	0	1,945	644	1,437	1,945	1,809
AERIAL COMMERCIAL SALVAGE (acres)	0	15	15	0	15	0
PERCENT OF SUBWATERSHED AREA SALVAGE	0%	7%	2%	5%	7%	7%
TOTAL RHCA COMMERCIAL SALVAGE (acres)	0	87	15	75	88	15
RHCA 1 (acres)	0	0	0	0	0	0
RHCA 3 (acres)	0	38	13	33	38	13
RHCA 4 (acres)	0	49	2	42	49	2
TEMPORARY ROADS (miles)	0	3.7	0	2.5	3.7	3.7
RE-OPEN UNCLASSIFIED ROADS (miles)	0	2.7	0.65	2.05	2.71	1.93
PRESCRIBED FIRE (acres)	0	365	365	0	365	365
ROADS						
OPEN ROAD DENSITY (mi/mi^2)	3.27	2.93	2.93	3.08	3.08	2.93
CLOSE ROADS (mi)	0.0	9.7	9.7	6.5	3.2	9.7
DECOMMISSION RDS (mi)	0.0	4.9	4.9	1.5	4.9	4.9
OPEN ROADS (mi)	137.1	122.5	122.5	129.1	129.0	122.5
SEDIMENT SAVINGS FROM ROAD ACTIONS (tons/yr)	0.00	0.18	0.18	0.16	0.16	0.18
SEDIMENT LOSS FROM OPEN ROADS (tons/yr)	1.02	0.84	0.84	0.86	0.86	0.84
OPEN ROADS within 300 ft of STREAM (mi)	6.4	3.6	3.6	4.0	4.0	3.6
CLOSE ROADS within 300 ft of STREAM (mi)	0.0	2.0	2.0	1.7	1.6	2.0
DECOMISSION RDS within 300 ft of STREAM (mi)	0.0	0.8	0.8	0.66	0.8	0.8

Present and Future Activities (see also Appendix A)

- Foster Butter Allotment is expected to have a NEPA decision before 2004 grazing season. Current use is based on 2003 monitoring and NEPA decision. Winter Rim Allotment will have a NEPA decision before 2004 grazing season and use will be based on 2003 monitoring and NEPA decision. Recently burned areas compared to unburned areas produce more aboveground biomass (Tracy and McNaughton, 1996). This in concert with the active control of livestock in burned areas to keep cattle off of riparian area should be effective. *The NEPA analysis or Rangeland Health Assessments (BLM) will allow for thorough review of the grazing within this allotment.*
- Personal use firewood: In 2002, an estimated 981 cords were removed from this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. *The hand pulling of weeds would cause no detectable impact to soil and water. There are no knows problems associated with this activity.*
- Rebuilding of recreation cabin at Fremont Point. *The construction would have minor impacts on the subwatershed.*
- Two trail bridges would be relocated and several miles would be reconstructed. *There would be short-term effects from the trail construction and isolated areas of compaction as a result of the trail but these activities would have limited effect on the subwatershed.*
- 517 East Forest Recovery Project/Triad Restoration Project: These treatments include reintroduction of fire where fire historically played a role, commercial and pre-commercial thinnings, aspen enhancements, and large woody debris additions to Benny Creek. *Any sediment input to these streams because of this project is predicted to have an insignificant effect on redband trout because of the minimal quantities and low risk of entering fish habitat because of riparian buffers, mitigation measures, and Forest BMP's. This project would have beneficial affects on the subwatershed.*

Cumulative Watershed Effects

See also "Summary Table - Benny Creek Subwatershed Cumulative Watershed Effects" that follows discussion.

Alternative A

The number of roads that remain open under this alternative and the number of open roads within 300 feet of stream channels are of concern. No ground disturbing activity as a result of salvage harvest and fuels reduction would occur under this alternative. However, the number of miles of road would allow a chronic sediment source and allow for a maximum increase in the drainage network to continue. The calculation of sediment loss from roads equates to 0.08 pound of sediment per acre within this subwatershed. Under this alternative the road density is increased by 0.93 mi/mi^2 due to unclassified roads.

Action Alternatives

Approximately 48% of the subwatershed burned in 2002 and therefore the project is limited to only 48% of the subwatershed. The salvage harvest and associated fuels reduction accounts for activity on 7% of the subwatershed area in Alternative C, G and H and is moderate compared to other subwatersheds. Alternative D calls for 2% and is rated as minor. Alternative E calls for 5% and is rated as low. Overall, the minor amount of sediment associated with the harvest and the minimal amount of the subwatershed affected by the harvest should have minimal impact on the subwatershed. However, this subwatershed has all four units of concern when the sediment modeling was done. Units 130, 131, 133, and 134 all showed a higher probability of sediment production as a result of the harvest treatment. The four units are in all alternatives except for Alternative D where unit 130 is removed from salvage harvest. The risk associated with sediment on these units merits a site visit to check timely recovery after activities are complete. Monitoring of these sites to check timely recovery. The prescribed burn accounts for 1.4% of the subwatershed under all alternatives except Alternative E. However, several commercial salvage units are at coincident locations with the proposed prescribed burn locations. The temporary and unclassified roads would temporarily increase the miles of road by 4.5% for Alternatives C and G, by 4% for Alternative H, by 3.3% for Alternative E and by 0.5% for Alternative D. The increase in road miles would be short term and proper decommissioning of the roads would occur after the activity is complete. The unclassified road density would decrease from 0.93 mi/mi^2 to 0.64 mi/mi^2, 0.85 mi/mi^2, 0.71 mi/mi^2, 0.64 mi/mi^2 and 0.66 mi/mi^2. Sedimentation from

salvage harvest is expected to be similar and minor for all action alternatives with Alternative D generating the least amount of sedimentation.

Approximately 10 miles of road would be closed and 5 miles of road would be decommissioned under Alternatives C, D and H. Under Alternative E 6.5 miles and 1.5 miles are closed and decommissioned, respectively. Alternative G closed 3.2 miles of road and decommissioned 4.9 miles of road. The reduction in road density is greater than 10% of the original road density for Alternative C, D and H. The closure and decommissioning of 2.8 miles of road within 300 feet of intermittent and perennial streams would be a primary improvement to the health of the subwatershed under Alternative C, D and H. The reduction in road density for Alternative E and G was 6% compared to the original road density. The sediment savings from road actions is generally the same in all alternatives as is the sediment loss from roads within this subwatershed. The road density would remain high for the subwatershed under all action alternatives. Alternatives C, D and H are the most aggressive with respect to road activity and would result in the most benefit of the action alternatives.

Temperature characteristics in the streams of the subwatershed are not expected to change as a result of any of the action alternatives.

Aspen enhancement would be implemented in Alternatives C, D, G and H. The enhancement of riparian vegetation, particularly where conifer encroachment occurs, has a positive effect on the subwatershed.
Road activities in the action alternatives are expected to restore or maintain the current functionality rating of the roads. Action alternatives under which large wood would be place in a stream in a particular subwatershed was rated as restoring that element as a result of the project.

Cumulative effects from the action alternatives are expected to be low in this subwatershed due to the recovery expected on private land salvage harvest, the effective rehabilitation of the suppression activities, monitoring and management of livestock use and allotment condition and monitoring of possible sediment source units. The action alternatives would reduce fuel loads and reduce road densities and their associated sedimentation to varying degrees.

Table 3.xx Summary Table - Benny Creek Subwatershed Cumulative Watershed Effects

	NAME - HUC								
WATERSHED	SILVER CREEK - 1712000502								
SUBWATERSHED	**BENNY CREEK -** 171200050204								
	LOW		MODERATE			HIGH			
SUBWATERSHED SENSITIVITY			X						
Characteristic(s) rated HIGH	Centroid elevation								
	CURRENT CONDITION - FUNCTIONALITY			**Alt A**	**Alt C**	**Alt D**	**Alt E**	**Alt G**	**Alt H**
ELEMENTS	FUNCTIONING APPROPRIATELY	FUNCTIONING AT RISK	FUNCTIONING AT UNACCEPTABLE RISK	RESTORE (**R**), MAINTAIN (**M**) or DEGRADE (**D**). Improvement as a result of the project? – **Yes** or **No**					
UPLANDS									
Roads			**X**	**D**	**R - Yes**	**R - Yes**	**M - Yes**	**M - Yes**	**R - Yes**
Canopy			**X**	**M**	**M**	**M**	**M**	**M**	**M**
Soil	**X**			**M**	**M**	**M**	**M**	**M**	**M**
RIPARIAN VEGETATION / BANK STABILITY	**X**			**M**	**M**	**M**	**M**	**M**	**M**
CHANNEL CONDITIONS									
Pool frequency	**X**			**M**	**M**	**M**	**M**	**M**	**M**
Large wood frequency	**X**			**M**	**M**	**M**	**M**	**M**	**M**
Temperature	NOT AVAILABLE								
Fine sediment	NOT AVAILABLE								
Fish passage		**X**		**M**	**M**	**M**	**M**	**M**	**M**

East Duncan Creek

Existing Condition

Sensitivity

East Duncan Creek 6th field watershed (subwatershed) (HUC171200050302) is approximately 18 square miles and is part of the Silver Lake 5th field watershed. There are no perennial streams within the subwatershed but there are several intermittent streams. The subwatershed is dominated by East Duncan Creek, which is approximately 7 miles long and characterized by a series of steep canyons. The headwaters of East Duncan Creek begin at Winter Rim and flows down into Duncan Creek just north of the Forest Service boundary.

Hydrologic soil group C, which is characterized by slow rates of infiltration and water transmission, characterizes eight percent of the subwatershed. Hydrologic soil group D, which is characterized by very slow rates of infiltration and water transmission, characterizes eight percent of the subwatershed. Sixteen percent of the subwatershed area is characterized by hydrologic soil group C and D. The total index percent of hydrologic group C and D was rated as **low** for this subwatershed. The subwatershed is characterized by generally stable mass wasting characteristics with 50% of the subwatershed characterized as very stable and 50% was rated as not applicable for mass wasting. The sensitivity index for mass wasting was **high** for this subwatershed. All subwatersheds receive limited amounts of precipitation on average, which yields a less sensitive watershed on the whole. Approximately 45% of East Duncan Creek subwatershed is located within the rain-on-snow elevation range and the subwatershed was rated as **moderate**.

East Duncan Creek has very low drainage density of 0.64 mi/mi^2, which is well below the low class of 3 to 4 mi/mi^2 (Strahler 1964). In comparison to the other subwatersheds in the analysis area East Duncan Creek was rated as **low**. Subwatershed relief for East Duncan Creek is the very low amongst the eight subwatersheds being analyzed and was rated **low**. Over approximately 8.0 miles, an elevation of 1600 feet is lost for a resultant subwatershed relief ratio of 0.04 ft/ft. The centroid elevation of East Duncan Creek is 6131 feet, which is the highest in the analysis area and rated **high** for the sensitivity index. A higher centroid elevation value tends toward a more sensitive subwatershed.

Overall, East Duncan Creek has limited precipitation, no perennial streams, low sensitivity for streamflow generation areas, high sensitivity for mass wasting, and moderate sensitivity for rain-on-snow potential. The channel information rated as low for drainage density and subwatershed relief but high for centroid elevation. This information leads one to conclude that East Duncan Creek subwatershed has **moderate** sensitivity when compared to the other subwatersheds within the analysis area.

Functionality

East Duncan Creek is dominated by low-severity burn. Approximately 96% of the subwatershed burned with 0.3%, 12.9% and 83.1% of the subwatershed burned at high, moderate and low-severity, respectively.

The roads, canopy and soils within the subwatershed will be used to characterize the uplands of East Duncan Creek. According to the transportation layer in Geographical Information Systems (GIS) there are 76 miles of road within East Duncan Creek subwatershed equating to an open road density of 4.19 mi/mi^2, which places the subwatershed **functioning at unacceptable risk**. The Riparian Habitat Conservation Area (RHCA) for an intermittent stream is 50 feet on each side of the stream. Of the 137 miles of road approximately 1.2 miles are located within the RHCA for intermittent streams. There are 6.7 miles or 9% are located within 300 feet of intermittent streams. Roads cross channels at 15 locations, sites where direct sediment introduction occurs. The road impact index (RII) was calculated to be 0.21. Along with the 12 miles of stream channels, an estimated 46 of the 76 miles of road are hydrologically integrated with the stream network, thus increasing the drainage network by 395%—using study results from Wemple (1994).

The capability areas within East Duncan Creek were rated as having 70% of the area as low potential for erosion, 100% of the area as high potential for compaction, 99% of the area as low potential for displacement, and 100% as low potential for mass movement. Transects used to measure compaction were measured after the fire took place and were only measured on Forest Service land within the fire perimeter. East Duncan Creek was rated as having 39% and 61% of the inventoried

subwatershed area as low and moderate compaction, respectively. No transect within East Duncan Creek was found to have high compaction therefore is rated as **functioning appropriately**.

The canopy analysis showed that approximately 55%, 39% and 19% of Lodgepole Pine, Ponderosa Pine and White Fir, respectively, were within the historic range of variability. Seventy-two percent of the White Fir acres are above HRV while the other species show an equal mix between acres that are above and below HRV. Overall, 61% of the subwatershed is outside of HRV, which places the subwatershed at **functioning at unacceptable risk**.

Riparian vegetation and bank stability information for the East Duncan Creek subwatershed was generated from Ochoco Bottomline surveys for intermittent streams in fall of 2002. The streambank stability values will be used as a surrogate for the riparian vegetation rating. Inventories were completes on the main stem of East Duncan Creek and found no areas of bank instability. Therefore, the bank stability rating for East Duncan Creek is **functioning appropriately**.

Channel condition will be characterized and rated for functionality with respect to pool frequency, large wood frequency, temperature, fine sediment and fish passage. The pool frequency and large wood frequency is greater than the 75th percentile in all surveyed reaches of East Duncan Creek. The rating for pools and large wood per mile is **functioning appropriately**. No known measures of fine sediment were made for any of the intermittent streams within East Duncan Creek subwatershed. No temperature data is known to be available for any streams within this subwatershed. There were zero inventoried culverts within the subwatershed.

Table 3-XX. East Duncan Creek Subwatershed Channel Condition

REACH	ROSGEN	POOLS PER MILE			LARGE WOOD PER MILE			SUBSTRATE		REACH
	TYPE	50th	75th	Total	50th	75th	Total	DOM	SUB.	LENGTH (mi)
EAST DUNCAN CREEK										
1	B	9	17	59	2	8	90	Gravel	Cobble	2.3

The current condition of East Duncan Creek, with the functionality ratings for each element considered under Cumulative Watershed Effects, is shown in the summary table under "Environmental Consequences – Cumulative Watershed Effects". Generally, East Duncan Creek was rated as having moderate subwatershed sensitivity when compared to the other subwatersheds analyzed. It was rated as high sensitivity with respect to centroid elevation and mass wasting. The roads category was rated as functioning at risk. Canopy, soil condition, bank stability, pool frequency, and large wood frequency were rated as functioning appropriately. Temperature, sediment and fish passage information was not available.

Past Activities

- Fuels reduction: Pile burning: 1990-1994: 30 piles, 2000-2002: 10 piles. Post harvest pile burning: 1995-1999: 360 acres. *Underburning and pile burning is typically at low severity and had little impact on the subwatershed.*
- Silvicultural activities within the subwatershed have included timber stand improvement or the thinning of sub-merchantable trees and merchantable harvest of timber. Timber stand improvement within this subwatershed occurred on 1,219 acres. Timber harvest activities on forest service land have focused on modifying structure and composition of stand while generating merchantable products. This subwatershed has seen 1,605 acres of harvest varying from intermediate, and regeneration of both even aged and uneven aged harvest. *Past timber harvest activities have been the main reason for high road densities within the subwatershed and the problems associated with high road densities. Timber harvest can also caused compaction and other detrimental soil conditions, expose areas to increased surface erosion, and may modify streamflow regimes. General watershed effects of timber removal on watersheds are well documented (Meehan, 1991; Troendle and Leaf, 1981) though no specific studies have been completed on the Fremont National Forest .*
- Personal use firewood: Approximately 300 personal use firewood permits sold at district with 2.5% occurring in this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*
- Grazing has occurred in the Winter Rim pasture on the subwatershed as early as 1966 with sheep then transitioned to cattle in 1981. Numbers of animals have drastically reduced from 1500-2500 in 1966 to 300 cattle in 1981 to a 2 pasture rotation with 282 cattle to early season use with 660 cattle to currently 282 cattle on a 2 pasture rotation.

Clearly the use in the past has been heavy, but current management of livestock has limited their impacts on the subwatershed.

- Powerline and communications facilities consist of 1 miles of 500 KV PPL powerline. *No known problems with these facilities exist with respect to soil and water.*
- Recreational trail and dispersed recreational sites. *Activities associated with the trail and recreational areas at isolated or concentrated locations near streams may cause limited resource damage in the form of compaction or trampling.*
- Route marking on existing roads for Pole Butte Snowpark and Trail system. *Little to no problems associated with this activity exist with respect to soil and water.*
- An estimated 4270 acres of timber were removed from private land within the subwatershed, which equates to 37% of the subwatershed in the fall of 2002. *The long 2003 rain and snow season extending from March into May provided soil moisture conditions for seedbed response and ground cover recovery. The removal of salvage timber directly after the fire occurred along with the response to the fire allowed for greater sedimentation directly after the fire occurred. However, the precipitation and the openings created by the salvage has allowed for good ground cover recovery on the private land and has therefore limited sediment transport opportunities.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. *The hand pulling of weeds would cause no detectable impact to soil and water. There are no knows problems associated with this activity.*
- Past fire activity shows there have been 45 fires since 1948, of which 77% of the acres burned were caused by lightning. *The intense fire suppression has resulted in more dense stands throughout the area and may help lead to more intense fires that would have historically occurred.*
- 2002 Fire Suppression. 9 miles of dozer line were constructed within the subwatershed and trees were fallen for safety or suppression objectives. *The additional compacted surface of dozer lines add to the road density and sedimentation problems associated with roads/trails. It is assumed that dozer lines were rehabilitated with waterbars and drainage according to BMPs and have reduced sediment production to background levels.*
- Ponderosa pine thinning. 4 acres in 2000. *The reduction of overstocking of ponderosa pine stands has a positive effect on the watershed.*
- Juniper thinning. 90 acres in 2000. *The thinning of this aggressive species that has well surpassed historic stocking has a positive effect on the subwatershed.*
- BAER projects. Drainage ditches were cleaned throughout subwatershed. *This activity facilitated proper movement of moisture off of roads.*
- Industrial forest lands. Throughout the analysis area have logged extensively throughout the 20th century. By 2000, almost all stands were logged at least once. *The extensive use on private lands has increased ground disturbance and increased erosion.*

Toolbox Fire Recovery Project Activities (on a subwatershed basis)

Direct and indirect effects *on a project area basis* were discussed early in the Watershed section. This section concerns itself with how those direct and indirect effects apply to a cumulative effects finding, on a *subwatershed* basis.

The elements discussed under direct and indirect effects as they pertain to the East Duncan Creek subwatershed are found below.

Table 3-XX. East Duncan Creek Direct and Indirect Effects

EAST DUNCAN CREEK	ALT. A	ALT. C	ALT. D	ALT. E	ALT. G	ALT. H
TOTAL COMMERCIAL SALVAGE (acres)	0	1,284	598	1,021	1,284	1,228
GROUND BASED COMMERCIAL SALVAGE (acres)	0	1,273	598	1,021	1,273	1,228
AERIAL COMMERCIAL SALVAGE (acres)	0	11	0	0	11	0
PERCENT OF SUBWATERSHED AREA SALVAGE	0%	11%	5%	9%	11%	11%
TOTAL RHCA COMMERCIAL SALVAGE (acres)	0	45	22	39	45	22
RHCA 1 (acres)	0	0	0	0	0	0
RHCA 3 (acres)	0	42	21	37	42	21
RHCA 4 (acres)	0	3	1	2	3	1
TEMPORARY ROADS (miles)	0	1.42	0	1.42	1.42	1.42
RE-OPEN UNCLASSIFIED ROADS (miles)	0	0	0	0	0	0
PRESCRIBED FIRE (acres)	0	1,200	756	0	1,200	756
ROADS						
OPEN ROAD DENSITY (mi/mi^2)	4.19	2.90	2.90	3.36	3.36	2.93
CLOSE ROADS (mi)	0.0	8.3	8.3	14.0	0.0	9.7
DECOMMISSION ROADS (mi)	0.0	15.2	15.2	1.2	15.2	4.9
OPEN ROADS (mi)	76.0	52.5	52.5	60.8	60.8	52.5
SEDIMENT SAVINGS FROM ROAD ACTIONS (tons/yr)	0.00	0.04	0.04	0.03	0.03	0.04
SEDIMENT LOSS FROM OPEN ROADS (tons/yr)	0.39	0.35	0.35	0.36	0.36	0.35
OPEN ROADS within 300 ft of STREAM (mi)	1.9	0.3	0.3	0.3	0.3	0.3
CLOSE ROADS within 300 ft of STREAM (mi)	0.0	0.0	0.0	1.1	0.0	0.0
DECOMISSION ROADS within 300 ft of STREAM (mi)	0.0	1.6	1.6	0.5	1.6	1.6

Present and Future Activities

- Foster Butter Allotment is expected to have a NEPA decision before 2004 grazing season. Current use is based on 2003 monitoring and NEPA decision. Winter Rim Allotment will have a NEPA decision before 2004 grazing season and use will be based on 2003 monitoring and NEPA decision. Recently burned areas compared to unburned areas produce more aboveground biomass (Tracy and McNaughton, 1996). This in concert with the active control of livestock in burned areas to keep cattle off of riparian area should be effective. *The NEPA analysis or Rangeland Health Assessments (BLM) will allow for thorough review of the grazing within this allotment.*
- Personal use firewood: In 2002, an estimated 981 cords were removed from this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. *The hand pulling of weeds would cause no detectable impact to soil and water. There are no knows problems associated with this activity.*
- Approximately 0.5 miles of National Recreation Trail would be relocated and several miles would be reconstructed. *There would be short-term effects from the trail construction and isolated areas of compaction as a result of the trail but these activities would have limited effect on the subwatershed.*
- Windmill Restoration Project: This project proposes a variety of non-commercial treatments to restore the landscape to more historic conditions. These treatments include reintroduction of fire where fire historically played a role, pre-commercial thinnings, aspen enhancements, and large woody debris additions to East Duncan Creek. *Any sediment input to these streams because of this project is predicted to have no effect on redband trout because this species does not occur in these streams, which are intermittent. The subwatershed would benefit from these projects.*

Cumulative Watershed Effects

See also "Summary Table – East Duncan Creek Subwatershed Cumulative Watershed Effects" that follows discussion.

Alternative A

The number of roads that remain open under this alternative generates the highest road density of any subwatershed in the analysis area. No ground disturbing activity as a result of salvage harvest and fuels reduction would occur under this alternative. However, the number of miles of road would allow a chronic sediment source and allow for a maximum increase in the drainage network to continue. The calculation of sediment loss from roads equates to 0.07 pound of sediment per acre within this subwatershed.

Action Alternatives

Approximately 96% of the subwatershed burned in 2002. The salvage harvest and associated fuels reduction accounts for activity on 11% of the subwatershed area in Alternative C, G and H. In Alternative E harvest and fuels reduction accounts for 9% and in Alternative D it accounts for 5%. The minor amount of sediment associated with the harvest and the minimal amount of the subwatershed affected by the harvest should have minimal impact on the subwatershed. However, the addition of the acres of prescribed burn increases the percent of treated subwatershed by 10% and 6.5% for Alternatives C and G and Alternatives D and H, respectively. In concert, the prescribed burning and salvage account for treatment on 12%, 17% for Alternatives D and H, respectively and 21% for both Alternatives C and G. However, several commercial salvage units are at coincident locations with the proposed prescribed burn locations. Assuming the prescribed burn is of low-severity and the salvage produces minor amounts of sediment, the treatment should not be detrimental to the subwatershed. If either of the preceding statements is not true, the probability of detectable effects on the subwatershed increases in Alternative C and G. The temporary and unclassified roads would temporarily increase the miles of road by 1.9% for Alternatives C, E, G and H. No temporary or re-opened unclassified roads are expected for Alternative D. The increase in road miles would be short term and proper decommissioning of the roads would occur after the activity is complete. The unclassified road density would decrease from 0.93 mi/mi^2 to 0.64 mi/mi^2, 0.85 mi/mi^2, 0.71 mi/mi^2, 0.64 mi/mi^2 and 0.66 mi/mi^2. Sedimentation from salvage harvest is expected to be similar and minor for all action alternatives.

Due to nearly all subwatersheds being inside of the analysis area, the roads management activities within the subwatershed are extensive. Approximately 8.3 miles of road would be closed and 15.2 miles of road would be decommissioned under Alternatives C and D. Under Alternative E 14.0 miles and 1.2 miles are closed and decommissioned, respectively.

Alternative G closed 0.0 miles of road and decommissioned 15.2 miles of road. Alternative H closes 9.7 miles and decommissions 4.9 miles. The reduction in road density is greater than 10% of the original road density for all alternatives. The reduction is just over 30% in Alternative C, D and H. The closure and decommissioning of 1.6 miles of road within 300 feet of intermittent and perennial streams would be a primary improvement to the health of the subwatershed under all alternatives. The sediment savings from road actions is generally the same in all alternatives as is the sediment loss from roads within this subwatershed. The road density would remain high for the subwatershed under all alternatives. Alternatives C, D and H are the most aggressive with respect to road activity and would result in the most benefit of the action alternatives.

Temperature characteristics in the streams of the subwatershed are not expected to change as a result of any of the action alternatives.

The very high road density currently within the subwatershed and the short-term sedimentation associated with closure and decommissioning in order to reduce chronic problems from high road densities is a point of concern to varying degrees for all action alternatives. The subwatershed sensitivity was moderate and rated high for mass wasting. For these reasons, cumulative effects in the subwatershed are expected to be moderate. In addition, the recovery on private land salvage harvest, the effective rehabilitation of the suppression activities, monitoring and management of livestock use and allotment condition should not adversely affect the subwatershed.

Table 3.xx Summary Table – East Duncan Creek Subwatershed Cumulative Watershed Effects

	NAME - HUC								
WATERSHED	SILVER LAKE - 1712000503								
SUBWATERSHED	**EAST DUNCAN CREEK** - 171200050302								
	LOW		MODERATE			HIGH			
SUBWATERSHED SENSITIVITY			X						
Characteristic(s) rated HIGH	Centroid elevation, mass wasting								
	CURRENT CONDITION - FUNCTIONALITY			**Alt A**	**Alt C**	**Alt D**	**Alt E**	**Alt G**	**Alt H**
ELEMENTS	FUNCTIONING APPROPRIATELY	FUNCTIONING AT RISK	FUNCTIONING AT UNACCEPTABLE RISK	RESTORE (**R**), MAINTAIN (**M**) or DEGRADE (**D**). Improvement as a result of the project? – **Yes** or **No**					
UPLANDS									
Roads			**X**	**D**	**R - Yes**	**R - Yes**	**M - Yes**	**M - Yes**	**R - Yes**
Canopy			**X**	**M**	**M**	**M**	**M**	**M**	**M**
Soil	**X**			**M**	**M**	**M**	**M**	**M**	**M**
RIPARIAN VEGETATION / BANK STABILITY	**X**			**M**	**M**	**M**	**M**	**M**	**M**
CHANNEL CONDITIONS									
Pool frequency	**X**			**M**	**M**	**M**	**M**	**M**	**M**
Large wood frequency	**X**			**M**	**M**	**M**	**M**	**M**	**M**
Temperature	NOT AVAILABLE								
Fine sediment	NOT AVAILABLE								
Fish passage	NOT AVAILABLE								

Lower Duncan Creek

Existing Condition

Sensitivity

Lower Duncan Creek 6th field watershed (subwatershed) (HUC 171200050303) is approximately 39 square miles and is part of the Silver Lake 5th field watershed. There are no perennial streams within the subwatershed. The lower reaches of Duncan Creek are located in the far western portion of the subwatershed. Willow Creek and several other unnamed intermittent streams are located in Lower Duncan Creek subwatershed and these streams eventually flow into Silver Lake.

Hydrologic soil group C, which is characterized by slow rates of infiltration and water transmission, characterizes twenty-one percent of the subwatershed. Hydrologic soil group D, which is characterized by very slow rates of infiltration and water transmission, characterizes forty-nine percent of the subwatershed. Seventy percent of the subwatershed area is characterized by hydrologic soil group C and D. The total index percent of hydrologic group C and D was rated as **high** sensitivity for this subwatershed. The majority, 55%, of the subwatershed that was inventoried is characterized by very stable mass wasting characteristics. However, twelve percent of the area is at some risk for rotational slumps. The remaining 33% was rated as not applicable with respect to mass wasting. Bear in mind that the majority of the subwatershed is located within the portion of land where the stability data was unavailable and has little to known history of mass wasting. The sensitivity index based on the available information was **moderate** because the majority of the subwatershed is understood to have low mass wasting characteristics. All subwatersheds receive limited amounts of precipitation on average, which yields a less sensitive watershed on the whole. Approximately 85% of the Lower Duncan Creek subwatershed is located within the rain-on-snow elevation band and was rated as **high** for this reason.

Lower Duncan Creek has low drainage density of 1.13 mi/mi^2, which is well below the low class of 3 to 4 mi/mi2 (Strahler 1964). In comparison to the other subwatersheds in the analysis area Lower Duncan Creek was rated as **moderate**. Subwatershed relief for Lower Duncan Creek is high amongst the eight subwatersheds being analyzed and was rated as **high** sensitivity. Over approximately 5.6 miles, an elevation of 2746 feet is lost for a resultant subwatershed relief ratio of 0.09 ft/ft. The centroid elevation of Lower Duncan Creek is 5100 feet and is in the **moderate** range for the analysis area. A higher centroid elevation value tends toward a more sensitive subwatershed.

Overall, Lower Duncan Creek has limited precipitation, no perennial streams, high sensitivity for streamflow generation areas, very high sensitivity for mass wasting, and low sensitivity for rain-on-snow potential. The channel information rated as moderate for drainage density and centroid elevation but high for subwatershed relief. This information leads one to conclude that East Duncan Creek subwatershed has **high** sensitivity when compared to the other subwatersheds within the analysis area.

Functionality

Lower Duncan Creek is dominated by low-severity burn. Approximately 56% of the subwatershed burned with 1.6%, 5.2% and 48.9% of the subwatershed burned at high, moderate and low-severity, respectively.

The roads, canopy and soils within the subwatershed will be used to characterize the uplands of Lower Duncan Creek. According to the transportation layer in Geographical Information Systems (GIS) there are 79 miles of road within Lower Duncan Creek subwatershed equating to an open road density of 2.03 mi/mi^2, which places the subwatershed **functioning at risk**. The Riparian Habitat Conservation Area (RHCA) for an intermittent stream is 50 feet on each side of the stream. Of the 79 miles of road approximately 1.4 miles are located within the RHCA for intermittent streams. There are 12.5 miles or 16% are located within 300 feet of intermittent streams. Roads cross channels at 36 locations, sites where direct sediment introduction occurs. The road impact index (RII) was calculated to be 0.26. Along with the 44 miles of stream channels, an estimated 48 of the 79 miles of road are hydrologically integrated with the stream network, thus increasing the drainage network by 107%—using study results from Wemple (1994).

The capability areas within Lower Duncan Creek were rated as having 53% of the area as high potential for erosion, 56% of the area as high potential for compaction, 70% of the area as low potential for displacement, and 87% as low potential for mass movement. Transects used to measure compaction were measured after the fire took place and were only measured

on Forest Service land within the fire perimeter. Lower Duncan Creek was rated as having 62% and 38% of the inventoried subwatershed area as low and moderate compaction, respectively. No transect within Lower Duncan Creek was found to have high compaction and therefore is rated as **functioning appropriately**.

The canopy analysis showed that approximately 74% and 34% of Lodgepole Pine and Ponderosa Pine, respectively, were within the historic range of variability. Fifty-two percent of the acres of Ponderosa Pine are above HRV. Overall, 62% of the subwatershed is outside of HRV, which places the subwatershed at **functioning at unacceptable risk**.

Riparian vegetation and bank stability information for the Lower Duncan Creek subwatershed was generated from Ochoco Bottomline surveys for intermittent streams in fall of 2002. The streambank stability values will be used as a surrogate for the riparian vegetation rating. Inventories were completes on the Willow Creek, on Forest Service land, and found 88% bank instability overall. The first reach, totally 1.3 miles in length, had bank stability of 85%. The remaining reaches had higher bank stability but totaled 0.6 miles in length. Therefore, the bank stability rating for Lower Duncan Creek is **functioning at risk**.

Channel condition will be characterized and rated for functionality with respect to pool frequency, large wood frequency, temperature, fine sediment and fish passage. The pool frequency and large wood frequency is greater than the 75th percentile in the surveyed reach of Lower Duncan Creek. The rating for pools and large wood per mile is **functioning appropriately**. No known measures of fine sediment were made for any of the intermittent streams within Lower Duncan Creek subwatershed. No temperature data is known to be available for any streams within this subwatershed. There were zero inventoried culverts within the subwatershed.

Table 3-XX. Lower Duncan Creek Subwatershed Channel Condition

REACH	ROSGEN	POOLS PER MILE			LARGE WOOD PER MILE			SUBSTRATE		REACH
	TYPE	50th	75th	Total	50th	75th	Total	DOM	SUB.	LENGTH (mi)
WILLOW CREEK										
1	C	20	30	86	14	58	33	Gravel	Cobble	1.3
2	C	12	19	98	8	36	18	Gravel	Cobble	0.4
3	C	12	18	95	8	35	37	Gravel	Cobble	0.2

The current condition of Lower Duncan Creek, with the functionality ratings for each element considered under Cumulative Watershed Effects, is shown in the summary table under “Environmental Consequences – Cumulative Watershed Effects”.

Generally, Lower Duncan Creek was rated as having high subwatershed sensitivity when compared to the other subwatersheds analyzed. It was rated as high sensitivity with respect to the hydrologic soils group, mass wasting, and subwatershed relief. The roads category and bank stability were rated as functioning at risk. Canopy, soil condition, pool frequency, and large wood frequency were rated as functioning appropriately. Temperature, sediment and fish passage information was not available.

Past Activities

- Personal use firewood: Approximately 300 personal use firewood permits sold at district with 2.5% occurring in this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*
- Powerline and communications facilities consist of 4.5 miles of 500 KV PPL, 2.5 miles of SVE powerline, multiple communications site. *No known problems with these facilities exist with respect to soil and water.*
- Recreational trail and dispersed recreational sites. *Activities associated with the trail and recreational areas at isolated or concentrated locations near streams may cause limited resource damage in the form of compaction or trampling.*
- Grazing in the Dead Indian/Duncan Allotment prior to the early 1980’s to 2002 took place in pastures of this allotment with rest periods. *Clearly the use in the past has been heavy, but current management of livestock has limited their impacts on the subwatershed.*
- Six water impoundments. *Concentrated use by vehicles, livestock and wildlife around pond may cause compaction problems and associated water ponding on the surface.*

- The reservoir may or may not provide for fish movement through the infrastructure. *Ponding of water exposes more surface area to radiant heat and causes increases in water temperature.*
- Silvicultural activities within the subwatershed have included timber stand improvement or the thinning of sub-merchantable trees and merchantable harvest of timber. Timber stand improvement within this subwatershed occurred on 543 acres. Timber harvest activities on forest service land have focused on modifying structure and composition of stand while generating merchantable products. This subwatershed has 596 acres of harvest varying from intermediate, and regeneration of both even aged and uneven aged harvest. *Past timber harvest activities have been the main reason for high road densities within the subwatershed and the problems associated with high road densities. Timber harvest can also caused compaction and other detrimental soil conditions, expose areas to increased surface erosion, and may modify streamflow regimes. General watershed effects of timber removal on watersheds are well documented (Meehan, 1991, Troendle and Leaf, 1981) though no specific studies have been completed on the Fremont National Forest.*
- An estimated 2240 acres of timber were removed from private land within the subwatershed, which equates to 9% of the subwatershed in the fall of 2002. The long 2003 rain and snow season extending from March into May provided soil moisture conditions for seedbed response and ground cover recovery. *The removal of salvage timber directly after the fire occurred along with the response to the fire allowed for greater sedimentation directly after the fire occurred. However, the precipitation and the openings created by the salvage has allowed for good ground cover recovery on the private land and has therefore limited sediment transport opportunities.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. *The hand pulling of weeds would cause no detectable impact to soil and water. There are no knows problems associated with this activity.*
- Past fire activity shows there have been 38 fires since 1948, of which 64% of the acres burned were human caused. *The intense fire suppression has resulted in more dense stands throughout the area and may help lead to more intense fires that would have historically occurred.*
- 2002 Fire Suppression. 34 miles of dozer line were constructed within the subwatershed and trees were fallen for safety or suppression objectives. *The additional compacted surface of dozer lines add to the road density and sedimentation problems associated with roads/trails. It is assumed that dozer lines were rehabilitated with waterbars and drainage according to BMPs and have reduced sediment production to background levels.*
- 2002 Fire Suppression-Retardant Drops. The communications tower on Dean Indian Mountain received retardant primarily. *The location is a long distance to any substantial stream channel and therefore, more than likely had limited effects on the subwatershed.*
- 2002 Fire Suppression-Firing Operations. *The burning resulted in limited high-severity fire conditions.*
- BAER projects. Drainage ditches were cleaned throughout subwatershed. *This activity facilitated proper movement of moisture off of roads. A relief culvert was installed at Road 2914000 to facilitate high flows and increased debris coming off of the recently burned area.*
- Industrial forest lands. Throughout the analysis area have logged extensively throughout the 20th century. By 2000, almost all stands were logged at least once. *The extensive use on private lands has increased ground disturbance and increased erosion.*

Toolbox Fire Recovery Project Activities (on a subwatershed basis)

Direct and indirect effects *on a project area basis* were discussed early in the Watershed section. This section concerns itself with how those direct and indirect effects apply to a cumulative effects finding, on a *subwatershed* basis.

The elements discussed under direct and indirect effects as they pertain to the Lower Duncan Creek subwatershed are found below.

Table 3-XX. Lower Duncan Creek Direct and Indirect Effects

LOWER DUNCAN CREEK	ALT. A	ALT. C	ALT. D	ALT. E	ALT. G	ALT. H
TOTAL COMMERCIAL SALVAGE (acres)	0	1,514	765	1,251	1,515	1,048
GROUND BASED COMMERCIAL SALVAGE (acres)	0	1,207	468	944	1,207	1,048
AERIAL COMMERCIAL SALVAGE (acres)	0	308	297	309	308	0
PERCENT OF SUBWATERSHED AREA SALVAGE	0%	6%	3%	5%	6%	4%
TOTAL RHCA COMMERCIAL SALVAGE (acres)	0	22	0	40	22	0
RHCA 1 (acres)	0	0	0	0	0	0
RHCA 3 (acres)	0	21	0	20	21	0
RHCA 4 (acres)	0	2	0	0	2	0
TEMPORARY ROADS (miles)	0	1.14	0	1.14	1.14	1.14
RE-OPEN UNCLASSIFIED ROADS (miles)	0	0	0	0	0	0
PRESCRIBED FIRE (acres)	0	230	134	0	230	134
ROADS						
OPEN ROAD DENSITY (mi/mi^2)	2.03	1.78	1.78	1.96	1.96	1.78
CLOSE ROADS (mi)	0.0	6.9	6.9	2.7	0.0	6.9
DECOMMISSION ROADS (mi)	0.0	2.7	2.7	0.0	2.7	2.7
OPEN ROADS (mi)	79.3	69.7	69.7	76.6	76.6	69.7
SEDIMENT SAVINGS FROM ROAD ACTIONS (tons/yr)	0.00	0.02	0.02	0.00	0.00	0.00
SEDIMENT LOSS FROM OPEN ROADS (tons/yr)	0.50	0.48	0.48	0.49	0.49	0.48
OPEN ROADS within 300 ft of STREAM (mi)	0.7	0.0	0.0	0.0	0.6	0.0
CLOSE ROADS within 300 ft of STREAM (mi)	0.0	0.6	0.6	0.6	0.0	0.6
DECOMISSION ROADS within 300 ft of STREAM (mi)	0.0	0.1	0.1	0.1	0.1	0.1

Present and Future Activities

- Foster Butter Allotment is expected to have a NEPA decision before 2004 grazing season. Current use is based on 2003 monitoring and NEPA decision. Dead Indian/Duncan Allotment will not be used in 2003 or 2004 and be evaluated based on monitoring for further use. Recently burned areas compared to unburned areas produce more aboveground biomass (Tracy and McNaughton, 1996). This in concert with the active control of livestock in burned areas to keep cattle off of riparian area should be effective. *The NEPA analysis or Rangeland Health Assessments (BLM) will allow for thorough review of the grazing within this allotment.*
- Personal use firewood: In 2002, an estimated 981 cords were removed from this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. *The hand pulling of weeds would cause no detectable impact to soil and water. There are no knows problems associated with this activity.*
- Approximately 0.5 miles of National Recreation Trail would be relocated and several more miles would be reconstructed. *There would be short-term effects from the trail construction and isolated areas of compaction as a result of the trail but these activities would have limited effect on the subwatershed.*
- Juniper treatment-BLM. 10000 acres. *The thinning of this aggressive species that has well surpassed historic stocking has a positive effect on the subwatershed.*
- Seeding-BLM. 1650 acres. *This action should allow for more rapid recovery of subwatershed.*
- Seedling planting-BLM. 600 acres. *This action should allow for more rapid recovery of subwatershed.*
- Salvage harvest-BLM. 60 acres. *The reduction in fuels should be accomplished with minimal disturbance to the subwatershed.*

Cumulative Watershed Effects

See also "Summary Table – Lower Duncan Creek Subwatershed Cumulative Watershed Effects" that follows discussion.

Alternative A

The number of roads that remain open under this alternative generates a road density that satisfies the direction in the LRMP of having a road density that "does not exceed 2.5 mi/mi^2". The road density is rated as functioning at risk by USFWS (1998). No ground disturbing activity as a result of salvage harvest and fuels reduction would occur under this alternative. However, the opportunity to reduce the number of miles and lower the drainage density further is not available under this alternative.

Action Alternatives

Approximately 56% of the subwatershed burned in 2002 and activity on only 56% of the subwatershed is within the analysis area. The salvage harvest and associated fuels reduction accounts for activity on 6% of the subwatershed area in Alternative C and G, 5% in Alternative E, 4% in Alternative H and 3% in Alternative D. The minor amount of sediment associated with the harvest and the minimal amount of the subwatershed affected by the harvest should have minimal impact on the subwatershed. The prescribed fire in all alternatives would increase the area treated by less than 1%. The temporary and unclassified roads would temporarily increase the miles of road by 1.4% for Alternatives C, E, G and H. No temporary or re-opened unclassified roads are expected for Alternative D. The increase in road miles would be short term and proper decommissioning of the roads would occur after the activity is complete. The unclassified road density would decrease from 0.93 mi/mi^2 to 0.64 mi/mi^2, 0.85 mi/mi^2, 0.71 mi/mi^2, 0.64 mi/mi^2 and 0.66 mi/mi^2. Sedimentation from salvage harvest is expected to be similar and minor for all action alternatives.

Due to approximately half of the subwatershed being inside of the analysis area, the roads management activities within the subwatershed are somewhat limited. Approximately 6.9 miles of road would be closed and 2.7 miles of road would be decommissioned under Alternatives C, D and H. Under Alternative E 2.7 miles would be closed while under Alternative G 2.7 miles would be decommissioned. The reduction in road density is 12% of the original road density for Alternatives C, D and H. The reduction is just over 8% in Alternative E and G. The closure and decommissioning of 0.7 miles of road within 300 feet of intermittent and perennial streams would be a primary improvement to the health of the subwatershed under all alternatives except Alternative G. The sediment savings from road actions is generally the same in all alternatives as is the sediment loss from roads within this subwatershed. The road density would remain high for the subwatershed

under all alternatives. Alternatives C, D and H are the most aggressive with respect to road activity and would result in the most benefit of the action alternatives.

Temperature characteristics in the streams of the subwatershed are not expected to change as a result of any of the action alternatives.

Cumulative watershed effects in this subwatershed are moderate due to the planned activity of thinning 10,000 acres of juniper on BLM land, which constitutes 40% of the subwatershed. The effects of the action alternatives and the 60 acres of BLM salvage harvest are expected to be minor in this subwatershed. This is due to the moderate subwatershed sensitivity and the recovery expected on private land salvage harvest, the effective rehabilitation of the suppression activities, monitoring and management of livestock use and allotment condition and monitoring of possible sediment source units.

Table 3.xx Summary Table – Lower Duncan Creek Subwatershed Cumulative Watershed Effects

	NAME - HUC								
WATERSHED	SILVER LAKE - 1712000503								
SUBWATERSHED	**LOWER DUNCAN CREEK -** 171200050303								
	LOW		MODERATE			HIGH			
SUBWATERSHED SENSITIVITY			X						
Characteristic(s) rated HIGH	Soils hydrologic group, subwatershed relief								
	CURRENT CONDITION - FUNCTIONALITY			**Alt A**	**Alt C**	**Alt D**	**Alt E**	**Alt G**	**Alt H**
ELEMENTS	FUNCTIONING APPROPRIATELY	FUNCTIONING AT RISK	FUNCTIONING AT UNACCEPTABLE RISK	RESTORE (**R**), MAINTAIN (**M**) or DEGRADE (**D**). Improvement as a result of the project? – **Yes** or **No**					
UPLANDS									
Roads		**X**		**M**	**R - Yes**	**R - Yes**	**M - Yes**	**M - Yes**	**R - Yes**
Canopy			**X**	**M**	**M**	**M**	**M**	**M**	**M**
Soil	**X**			**M**	**M**	**M**	**M**	**M**	**M**
RIPARIAN VEGETATION / BANK STABILITY		**X**		**M**	**M**	**M**	**M**	**M**	**M**
CHANNEL CONDITIONS									
Pool frequency	**X**			**M**	**M**	**M**	**M**	**M**	**M**
Large wood frequency	**X**			**M**	**M**	**M**	**M**	**M**	**M**
Temperature	NOT AVAILABLE								
Fine sediment	NOT AVAILABLE								
Fish passage	NOT AVAILABLE								

Middle Silver Creek

Existing Condition

Sensitivity

Middle Silver Creek 6th field watershed (subwatershed) (HUC 171200050209) is approximately 61 square miles and is part of the Silver Creek 5th field watershed. There is one perennial stream within the subwatershed and several intermittent streams. The perennial stream in the Middle Silver Creek subwatershed is the most northern portion of Silver Creek. The portion of Silver Creek within the Middle Silver Creek subwatershed is regulated by a dam/spillway.

Hydrologic soil group C, which is characterized by slow rates of infiltration and water transmission, characterizes twenty percent of the subwatershed. Hydrologic soil group D, which is characterized by very slow rates of infiltration and water transmission, characterizes forty-one percent of the subwatershed. Sixty-one percent of the subwatershed area is characterized by hydrologic soil group C and D. The total index percent of hydrologic group C and D was rated as **high** sensitivity. The vast majority, 98%, of the subwatershed that was inventoried is characterized by very stable mass wasting characteristics. Bear in mind that the majority of the subwatershed is located within the portion of land where the stability data was unavailable. However, the area has little to known history of mass wasting. The sensitivity index for mass wasting based on the available information was **low** for this subwatershed. All subwatersheds receive limited amounts of precipitation on average, which yields a less sensitive watershed on the whole. A rain-on-snow event is of particular concern any area with substantial snow pack. Middle Silver Creek is located lower in the system and on average holds limited snow. According to the estimated rain-on-snow range for the Silver Creek 5th field watershed of 4500-6000 feet, approximately 65% of the subwatershed is within this range. The sensitivity index for this element was rated as **moderate**.

Middle Silver Creek has low drainage density of 1.03 mi/mi^2, which is well below the low class (3 to 4 mi/mi2) cited by Strahler (1964). In comparison to the other subwatersheds in the analysis area Middle Silver Creek was rated as **moderate** sensitivity. Subwatershed relief for Middle Silver Creek is low amongst the eight subwatersheds being analyzed and was rated as **moderate** sensitivity. Over approximately 10.2 miles, an elevation of 2825 feet is lost for a resultant subwatershed relief ratio of 0.05 ft/ft. The centroid elevation of Middle Silver Creek is 4600 feet and is in the low range for the analysis area and rated **low** for the sensitivity index. A higher centroid elevation value tends toward a more sensitive subwatershed.

Overall, Middle Silver Creek has limited precipitation; one regulated perennial stream, high sensitivity for streamflow generation areas, low sensitivity for mass wasting, and moderate sensitivity for rain-on-snow potential. The channel information rated as low for centroid elevation and moderate for drainage density and subwatershed relief. This information leads one to conclude that East Duncan Creek subwatershed has **moderate** sensitivity when compared to the other subwatersheds within the analysis area.

Functionality

Middle Silver Creek is dominated by low-severity burn. Approximately 4% of the subwatershed burned with 0.0%, 0.2% and 4.1% of the subwatershed burned at high, moderate and low-severity, respectively.

The roads, canopy and soils within the subwatershed will be used to characterize the uplands of Middle Silver Creek. According to the transportation layer in Geographical Information Systems (GIS) there are 113 miles of road within Middle Silver Creek subwatershed equating to an open road density of 1.86 mi/mi^2, which places the subwatershed **functioning at risk**. The Riparian Habitat Conservation Area (RHCA) for an intermittent stream is 50 feet on each side of the stream and 300 feet on each side of a perennial fish-bearing stream. Of the 137 miles of road approximately 4.1 miles are located within the RHCA for intermittent streams and 0.5 miles are located with the RHCA for perennial fish-bearing streams. There are 21.6 miles or 19% are located within 300 feet of intermittent or perennial streams. Roads cross channels at 55 locations, sites where direct sediment introduction occurs. The road impact index (RII) was calculated to be 0.34. Along with the 62 miles of stream channels, an estimated 68 of the 113 miles of road are hydrologically integrated with the stream network, thus increasing the drainage network by 109%—using study results from Wemple (1994).

The capability areas within Middle Silver Creek were rated as having 70% of the area as low potential for erosion, 98% of the area as high potential for compaction, 100% of the area as low potential for displacement, and 100% as low potential for mass movement. Transects used to measure compaction were measured after the fire took place and were only measured

on Forest Service land within the fire perimeter. Middle Silver Creek was rated as having 100% of the inventoried subwatershed area as low compaction. No transect within Middle Silver Creek was found to have high compaction and therefore is rated as **functioning appropriately**.

The canopy analysis showed that approximately 33% and 45% of Ponderosa Pine and White Fir, respectively, were within the historic range of variability. Fifty-two percent of the White Fir is above HRV. Overall, 65% of the subwatershed is outside of HRV, which places the subwatershed at **functioning at unacceptable risk**.

Information regarding the bank stability and riparian vegetation for Middle Silver Creek subwatershed is only available for a small portion of the far northern portion of main stem of Silver Creek within the subwatershed. No inventories of intermittent streams in the subwatershed were completed after the fire. The riparian vegetation is dominated by willow, sedge and grass. The bank stability was inventoried as 99% stable. This limited information yields a **functioning appropriately** rating.

Channel condition will be characterized and rated for functionality with respect to pool frequency, large wood frequency, temperature, fine sediment and fish passage. The pool frequency is greater than the 75th percentile in the surveyed reach of Silver Creek that is located within Middle Silver subwatershed. This section of Silver Creek is primarily a meadow site and thus was not evaluated for large wood. The rating for pools is **functioning appropriately**. No known measures of fine sediment and temperature are known to be available for this section of Silver Creek or on any of the other streams within this subwatershed. However, the section of Silver Creek within this subwatershed is on the 303(d) list for stream temperature (see Upper Silver Creek subwatershed channel condition discussion) and will be rated as **functioning at unacceptable risk**. There are zero inventoried culverts within Middle Silver subwatershed.

Table 3-XX. Middle Silver Creek Subwatershed Channel Condition

REACH	ROSGEN	POOLS PER MILE			LARGE WOOD PER MILE			SUBSTRATE		REACH
	TYPE	50th	75th	Total	50th	75th	Total	DOM	SUB.	LENGTH (mi)
SILVER CREEK										
1	C	17	30	49	**	**	0	Gravel	Sand	0.7

The current condition of Lower Silver Creek, with the functionality ratings for each element considered under Cumulative Watershed Effects, is shown in the summary table under “Environmental Consequences – Cumulative Watershed Effects”. Generally, Middle Silver Creek was rated as having moderate subwatershed sensitivity when compared to the other subwatersheds analyzed. It was rated as high sensitivity with respect to the hydrologic soils group. The roads category was rated as functioning at risk. Canopy, soil compaction and pool frequency were rated as functioning appropriately. Temperature was rated as functioning at unacceptable risk. Sediment and fish passage information was not available.

Past Activities

- Fuels reduction: Under-burning: 1980-1984: 280 acres, 1985-1989: 650 acres Pretreatment: 2000-2002: 780 acres. Pile burning: 1990-1994: 2 piles, 2000-2002: 2 piles. *Underburning and pile burning is typically at low severity and had little impact on the subwatershed.*
- Silvicultural activities within the subwatershed have included timber stand improvement or the thinning of sub-merchantable trees and merchantable harvest of timber. Timber stand improvement within this subwatershed occurred on 935 acres. Timber harvest activities on forest service land have focused on modifying structure and composition of stand while generating merchantable products. This subwatershed has seen 1,635 acres of harvest varying from intermediate, and regeneration of both even aged and uneven aged harvest. *Past timber harvest activities have been the main reason for high road densities within the subwatershed and the problems associated with high road densities. Timber harvest can also caused compaction and other detrimental soil conditions, expose areas to increased surface erosion, and may modify streamflow regimes. General watershed effects of timber removal on watersheds are well documented (Meehan, 1991, Troendle and Leaf, 1981) though no specific studies have been completed on the Fremont National Forest .*
- Personal use firewood: Approximately 300 personal use firewood permits sold at district with 2.5% occurring in this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*

- Powerline and communications facilities consist of 5.5 miles of 500 KV BPA/PGE/PPL powerline, 10 miles of Midstate Electric powerline. *No known problems with these facilities exist with respect to soil and water.*
- Recreational trail and dispersed recreational sites. *Activities associated with the trail and recreational areas at isolated or concentrated locations near streams may cause limited resource damage in the form of compaction or trampling.*
- National Recreation Trailhead with corrals and campsite. *Compacted areas around campsites and facilities limit infiltration and may increase ponding.*
- Grazing in Silver Bridge prior to early 1980's to 2003 occurred in this subwatershed. Dead Indian/Duncan Allotment prior to the early 1980's to 2002 had 386 AUMS, rested in 2003. Murdock Allotment prior to early 1980's had 705 AUMS, 545 AUMS from 1890's to 2003. Silver Creek Allotment prior to early 1980's to 2003 had 200 AUMS. *Clearly the use in the past has been heavy, but current management of livestock has limited their impacts on the subwatershed.*
- Six diversions divert 1, 1, 1.5, 2.6, 3, 15.4 and 60 cfs. The diversions may or may not provide for fish movement through the infrastructure. *Ponding of water exposes more surface area to radiant heat and causes increases in water temperature.*
- Three water impoundments. *Concentrated use by vehicles, livestock and wildlife around pond may cause compaction problems and associated water ponding on the surface.*
- An estimated 110 acres of timber were removed from private land within the subwatershed, which equates to less than 1% of the subwatershed in the fall of 2002. *This activity had little to no effect on soil and water within the subwatershed.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. *The hand pulling of weeds would cause no detectable impact to soil and water. There are no knows problems associated with this activity.*
- Past fire activity shows there have been 35 fires since 1948, of which 71% of the acres burned were human caused. *The intense fire suppression has resulted in more dense stands throughout the area and may help lead to more intense fires that would have historically occurred.*
- 2002 Fire Suppression. 19 miles of dozer line were constructed within the subwatershed and trees were fallen for safety or suppression objectives. *The additional compacted surface of dozer lines add to the road density and sedimentation problems associated with roads/trails. It is assumed that dozer lines were rehabilitated with waterbars and drainage according to BMPs and have reduced sediment production to background levels.*
- 2002 Fire Suppression-Retardant Drops. There was some retardant dropped on the subwatershed. *The locations of the drops are unknown but it is assumed the effects are limited due to the limited number of drops and the nature of the material.*
- Ponderosa pine thinning. 330 acres in 2000. *The reduction of overstocking of ponderosa pine stands has a positive effect on the watershed.*
- Juniper thinning. 210 acres in 2000. *The thinning of this aggressive species that has well surpassed historic stocking has a positive effect on the subwatershed.*
- BAER projects. Drainage ditches were cleaned throughout subwatershed. *This activity facilitated proper movement of moisture off of roads.*
- Industrial forest lands. Throughout the analysis area have logged extensively throughout the 20th century. By 2000, almost all stands were logged at least once. *The extensive use on private lands has increased ground disturbance and increased erosion.*

Toolbox Fire Recovery Project Activities (on a subwatershed basis)

Direct and indirect effects *on a project area basis* were discussed early in the Watershed section. This section concerns itself with how those direct and indirect effects apply to a cumulative effects finding, on a *subwatershed* basis.

The elements discussed under direct and indirect effects as they pertain to the Middle Silver Creek subwatershed are found below.

Table 3-XX. Middle Silver Creek Direct and Indirect Effects by Alternative

MIDDLE SILVER CREEK	ALT. A	ALT. C	ALT. D	ALT. E	ALT. G	ALT. H
TOTAL COMMERCIAL SALVAGE (acres)	0	419	84	330	419	410
GROUND BASED COMMERCIAL SALVAGE (acres)	0	419	84	330	419	410
AERIAL COMMERCIAL SALVAGE (acres)	0	0	0	0	0	0
PERCENT OF SUBWATERSHED AREA SALVAGE	0%	1%	0%	1%	1%	1%
TOTAL RHCA COMMERCIAL SALVAGE (acres)	0	9	0	6	9	0
RHCA 1 (acres)	0	0	0	0	0	0
RHCA 3 (acres)	0	3	0	2	3	0
RHCA 4 (acres)	0	6	0	4	6	0
TEMPORARY ROADS (miles)	0	0.79	0	0.79	0.79	0.79
RE-OPEN UNCLASSIFIED ROADS (miles)	0	0	0	0	0	0
PRESCRIBED FIRE (acres)	0	0	0	0	0	0
ROADS						
OPEN ROAD DENSITY (mi/mi^2)	1.86	1.82	1.82	1.84	1.84	1.82
CLOSE ROADS (mi)	0.0	1.6	1.6	1.3	0.7	1.6
DECOMMISSION ROADS (mi)	0.0	0.9	1.9	0.2	0.9	0.9
OPEN ROADS (mi)	113.0	110.6	110.6	111.5	111.5	122.5
SEDIMENT SAVINGS FROM ROAD ACTIONS (tons/yr)	0.00	0.09	0.09	0.08	0.08	0.09
SEDIMENT LOSS FROM OPEN ROADS (tons/yr)	0.90	0.81	0.81	0.83	0.83	0.81
OPEN ROADS within 300 ft of STREAM (mi)	1.3	0.4	0.4	0.6	0.6	0.4
CLOSE ROADS within 300 ft of STREAM (mi)	0.0	0.4	0.4	0.6	0.3	0.4
DECOMISSION ROADS within 300 ft of STREAM (mi)	0.0	0.5	0.5	0.1	0.4	0.5

Present and Future Activities

- Foster Butter Allotment is expected to have a NEPA decision before 2004 grazing season. Current use is based on 2003 monitoring and NEPA decision. Silver Bridge-BLM- Allotment has 262 AUMS on rest rotation with riparian pasture. Dead Indian Allotment will not be used in 2004 and be evaluated based on monitoring for further use. Murdock Allotment-BLM-Allotment will have 545 AUMS on rest rotation. Silver Creek-BLM-Allotment will have 200 AUMS mid April to late May. Recently burned areas compared to unburned areas produce more aboveground biomass (Tracy and McNaughton, 1996). This in concert with the active control of livestock in burned areas to keep cattle off of riparian area should be effective. *The NEPA analysis or Rangeland Health Assessments (BLM) will allow for thorough review of the grazing within this allotment.*
- Personal use firewood: In 2002, an estimated 981 cords were removed from this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. *The hand pulling of weeds would cause no detectable impact to soil and water. There are no knows problems associated with this activity.*
- Several miles of NRT will be reconstructed. *There would be short-term effects from the trail construction and isolated areas of compaction as a result of the trail but these activities would have limited effect on the subwatershed.*
- Approximately 4200 acres are planned for prescribed burning in 2004/2005. *This activity will be fully analyzed.*
- Juniper treatment-BLM. 1000 acres. *The thinning of this aggressive species that has well surpassed historic stocking has a positive effect on the subwatershed.*
- Seeding-BLM. 90 acres. *This activity will allow for more rapid recovery of subwatershed.*

Cumulative Watershed Effects

See also "Summary Table – Middle Silver Creek Subwatershed Cumulative Watershed Effects" that follows discussion.

Alternative A

The number of roads that remain open under this alternative generates a road density that satisfies the direction in the LRMP of having a road density that "does not exceed 2.5 mi/mi^2". The road density is rated as functioning at risk by USFWS (1998). No ground disturbing activity as a result of salvage harvest and fuels reduction would occur under this alternative. However, the opportunity to reduce the number of miles and lower the drainage density further is not available under this alternative.

Action Alternatives

Approximately 4% of the subwatershed burned in 2002 and activity on only 4% of the subwatershed is within the analysis area. The salvage harvest and associated fuels reduction accounts for activity on less than 1% to 1% of the subwatershed area. The minor amount of sediment associated with the harvest and the very limited amount of the subwatershed affected by the harvest should have little to no impact on the subwatershed. The temporary and unclassified roads would temporarily increase the miles of road by 0.7 % for Alternatives C, E, G and H. There is no prescribed fire planned in this subwatershed. No temporary or re-opened unclassified roads are expected for Alternative D. The increase in road miles would be short term and proper decommissioning of the roads would occur after the activity is complete. The unclassified road density would decrease from 0.93 mi/mi^2 to 0.64 mi/mi^2, 0.85 mi/mi^2, 0.71 mi/mi^2, 0.64 mi/mi^2 and 0.66 mi/mi^2. Sedimentation from salvage harvest is expected to be similar and minor for all action alternatives.

Due to approximately only 4% of the subwatershed being inside of the analysis area, the roads management activities within the subwatershed are very limited. Approximately 1.6 miles of road would be closed and 0.9 miles of road would be decommissioned under Alternatives C, D and H. Under Alternative E 1.3 miles would be closed and 0.2 miles would be decommissioned. Alternative G 0.7 miles would be closed and 0.9 miles would be decommissioned. The reduction in road density is minor compared to the original road density. The closure and decommissioning of 0.7 to 0.9 miles of road within 300 feet of intermittent and perennial streams would be an improvement to the health of the subwatershed under all alternatives. The sediment savings from road actions is generally the same in all alternatives as is the sediment loss from roads within this subwatershed. The road density would remain high for the subwatershed under all alternatives. Alternatives C, D and H are the most aggressive with respect to road activity and would result in the most benefit of the action alternatives.

Temperature characteristics in the streams of the subwatershed are not expected to change as a result of any of the action alternatives.

Aspen enhancement would be implemented in Alternatives C, D, G and H. The enhancement of riparian vegetation, particularly where conifer encroachment occurs, has a positive effect on the subwatershed.

The cumulative watershed effects are expected to be low for this subwatershed. This is due to the expected recovery of the salvage on private land, the minor amount of BLM salvage planned for the subwatershed, the active management of livestock and monitoring of use within allotments and the effective rehabilitation of the suppression activities. The stream is currently listed under the 303(d) list. The action alternative has less than 10 acres of RHCA harvest in all action alternatives and this would not affect the temperature of Silver Creek to a measurable degree.

Table 3.xx Summary Table – Middle Silver Creek Subwatershed Cumulative Watershed Effects

	NAME - HUC								
WATERSHED	SILVER CREEK - 1712000502								
SUBWATERSHED	**MIDDLE SILVER CREEK -** 171200050309								
	LOW		MODERATE			HIGH			
SUBWATERSHED SENSITIVITY			X						
Characteristic(s) rated HIGH	Soils hydrology group								
	CURRENT CONDITION - FUNCTIONALITY			**Alt A**	**Alt C**	**Alt D**	**Alt E**	**Alt G**	**Alt H**
ELEMENTS	FUNCTIONING APPROPRIATELY	FUNCTIONING AT RISK	FUNCTIONING AT UNACCEPTABLE RISK	RESTORE (**R**), MAINTAIN (**M**) or DEGRADE (**D**). Improvement as a result of the project? – **Yes** or **No**					
UPLANDS									
Roads		**X**		**M**	**M - Yes**	**M - Yes**	**M - Yes**	**M - Yes**	**M - Yes**
Canopy			**X**	**M**	**M**	**M**	**M**	**M**	**M**
Soil	**X**			**M**	**M**	**M**	**M**	**M**	**M**
RIPARIAN VEGETATION / BANK STABILITY	**X**			**M**	**M**	**M**	**M**	**M**	**M**
CHANNEL CONDITIONS									
Pool frequency	**X**			**M**	**M**	**M**	**M**	**M**	**M**
Large wood frequency	NOT APPROPRIATE FOR STREAM TYPE								
Temperature			**X**	**M**	**M**	**M**	**M**	**M**	**M**
Fine sediment	NOT AVAILABLE								
Fish passage	NOT AVAILABLE								

Thompson Reservoir

Existing Condition

Sensitivity

Thompson Reservoir 6th field watershed (subwatershed) (HUC 171200050205) is approximately 64 square miles and is part of the Silver Creek 5th field watershed. There is one perennial stream within the subwatershed and several intermittent streams. The perennial stream in the Thompson Reservoir subwatershed is Guyer Creek. Guyer Creek begins on the eastern face of Yamsay Mountain, flow for approximately 11 miles and feeds into Thompson Reservoir. The primary intermittent streams within the subwatershed are Strawberry Creek, Indian Creek, and the headwaters of Silver Creek and Squaw Creek.

Hydrologic soil group C, which is characterized by slow rates of infiltration and water transmission, characterizes thirteen percent of the subwatershed. Hydrologic soil group D, which is characterized by very slow rates of infiltration and water transmission, characterizes twelve percent of the subwatershed. Twenty-four percent of the subwatershed area is characterized by hydrologic soil group C and D. The total index percent of hydrologic group C and D was rated as **low**. The vast majority, 72%, of the subwatershed is characterized by very stable mass wasting characteristics. Three percent of the subwatershed is at risk for rotational slumps. The sensitivity index for mass wasting was **moderate** for this subwatershed. All subwatersheds receive limited amounts of precipitation on average, which yields a less sensitive watershed on the whole. A rain-on-snow event is of particular concern any area with substantial snow pack. Thompson Reservoir is located high in the system and on average holds snow in the upper elevations well into the spring. According to the estimated rain-on-snow range for the Silver Creek 5th field watershed of 4500-6000 feet, approximately 65% of the subwatershed is within this range. The sensitivity index for this element was rated as **moderate**.

Thompson Reservoir has low drainage density of 1.10 mi/mi^2, which is well below the low class 3-4 mi/mi^2 (Strahler, 1964). In comparison to the other subwatersheds in the analysis area Thompson Reservoir was rated as **moderate**. Subwatershed relief for Thompson Reservoir is low amongst the eight subwatersheds being analyzed and was rated as **moderate** sensitivity. Over approximately 9.7 miles, an elevation of 2604 feet is lost for a resultant subwatershed relief ratio of 0.05 ft/ft. The centroid elevation of Thompson Reservoir is 5000 feet and is low for the analysis area and rated **moderate**. A higher centroid elevation value tends toward a more sensitive subwatershed.

Overall, Thompson Reservoir has limited precipitation, one perennial stream, moderate sensitivity for streamflow generation areas, moderate sensitivity for mass wasting, and moderate sensitivity for rain-on-snow potential. The channel information rated as moderate for drainage density, subwatershed relief and centroid elevation. This information leads one to conclude that East Duncan Creek subwatershed has **moderate** sensitivity when compared to the other subwatersheds within the analysis area.

Functionality

Thompson Reservoir is dominated by low-severity burn. Approximately 20% of the subwatershed burned with 0.1%, 3.7% and 16.2% of the subwatershed burned at high, moderate and low-severity, respectively.

The roads, canopy and soils within the subwatershed will be used to characterize the uplands of Thompson Reservoir. According to the transportation layer in Geographical Information Systems (GIS) there are 254 miles of road within Thompson Reservoir subwatershed equating to an open road density of 3.95 mi/mi^2. The Riparian Habitat Conservation Area (RHCA) for an intermittent stream is 50 feet on each side of the stream and 300 feet on each side of a perennial fish-bearing stream. Of the 254 miles of road approximately 3.7 miles are located within the RHCA for intermittent streams and 2.1 miles are located with the RHCA for perennial fish-bearing streams. There are 34 miles or 13% are located within 300 feet of intermittent or perennial streams. Roads cross channels at 70 locations (7 perennial stream crossings and 63 intermittent stream crossings), sites where direct sediment introduction occurs. The road impact index (RII) was calculated to be 0.93. Along with the 71 miles of stream channels, an estimated 152 of the 254 miles of road are hydrologically integrated with the stream network, thus increasing the drainage network by 216%—using study results from Wemple (1994). The road density of this subwatershed places it into the **functioning at unacceptable risk** category.

The capability areas within Thompson Reservoir were rated as having 58% of the area as low potential for erosion, 50% of the area as high potential for compaction, 45% of the area as low potential for compaction, 44% of the area as low potential for displacement, and 100% as low potential for mass movement. Transects used to measure compaction were measured

after the fire took place and were only measured on Forest Service land within the fire perimeter. Thompson Reservoir was rated as having 72% and 28% of the inventoried subwatershed area as low and moderate compaction, respectively. No transect within Thompson Reservoir was found to have high compaction and therefore is rated as functioning appropriately. The canopy analysis showed that approximately 61%, 43% and 75% of Lodgepole Pine, Ponderosa Pine and White Fir, respectively, were within the historic range of variability. Overall, 50% of the subwatershed is outside of HRV, which places the subwatershed at **functioning at unacceptable risk**.

Information regarding the stream information for Thompson Reservoir subwatershed is only available for a Guyer Creek, a perennial stream, and two intermittent streams: Strawberry and Indian Creeks. Approximately 3.0 miles of Guyer Creek are in the project area, 1.9 on National Forest System Lands and 1.1 on private lands. No data is available for the private portions of Guyer Creek and all discussions regarding Guyer Creek will be regarding that portion on National Forest System Lands. All 3.0 miles of Guyer Creek within the fire perimeter burned during the Silver Fire. Mortality in RHCAs varied from low to moderate with pockets of very high. Along Guyer Creek, the riparian vegetation immediately adjacent to the channel was lightly to moderately burned. Some overstory ponderosa pines in the RHCAs and adjacent uplands were burned to the crowns or suffered significant heat scorch. Few pieces of large woody debris in the stream channel and adjacent floodplain was consumed throughout the affected reaches.

The dominant plant types in Guyer Creek are highly similar to late-seral species in composition and structure, resulting in bank stability values of 99% of greater. Again, there is evidence of lodgepole pine encroachment into the riparian area in every reach. Similar to both West Fork Silver and North Fork Silver Creeks, the abundance of late-seral vegetation, primarily alder, willow, and sedge, promotes the high bank stability values found along the entire length of Guyer Creek. All of the reaches surveyed are in an allotment that was either vacant or in non-use from 1990-1997. Current grazing strategies in Reach 2 call for short season/early grazing, which will continue to allow riparian areas to move towards their potential, while the upper reaches (outside of the project area) will not be grazed, as they have been administratively excluded from the allotment. The altered fire regime in the region continues to promote higher densities of lodgepole pine in riparian areas, creating a minor shift in relative species abundance. Ochoco Bottomline surveys of two intermittent streams, Strawberry Creek and Indian Creek, within Thompson Reservoir were completed after the fires of 2002. The overall stability rating for Strawberry and Indian Creeks was 94% and 93%, respectively. Silver Creek and Squaw Creek were not inventoried after the fire because little to none of these intermittent streams is located inside of the fire boundary. This information yields a **functioning appropriately** rating for the subwatershed.

Aquatic Habitat Condition

Table 3.xx. Aquatic Habitat Rating in Guyer Creek, Summer 2000

Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Rosgen Channel Type
						50% / 75%	50% / 75%	50% / 75%		
1		Private			1 Desired				<20	
					1 Current				NA	
					1 Rating					
2	1.9	USFS	8	2	2 Desired	13 / 56	40 / 67	1 / 3	<20	B, E
					2 Current	52	107	0	NA	B, E_b B_c, E
					2 Rating	FA	FA	FUR		FA
3	2.9	USFS	7	2-4	3 Desired	15 / 64	45 / 76	1 / 3	<20	E, B
					3 Current	60	137	0	46	E_b, E, B_c, B
					3 Rating	FA	FA	FUR	FUR	FA
4	0.7	USFS	5	2-4	4 Desired	21 / 90	63 / 107	1 / 4	<20	E_b, B
					4 Current	48	155	0	NA	E_b, B
					4 Rating	FA	FA	FUR		FA
5	2.0	USFS	5	2-4	5 Desired	21 / 90	63 / 107	1 / 4	<20	E_b, E, B
					5 Current	52	151	0	46	E_b, E, B
					5 Rating	FA	FA	FUR	FUR	FA
6	1.1	USFS	4	>4	6 Desired	26 / 88	40 / 77	0 / 0	<25	B_a, B, A
					6 Current	36	78	0	NA	B_a, B, A
					6 Rating	FA	FA	FA		FA

FA – Functioning Appropriately, FAR – Functioning Appropriately but-at-Risk, FUR – Functioning At Unacceptable Risk, NA – Information Not Available; Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

Table 3-XX. Channel Condition for Intermittent Streams within Thompson Reservoir Subwatershed

REACH	ROSGEN	POOLS PER MILE			LARGE WOOD PER MILE			SUBSTRATE		REACH
	TYPE	50th	75th	Total	50th	75th	Total	DOM	SUB.	LENGTH (mi)
STRAWBERRY CREEK										
2	B	10	15	77	7	28	148	Sand	Gravel	1.5
3	A/B	25	37	64	17	72	43	Gravel	Sand	1.6
4	B	51	77	84	35	150	26	Gravel	Boulder	0.4
INDIAN CREEK										
1	C	15	22	34	10	43	34	Gravel	Sand	0.4
3	C	16	25	50	11	48	52	Grass	Silt/clay	0.9
4	B	37	57	38	26	109	68	Sand	Gravel	0.4

Channel condition will be characterized and rated for functionality with respect to pool frequency, large wood frequency, temperature, fine sediment and fish passage. The pool frequency is greater than the 75th percentile in the surveyed reaches of Guyer Creek and Strawberry Creek and in two of the three reaches in Indian Creek. The reach that is below the 75th percentile is less than 0.4 miles long and just greater than the 50th percentile. This information yields a **functioning appropriately** rating because the overwhelming characteristic of the surveyed streams is above the 75th percentile for pools. In terms of the large pool component, however, no deep (large) pools could be found in any of the reaches of Guyer Creek. Thus, all reaches of Guyer Creek received **functioning at unacceptable risk** ratings for the large pool habitat element. The large wood per mile for almost all reaches surveyed is between the 50th and 75th percentile and rates as **functioning at risk**.

Temperature data is available on Guyer Creek at 5360 feet elevation and is located outside of the fire perimeter. The recorded seven-day average maximum temperature for 1994, 1995, 1996, 1997 and 2000 is 17.0°C, 15.0°C, 15.6°C, 15.0°C and 16.2°C, respectively. There is no known data for temperature on any other stream within this subwatershed. The seven-day average maximum for the years of record is less than 17.8°C and **functioning appropriately**.

Forty-six percent fine sediments were documented at the sampling sites located in reaches upstream of the project area, promoting only 13% embryo survival. Although no measurements have been made in reach 2, it is assumed that higher than normal sediment levels occur here as well thus resulting in **functioning at unacceptable risk** rating.

The relatively high sediment levels reported within these upper reaches are somewhat unexpected as road crossings and bank instability are both minimal upstream from the sampling locations. One possible explanation is that the samples were taken at the lower end of a low gradient meadow reach, which may act as a natural settling point for fine sediment. In addition, reported values are likely associated with the naturally high erosion rates associated with soils and geomorphology of the area.

There are eight inventoried culverts within the Thompson Reservoir subwatershed and seven road crossings. Two culverts are inside of the fire perimeter, on intermittent streams, and one impedes fish passage while the other lacks information to make a determination. Four of the five culverts of Guyer Creek impede fish passage and are all located outside of the fire perimeter. Two of the four red culverts are located in the lower reaches of the stream system while the other two are in the upper reaches of the system. Replaced in 2000, the green culvert is located in the mid reaches of the system at road 3038000. The final culvert is high in the system, impedes fish passage and is located on an unnamed intermittent stream. The fish passage condition in Thompson Reservoir is **functioning at unacceptable risk** due to the red culverts low in the system on Guyer Creek.

All reaches of Guyer Creek are **functioning appropriately** in terms of their potential stream type as the shape and size of the stream channel is in balance with its setting. The abundance of alder and sedge in these reaches promotes high bank stability and narrow and deep channels that are resistant to the erosive energy associated with high flows. In addition, management activities appear to be conducive to maintaining vegetation in floodplains, which are able to dissipate energy associated with high flow events. Any modification to the magnitude and timing of stream flows has not shifted channels

from their natural potential, even though upland vegetation and road density both received functioning appropriately but-at-risk ratings.

The current condition of Thompson Reservoir, with the functionality ratings for each element considered under Cumulative Watershed Effects, is shown in the summary table under "Environmental Consequences – Cumulative Watershed Effects".

Generally, Thompson Reservoir was rated as having moderate subwatershed sensitivity when compared to the other subwatersheds analyzed. It was not rated as high sensitivity with respect to any elements. The roads category and fish passage were rated as functioning at unacceptable risk. Canopy and large wood frequency were rated as functioning at risk. Soil compaction, bank stability, pool frequency, and temperature were rated as functioning appropriately. Sediment information was not available.

Past Activities

- Fuels reduction: Under-burning: 1984-1989: 1500 acres, 1990-1994: 270 acres, 1995-1999: 1860 acres, 200-2002: 350 acres. Pretreatment: 2000-2002: 4100 acres and 200-2002 160 acres. Pile burning: 1990-1994: 420 piles, 1995-1999 50 piles. Post harvest burning 600 acres 1990-1994. Crushing 150 acres 1995-1999. *Underburning and pile burning is typically at low severity and had little impact on the subwatershed. Crushing may increase compaction but most likely had little impact on the subwatershed.*
- Silvicultural activities within the subwatershed have included timber stand improvement or the thinning of sub-merchantable trees and merchantable harvest of timber. Timber stand improvement within this subwatershed occurred on 5,996 acres. Timber harvest activities on forest service land have focused on modifying structure and composition of stand while generating merchantable products. This subwatershed has seen 7,366 acres of harvest varying from intermediate, regeneration of both even aged and uneven aged, and salvage harvest. *Past timber harvest activities have been the main reason for high road densities within the subwatershed and the problems associated with high road densities. Timber harvest can also caused compaction and other detrimental soil conditions, expose areas to increased surface erosion, and may modify streamflow regimes. General watershed effects of timber removal on watersheds are well documented (Meehan, 1991, Troendle and Leaf, 1981) though no specific studies have been completed on the Fremont National Forest* .
- Personal use firewood: Approximately 300 personal use firewood permits sold at district with 2.5% occurring in this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*
- Grazing has occurred in the Yamsay Mountain allotment on the subwatershed as early as 1944 with sheep then transitioned to cattle in 1946. Numbers of animals have drastically reduced from 1000 in 1944, 172 cattle in 1946, 323 cattle in 1961, 100 cattle in 1967, 200 cattle in 1979 on a rest/rotation, not used in 1992 through 1999, 50-100 short duration cattle from 2000 to 2002, and currently 100 cattle early deferred. *Clearly the use in the past has been heavy, but current management of livestock has limited their impacts on the subwatershed.*
- Grazing has occurred in the Winter Rim pasture on the subwatershed as early as 1966 with sheep then transitioned to cattle in 1981. Numbers of animals have drastically reduced from 1500-2500 in 1966 to 300 cattle in 1981 to a 2 pasture rotation with 282 cattle to early season use with 660 cattle to currently 282 cattle on a 2 pasture rotation. Thompson Valley Allotment was through the summer months of 1946-1955 by 220 cattle. Foster Butter Allotment was used in 1966 by 1602 cattle on a rest rotation, 1980-1992 by 6807 AUMS on rest rotation by pasture and 1993-2002 by 6297 AUMS early season. Silver Creek common was used by 1000 sheep in September 1940-1942 and by 100 cattle from 1961-1980 (May – Sept.). *Clearly the use in the past has been heavy, but current management of livestock has limited their impacts on the subwatershed.*
- Powerline and communications facilities consist of 1.5 miles of 500 KV BPA/PGE/PPL powerline and 6 miles of Midstate Electric powerline. *No known problems with these facilities exist with respect to soil and water.*
- Recreational trail and dispersed recreational sites. *Activities associated with the trail and recreational areas at isolated or concentrated locations near streams may cause limited resource damage in the form of compaction or trampling.*
- Thompson Reservoir Campground and East Bay Campground. Associated paved surfaces limit infiltration and increase running timing minimally. *Compacted areas around campsites and facilities limit infiltration and may increase ponding.*
- Route marking on existing roads for Pole Butte Snowpark and Trail system. *Little to no problems associated with this activity exist with respect to soil and water.*

- One water impoundment. *Concentrated use by vehicles, livestock and wildlife around pond may cause compaction problems and associated water ponding on the surface.*
- The reservoir may or may not provide for fish movement through the infrastructure. *Ponding of water exposes more surface area to radiant heat and causes increases in water temperature.*
- Non-industrial private land has partially harvested a limited number of ponderosa pine. *Little impact on soil and water has occurred as a result of this activity.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. *The hand pulling of weeds would cause no detectable impact to soil and water. There are no knows problems associated with this activity.*
- Past fire activity shows there have been 155 fires since 1948, of which 88% of the acres burned were human caused and the largest fire was 3,240 acres. *The intense fire suppression has resulted in more dense stands throughout the area and may help lead to more intense fires that would have historically occurred.*
- 2002 Fire Suppression. 30 miles of dozer line and 1 mile of hand line were constructed within the subwatershed and trees were fallen for safety or suppression objectives. *The additional compacted surface of dozer lines add to the road density and sedimentation problems associated with roads/trails. It is assumed that dozer lines were rehabilitated with waterbars and drainage according to BMPs and have reduced sediment production to background levels.*
- 2002 Fire Suppression-Retardant Drops. There was some retardant dropped on the subwatershed. *The exact locations of the drops are unknown but it is assumed the effects are limited due to the limited number of drops and the nature of the material.*
- Aspen enhancement. 130 acres in 2000. *The enhancement of riparian vegetation, particularly where conifer encroachment occurs has a positive effect on the watershed.*
- BAER projects. Drainage ditches were cleaned throughout subwatershed. *This activity facilitated proper movement of moisture off of roads.*
- Industrial forest lands. Throughout the analysis area have logged extensively throughout the 20th century. By 2000, almost all stands were logged at least once. *The extensive use on private lands has increased ground disturbance and increased erosion.*

Toolbox Fire Recovery Project Activities (on a subwatershed basis)

Direct and indirect effects *on a project area basis* were discussed early in the Watershed section. This section concerns itself with how those direct and indirect effects apply to a cumulative effects finding, on a *subwatershed* basis.

The elements discussed under direct and indirect effects as they pertain to the Thompson Reservoir subwatershed are found below.

Table 3-XX. Thompson Reservoir Direct and Indirect Effects by Alternative

THOMPSON RESERVOIR	ALT. A	ALT. C	ALT. D	ALT. E	ALT. G	ALT. H
TOTAL COMMERCIAL SALVAGE (acres)	0	3,060	1,195	2,684	3,059	2,829
GROUND BASED COMMERCIAL SALVAGE (acres)	0	3,060	1,195	2,684	3,059	2,829
AERIAL COMMERCIAL SALVAGE (acres)	0	0	0	0	0	0
PERCENT OF SUBWATERSHED AREA SALVAGE	0%	7%	3%	7%	7%	7%
TOTAL RHCA COMMERCIAL SALVAGE (acres)	0	109	37	110	108	37
RHCA 1 (acres)	0	1	0	1	0	0
RHCA 3 (acres)	0	60	28	60	60	28
RHCA 4 (acres)	0	48	9	48	48	9
TEMPORARY ROADS (miles)	0	2.58	0	2.04	2.58	2.47
RE-OPEN UNCLASSIFIED ROADS (miles)	0	0.74	0	0.74	0.74	0.74
PRESCRIBED FIRE (acres)	0	0	0	0	0	0
ROADS						
OPEN ROAD DENSITY (mi/mi^2)	3.95	3.67	3.59	3.70	3.70	3.63
CLOSE ROADS (mi)	0.0	5.4	8.0	9.7	0.6	5.4
DECOMMISSION ROADS (mi)	0.0	12.5	15.2	6.1	15.2	15.2
OPEN ROADS (mi)	253.9	236.0	230.7	238.1	238.1	233.3
SEDIMENT SAVINGS FROM ROAD ACTIONS (tons/yr)	0.00	0.07	0.08	0.06	0.06	0.07
SEDIMENT LOSS FROM OPEN ROADS (tons/yr)	1.82	1.75	1.74	1.75	1.75	1.75
OPEN ROADS within 300 ft of STREAM (mi)	5.6	3.8	3.5	3.9	3.8	3.5
CLOSE ROADS within 300 ft of STREAM (mi)	0.0	0.4	0.4	0.1	0.0	0.4
DECOMISSION ROADS within 300 ft of STREAM (mi)	0.0	1.4	1.7	1.6	1.8	1.7

Present and Future Activities

- Grazing in the Yamsay Mountain Allotment is currently at 100 cattle early deferred from July 16 to August 31 and planning under NEPA is scheduled for 2007. Foster Butter Allotment is expected to have a NEPA decision before 2004 grazing season. Current use is based on 2003 monitoring and NEPA decision. Winter Rim Allotment will have a NEPA decision before 2004 grazing season and use will be based on 2003 monitoring and NEPA decision. Recently burned areas compared to unburned areas produce more aboveground biomass (Tracy and McNaughton, 1996). This in concert with the active control of livestock in burned areas to keep cattle off of riparian area should be effective. *The NEPA analysis or Rangeland Health Assessments (BLM) will allow for thorough review of the grazing within this allotment.*
- Personal use firewood: In 2002, an estimated 981 cords were removed from this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*
- Some removal of timber from private non-industrial forest lands. *This is a small portion of the subwatershed and should have little impact on soil and water within the subwatershed.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. *The hand pulling of weeds would cause no detectable impact to soil and water. There are no knows problems associated with this activity.*
- 517 East Forest Recovery Project/Triad Restoration Project: These treatments include reintroduction of fire where fire historically played a role, commercial and pre-commercial thinnings, aspen enhancements, and large woody debris additions to Squaw Creek. *Any sediment input to these streams because of this project is predicted to have an insignificant effect on redband trout because of the minimal quantities and low risk of entering fish habitat because of riparian buffers, mitigation measures, and Forest BMP's. This project would have beneficial affects on the subwatershed.*

Cumulative Watershed Effects

See also "Summary Table – Thompson Reservoir Subwatershed Cumulative Watershed Effects" that follows discussion.

Alternative A

The number of roads that remain open under this alternative and the number of open roads within 300 feet of stream channels are of concern. The road density under this alternative is the second highest of the eight subwatersheds analyzed. No ground disturbing activity as a result of salvage harvest and fuels reduction would occur under this alternative. However, the number of miles of road would allow a chronic sediment source and allow for a maximum increase in the drainage network to continue. The calculation of sediment loss from roads equates to 0.09 pound of sediment per acre within this subwatershed.

Action Alternatives

Approximately 20% of the subwatershed burned in 2002 and activity on only 20% of the subwatershed is within the analysis area. The salvage harvest and associated fuels reduction accounts for activity on 7% of the subwatershed area for all alternatives except Alternative D. Salvage and fuels activity accounts for 3% of the subwatershed area in Alternative D. The minor amount of sediment associated with the harvest and the very limited amount of the subwatershed affected by the harvest should have little to no impact on the subwatershed. There is no prescribed fire planned in this subwatershed. The temporary and unclassified roads would temporarily increase the miles of road by 1.3% for Alternatives C, G and H and by 1.1% for Alternative E. No temporary or re-opened unclassified roads are expected for Alternative D. The increase in road miles would be short term and proper decommissioning of the roads would occur after the activity is complete. The unclassified road density would decrease from 0.93 mi/mi^2 to 0.64 mi/mi^2, 0.85 mi/mi^2, 0.71 mi/mi^2, 0.64 mi/mi^2 and 0.66 mi/mi^2. Sedimentation from salvage harvest is expected to be similar and minor for all action alternatives.

Due to approximately only 20% of the subwatershed being inside of the analysis area, the roads management activities within the subwatershed are somewhat limited. Approximately 5.4 miles of road would be closed and 15.2 miles of road would be decommissioned under Alternatives D and H. Alternative C would close 5.4 miles of road and decommission 12.5 miles of road. Under Alternative E 9.7 miles would be closed and 6.1 miles would be decommissioned. Under Alternative G, 0.6 miles would be closed and 15.2 miles would be decommissioned. The reduction in road density is less than 10% in all alternatives compared to the original road density. The closure and decommissioning of 2.1 to 1.7 miles of road within 300 feet of intermittent and perennial streams would be an improvement to the health of the subwatershed under all alternatives. The sediment savings from road actions is generally the same in all alternatives as is the sediment

loss from roads within this subwatershed. The road density would remain high for the subwatershed under all alternatives. Alternatives C, D and H are the most aggressive with respect to road activity and would result in the most benefit of the action alternatives.

Temperature characteristics in the streams of the subwatershed are not expected to change as a result of any of the action alternatives.

Aspen enhancement, large wood placement and deciduous planting in perennial riparian areas would be implemented in Alternatives C, D, G and H. The enhancement of riparian vegetation, particularly where conifer encroachment occurs, has a positive effect on the subwatershed. Large wood placement would take place within the subwatershed and provide for hiding cover and stream variability that would enhance fish habitat. Deciduous planting in riparian areas of the perennial stream in the subwatershed would occur in areas that burned particularly hot.

The high road density currently within the subwatershed and the short-term sedimentation associated with closure and decommissioning in order to reduce chronic problems from high road densities is a point of concern to varying degrees for all action alternatives. The subwatershed sensitivity was moderate. For these reasons, cumulative effects in the subwatershed are expected to be moderate. In addition, the effective rehabilitation of the suppression activities, monitoring and management of livestock use and allotment condition should not adversely affect the subwatershed.

Table 3.xx Summary Table – Thompson Reservoir Subwatershed Cumulative Watershed Effects

	NAME - HUC								
WATERSHED	SILVER CREEK - 1712000502								
SUBWATERSHED	**THOMPSON RESERVOIR** - 171200050205								
	LOW		MODERATE			HIGH			
SUBWATERSHED SENSITIVITY			X						
Characteristic(s) rated HIGH	None								
	CURRENT CONDITION - FUNCTIONALITY			**Alt A**	**Alt C**	**Alt D**	**Alt E**	**Alt G**	**Alt H**
ELEMENTS	FUNCTIONING APPROPRIATELY	FUNCTIONING AT RISK	FUNCTIONING AT UNACCEPTABLE RISK	RESTORE (**R**), MAINTAIN (**M**) or DEGRADE (**D**). Improvement as a result of the project? – **Yes** or **No**					
UPLANDS									
Roads			**X**	**D**	**M - Yes**	**M - Yes**	**M - Yes**	**M - Yes**	**M - Yes**
Canopy			**X**	**M**	**M**	**M**	**M**	**M**	**M**
Soil	**X**			**M**	**M**	**M**	**M**	**M**	**M**
RIPARIAN VEGETATION / BANK STABILITY	**X**			**M**	**M**	**M**	**M**	**M**	**M**
CHANNEL CONDITIONS									
Pool frequency	**X**			**M**	**M**	**M**	**M**	**M**	**M**
Large wood frequency		**X**		**M**	**R - Yes**	**R - Yes**	**M - No**	**R - Yes**	**R - Yes**
Temperature	X			**M**	**M**	**M**	**M**	**M**	**M**
Fine sediment	NOT AVAILABLE								
Fish passage			**X**	**M**	**M**	**M**	**M**	**M**	**M**

Upper Duncan Creek

Existing Condition

Sensitivity

Upper Duncan Creek 6th field watershed (subwatershed) (HUC 171200050301) is approximately 35 square miles and is part of the Silver Lake 5th field watershed. There are no perennial streams within the subwatershed but there are several intermittent streams. The subwatershed is dominated by Duncan Creek, which is approximately 11 miles long and characterized by a series of steep canyons and high elevation meadows. The headwaters of Duncan Creek begin at Winter Rim and several intermittent tributaries to Duncan Creek original off of the east face of Foster Butte. The subwatershed has several small, seasonally wet, high elevation lakes located in the western portion of the subwatershed. McCall Creek is the primary intermittent stream in the subwatershed and drains the northwestern portion of the subwatershed.

Hydrologic soil group C, which is characterized by slow rates of infiltration and water transmission, characterizes nine percent of the subwatershed. Hydrologic soil group D, which is characterized by very slow rates of infiltration and water transmission, characterizes thirteen percent of the subwatershed. Twenty-two percent of the subwatershed area is characterized by hydrologic soil group C and D. The total index percent of hydrologic group C and D was rated as **low**. The subwatershed is dominated by very stable mass wasting characteristics with 72% of the subwatershed being rated as very stable. Three percent of the area is at some risk for rotational slumps. The sensitivity index for mass wasting was **moderate** for this subwatershed. All subwatersheds receive limited amounts of precipitation on average, which yields a less sensitive watershed on the whole. Approximately 60% of the Upper Duncan Creek subwatershed is located within the rain-on-snow range and was rated as **moderate**.

Upper Duncan Creek has a very low drainage density of 0.84 mi/mi^2, which is well below the low class of 3 to 4 mi/mi^2 (Strahler, 1964). In comparison to the other subwatersheds in the analysis area Upper Duncan Creek was rated as **low**. Subwatershed relief for Upper Duncan Creek is the lowest of the eight subwatersheds being analyzed and was rated as **low** sensitivity. Over approximately 10.8 miles, an elevation of 1620 feet is lost for a resultant subwatershed relief ratio of 0.03 ft/ft. The centroid elevation of Upper Duncan Creek is 5930 feet, which is the second highest in the analysis area and rated as **high**. A higher centroid elevation value tends toward a more sensitive subwatershed.

Overall, Upper Duncan Creek has limited precipitation, no perennial streams, low sensitivity for streamflow generation areas, moderate sensitivity for mass wasting, and moderate sensitivity for rain-on-snow potential. The channel information rated as low for drainage density and subwatershed relief and high for centroid elevation. This information leads one to conclude that East Duncan Creek subwatershed has **moderate** sensitivity when compared to the other subwatersheds within the analysis area.

Functionality

Upper Duncan Creek is dominated by low-severity burn. Approximately 80% of the subwatershed burned with 0.1%, 12.4% and 67.5% of the subwatershed burned at high, moderate and low-severity, respectively.

The roads, canopy and soils within the subwatershed will be used to characterize the uplands of Upper Duncan Creek. According to the transportation layer in Geographical Information Systems (GIS) there are 134 miles of road within Upper Duncan Creek subwatershed equating to an open road density of 3.87 mi/mi^2, which places the subwatershed **functioning at unacceptable risk**. The Riparian Habitat Conservation Area (RHCA) for an intermittent stream is 50 feet on each side of the stream. Of the 134 miles of road approximately 1.6 miles are located within the RHCA for intermittent streams. There are 10.7 miles or 8% are located within 300 feet of intermittent streams. Roads cross channels at 36 locations, sites where direct sediment introduction occurs. The road impact index (RII) was calculated to be 0.47. Along with the 29 miles of stream channels, an estimated 80 of the 134 miles of road are hydrologically integrated with the stream network, thus increasing the drainage network by 278%—using study results from Wemple (1994).

The capability areas within Upper Duncan Creek were rated as having 65% of the area as low potential for erosion, 98% of the area as high potential for compaction, 93% of the area as low potential for displacement, and 100% as low potential for mass movement. Transects used to measure compaction were measured after the fire took place and were only measured on Forest Service land within the fire perimeter. Upper Duncan Creek was rated as having 72% and 28% of the inventoried

subwatershed area as low and moderate compaction, respectively. No transect within Upper Duncan Creek was found to have high compaction and therefore is rated as **functioning appropriately**.

The canopy analysis showed that approximately 74%, 43% and 65% of Lodgepole Pine, Ponderosa Pine and White Fir, respectively, were within the historic range of variability. Overall, 49% of the subwatershed is outside of HRV, which places the subwatershed at **functioning at unacceptable risk**.

Riparian vegetation and bank stability information for the Upper Duncan Creek subwatershed was generated from Ochoco Bottomline surveys for intermittent streams in fall of 2002. The streambank stability values will be used as a surrogate for the riparian vegetation rating. Inventories were completes on the main stem of Duncan Creek and McCall Creek. The inventories found 97% stability on Duncan Creek, 88% and 96% stability on two 0.5-mile reaches of McCall Creek. Therefore, the bank stability rating for Duncan Creek is **functioning appropriately** due to the overall stability of the length of stream inventoried is greater than 90%.

Channel condition will be characterized and rated for functionality with respect to pool frequency, large wood frequency, temperature, fine sediment and fish passage. The pool frequency and large wood frequency is greater than the 75th percentile in two of the three surveyed reaches of Duncan and McCall Creek. The second reach in McCall Creek is below the 50th percentile and functioning at unacceptable risk. However, the rating for pools and large wood per mile for over 90% of the surveyed streams is **functioning appropriately** and is the rating for the entire subwatershed. No known measures of fine sediment were made for any of the intermittent streams within Upper Duncan Creek subwatershed. No temperature data is known to be available for any streams within this subwatershed. There are zero inventoried culverts in this subwatershed.

Table 3-XX. Upper Duncan Creek Subwatershed Channel Condition

REACH	ROSGEN	POOLS PER MILE			LARGE WOOD PER MILE			SUBSTRATE		REACH
	TYPE	50th	75th	Total	50th	75th	Total	DOM	SUB.	LENGTH (mi)
DUNCAN CREEK										
1	B	6	11	65	1	5	68	Boulder	Gravel	4.2
McCALL CREEK										
1	C	17	26	43	12	49	19	Cobble	Gravel	0.6
2	C	18	27	8	12	52	8	Sand	Cobble	0.5

The current condition of Upper Duncan Creek, with the functionality ratings for each element considered under Cumulative Watershed Effects, is shown in the summary table under "Environmental Consequences – Cumulative Watershed Effects". Generally, Upper Duncan Creek was rated as having moderate subwatershed sensitivity when compared to the other subwatersheds analyzed. It was rated as high sensitivity with respect to the centroid elevation. The roads category was rated as functioning at unacceptable risk. Canopy, soil compaction, bank stability, pool frequency and large wood frequency were rated as functioning appropriately. Temperature, sediment and fish passage information was not available.

Past Activities

- Fuels reduction: Under-burning: 1995-1999: 250 acres. Pile burning: 1990-1994: 220 piles. Post harvest pile burning: 1995-1999: 560 acres. *Underburning is typically at low severity and had little impact on the subwatershed.*
- Silvicultural activities within the subwatershed have included timber stand improvement or the thinning of sub-merchantable trees and merchantable harvest of timber. Timber stand improvement within this subwatershed occurred on 2,106 acres. Timber harvest activities on forest service land have focused on modifying structure and composition of stand while generating merchantable products. This subwatershed has seen 3,270 acres of harvest varying from intermediate and regeneration of both even aged and uneven aged harvest. *Past timber harvest activities have been the main reason for high road densities within the subwatershed and the problems associated with high road densities. Timber harvest can also caused compaction and other detrimental soil conditions, expose areas to increased surface erosion, and may modify streamflow regimes. General watershed effects of timber removal on watersheds are well documented (Meehan, 1991, Troendle and Leaf, 1981) though no specific studies have been completed on the Fremont National Forest .*

- Personal use firewood: Approximately 300 personal use firewood permits sold at district with 2.5% occurring in this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*
- Grazing has occurred in the Winter Rim pasture on the subwatershed as early as 1966 with sheep then transitioned to cattle in 1981. Numbers of animals have drastically reduced from 1500-2500 in 1966 to 300 cattle in 1981 to a 2 pasture rotation with 282 cattle to early season use with 660 cattle to currently 282 cattle on a 2 pasture rotation. *Clearly the use in the past has been heavy, but current management of livestock has limited their impacts on the subwatershed.*
- Powerline and communications facilities consist of 6 miles of 500 KV BPA/PGE/PPL powerline and 2 miles of 500 KV PPL powerline. *No known problems with these facilities exist with respect to soil and water.*
- Recreational trail. *Activities associated with the trail and recreational areas at isolated or concentrated locations near streams may cause limited resource damage in the form of compaction or trampling.*
- Route marking on existing roads for Pole Butte Snowpark and Trail system. *Little to no problems associated with this activity exist with respect to soil and water.*
- Four water impoundments. *Concentrated use by vehicles, livestock and wildlife around pond may cause compaction problems and associated water ponding on the surface.*
- An estimated 5390 acres of timber were removed from private land within the subwatershed, which equates to 24% of the subwatershed in the fall of 2002. *The long 2003 rain and snow season extending from March into May provided soil moisture conditions for seedbed response and ground cover recovery. The removal of salvage timber directly after the fire occurred along with the response to the fire allowed for greater sedimentation directly after the fire occurred. However, the precipitation and the openings created by the salvage has allowed for good ground cover recovery on the private land and has therefore limited sediment transport opportunities.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. *The hand pulling of weeds would cause no detectable impact to soil and water. There are no knows problems associated with this activity.*
- Past fire activity shows there have been 76 fires since 1948, of which 76% of the acres burned were caused by lightning and the largest fire was 120 acres. *The intense fire suppression has resulted in more dense stands throughout the area and may help lead to more intense fires that would have historically occurred.*
- 2002 Fire Suppression. 29 miles of dozer line were constructed within the subwatershed and trees were fallen for safety or suppression objectives. *The additional compacted surface of dozer lines add to the road density and sedimentation problems associated with roads/trails. It is assumed that dozer lines were rehabilitated with waterbars and drainage according to BMPs and have reduced sediment production to background levels.*
- Ponderosa pine thinning. 2 acres in 2000. *The reduction of overstocking of ponderosa pine stands has a positive effect on the watershed.*
- Juniper thinning. 30 acres in 2000. *The thinning of this aggressive species that has well surpassed historic stocking has a positive effect on the subwatershed.*
- BAER projects. Drainage ditches were cleaned throughout subwatershed. *This activity facilitated proper movement of moisture off of roads.*
- Industrial forest lands. Throughout the analysis area have logged extensively throughout the 20th century. By 2000, almost all stands were logged at least once. *The extensive use on private lands has increased ground disturbance and increased erosion.*

Toolbox Fire Recovery Project Activities (on a subwatershed basis)

Direct and indirect effects *on a project area basis* were discussed early in the Watershed section. This section concerns itself with how those direct and indirect effects apply to a cumulative effects finding, on a *subwatershed* basis.

The elements discussed under direct and indirect effects as they pertain to the Upper Duncan Creek subwatershed are found below.

Table 3-XX. Upper Duncan Creek Direct and Indirect Effects by Alternative

UPPER DUNCAN CREEK	ALT. A	ALT. C	ALT. D	ALT. E	ALT. G	ALT. H
TOTAL COMMERCIAL SALVAGE (acres)	0	2,202	1,237	1,792	2,205	1,975
GROUND BASED COMMERCIAL SALVAGE (acres)	0	2,128	1,188	1,792	2,130	1,975
AERIAL COMMERCIAL SALVAGE (acres)	0	75	49	0	75	0
PERCENT OF SUBWATERSHED AREA SALVAGE	0%	10%	6%	8%	10%	9%
TOTAL RHCA COMMERCIAL SALVAGE (acres)	0	136	43	111	136	43
RHCA 1 (acres)	0	0	0	0	0	0
RHCA 3 (acres)	0	105	40	92	105	40
RHCA 4 (acres)	0	31	3	19	31	3
TEMPORARY ROADS (miles)	0	1.39	0	1.05	1.39	1.38
RE-OPEN UNCLASSIFIED ROADS (miles)	0	2.36	1.49	1.08	2.36	1.8
PRESCRIBED FIRE (acres)	0	1,777	1,195	0	1,777	1,195
ROADS						
OPEN ROAD DENSITY (mi/mi^2)	3.86	2.86	2.86	3.42	3.42	2.86
CLOSE ROADS (mi)	0.0	21.0	21.0	15.2	1.9	21.0
DECOMMISSION ROADS (mi)	0.0	13.6	13.6	0.2	13.6	13.6
OPEN ROADS (mi)	133.7	99.1	99.1	118.2	118.2	99.1
SEDIMENT SAVINGS FROM ROAD ACTIONS (tons/yr)	0.00	0.14	0.14	0.09	0.09	0.14
SEDIMENT LOSS FROM OPEN ROADS (tons/yr)	0.87	0.72	0.72	0.77	0.77	0.72
OPEN ROADS within 300 ft of STREAM (mi)	5.2	3.0	3.0	3.4	3.4	3.0
CLOSE ROADS within 300 ft of STREAM (mi)	0.0	0.7	0.7	1.6	0.4	0.7
DECOMISSION ROADS within 300 ft of STREAM (mi)	0.0	1.5	1.5	0.2	1.4	1.5

Present and Future Activities

- Foster Butter Allotment is expected to have a NEPA decision before 2004 grazing season. Current use is based on 2003 monitoring and NEPA decision. Winter Rim Allotment will have a NEPA decision before 2004 grazing season and use will be based on 2003 monitoring and NEPA decision. Recently burned areas compared to unburned areas produce more aboveground biomass (Tracy and McNaughton, 1996). This in concert with the active control of livestock in burned areas to keep cattle off of riparian area should be effective. *The NEPA analysis or Rangeland Health Assessments (BLM) will allow for thorough review of the grazing within this allotment.*
- Personal use firewood: In 2002, an estimated 981 cords were removed from this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. The hand pulling of weeds would cause no detectable impact to soil and water. *There are no knows problems associated with this activity.*
- Windmill Restoration Project: This project proposes a variety of non-commercial treatments to restore the landscape to more historic conditions. These treatments include reintroduction of fire where fire historically played a role, pre-commercial thinnings, aspen enhancements, and large woody debris additions to East Duncan Creek. *Any sediment input to these streams because of this project is predicted to have no effect on redband trout because this species does not occur in these streams, which are intermittent. The subwatershed would benefit from these projects.*

Cumulative Watershed Effects

See also "Summary Table – Upper Duncan Subwatershed Cumulative Watershed Effects" that follows discussion.

Alternative A

The number of roads that remain open under this alternative generates the third highest road density of any subwatershed in the analysis area. There are 5.2 miles of road within 300 feet of intermittent and perennial streams that remain open under this alternative. No ground disturbing activity as a result of salvage harvest and fuels reduction would occur under this alternative. However, the number of miles of road would allow a chronic sediment source and allow for a maximum increase in the drainage network to continue. The calculation of sediment loss from roads equates to 0.07 pound of sediment per acre within this subwatershed.

Action Alternatives

Approximately 96% of the subwatershed burned in 2002. The salvage harvest and associated fuels reduction accounts for activity on 6% to 10% of the subwatershed area. The minor amount of sediment associated with the harvest and the small amount of the subwatershed affected by the harvest should have minimal impact on the subwatershed. However, the addition of the acres of prescribed burn increases the percent of treated subwatershed by 8% and 5.4% for Alternatives C and G and Alternatives D and H, respectively. In concert, the prescribed burning and salvage account for treatment on 11% and 14% for Alternatives D and H, respectively and 18% for both Alternatives C and G. However, several commercial salvage units are at coincident locations with the proposed prescribed burn locations. Assuming the prescribed burn is of low-severity and the salvage produces minor amounts of sediment, the treatment should not be detrimental to the subwatershed. If either of the preceding statements is not true, the probability of detectable effects on the subwatershed increases in Alternative C and G and to a lesser degree in Alternative D and H. Several of the salvage units are coincident with the locations of the proposed prescribed burn areas in Alternative C, D, G, and H. Temporary and unclassified roads would temporarily increase the miles of road by 2.8% for Alternatives C and G, by 2.4% for Alternative H, by 1.5% for Alternative E and by 1.1% for Alternative D. The increase in road miles would be short term and proper decommissioning of the roads would occur after the activity is complete. The unclassified road density would decrease from 0.93 mi/mi^2 to 0.64 mi/mi^2, 0.85 mi/mi^2, 0.71 mi/mi^2, 0.64 mi/mi^2 and 0.66 mi/mi^2. Sedimentation from salvage harvest is expected to be similar and minor for all action alternatives.

Due to nearly all of the subwatersheds being inside of the analysis area, the roads management activities within the subwatershed are extensive. Approximately 21.0 miles of road would be closed and 13.6 miles of road would be decommissioned under Alternatives C, D and H. Under Alternative E 15.2 miles and 0.2 miles are closed and decommissioned, respectively. Alternative G closed 1.9 miles of road and decommissioned 13.6 miles of road. The

reduction in road density is greater than 10% of the original road density for all alternatives. Alternatives C, D and H reduce the road density by 26% from the original. The closure and decommissioning of 2.2 miles of road in Alternative C, D and H and 1.8 miles of road in Alternative E and G within 300 feet of intermittent and perennial streams would be a primary improvement to the health of the subwatershed. The sediment savings from road actions is generally the same in all alternatives as is the sediment loss from roads within this subwatershed. The road density would remain high for the subwatershed under all alternatives. Alternatives C, D and H are the most aggressive with respect to road activity and would result in the most benefit of the action alternatives.

Temperature characteristics in the streams of the subwatershed are not expected to change as a result of any of the action alternatives.

The high road density currently within the subwatershed and the short-term sedimentation associated with closure and decommissioning in order to reduce chronic problems from high road densities is a point of concern to varying degrees for all action alternatives. The subwatershed sensitivity was moderate. For these reasons, cumulative effects in the subwatershed are expected to be moderate. In addition, the recovery on private land salvage harvest, the effective rehabilitation of the suppression activities, monitoring and management of livestock use and allotment condition should not adversely affect the subwatershed.

Table 3.xx Summary Table – Upper Duncan Creek Subwatershed Cumulative Watershed Effects

	NAME - HUC								
WATERSHED	SILVER LAKE - 1712000503								
SUBWATERSHED	**UPPER DUNCAN CREEK -** 171200050301								
	LOW		MODERATE			HIGH			
SUBWATERSHED SENSITIVITY			X						
Characteristic(s) rated HIGH	Centroid elevation								
	CURRENT CONDITION - FUNCTIONALITY			**Alt A**	**Alt C**	**Alt D**	**Alt E**	**Alt G**	**Alt H**
ELEMENTS	FUNCTIONING APPROPRIATELY	FUNCTIONING AT RISK	FUNCTIONING AT UNACCEPTABLE RISK	RESTORE (**R**), MAINTAIN (**M**) or DEGRADE (**D**). Improvement as a result of the project? – **Yes** or **No**					
UPLANDS									
Roads			**X**	**D**	**R - Yes**	**R - Yes**	**M - Yes**	**M - Yes**	**R - Yes**
Canopy			**X**	**M**	**M**	**M**	**M**	**M**	**M**
Soil	**X**			**M**	**M**	**M**	**M**	**M**	**M**
RIPARIAN VEGETATION / BANK STABILITY	**X**			**M**	**M**	**M**	**M**	**M**	**M**
CHANNEL CONDITIONS									
Pool frequency	**X**			**M**	**M**	**M**	**M**	**M**	**M**
Large wood frequency	**X**			**M**	**M**	**M**	**M**	**M**	**M**
Temperature	NOT AVAILABLE								
Fine sediment	NOT AVAILABLE								
Fish passage	NOT AVAILABLE								

Upper Silver Creek

Existing Condition

Sensitivity

Upper Silver Creek 6th field watershed (subwatershed) (HUC 171200050206) is approximately 25 square miles and is part of the Silver Creek 5th field watershed. There is one perennial stream within the subwatershed and several intermittent streams. The perennial stream in the Upper Silver Creek subwatershed is the main stem of Silver Creek. This portion of Silver Creek begins at the outlet of Thompson Reservoir and flows for approximately 12 miles until it is joined by West Fork Silver Creek near the mouth of the subwatershed. Auger Creek is the primary intermittent stream within the subwatershed.

Hydrologic soil group C, which is characterized by slow rates of infiltration and water transmission, characterizes nine percent of the subwatershed. Hydrologic soil group D, which is characterized by very slow rates of infiltration and water transmission, characterizes thirteen percent of the subwatershed. Twenty-two percent of the subwatershed area is characterized by hydrologic soil group C and D. The total index percent of hydrologic group C and D was rated as **low** sensitivity. The vast majority, 83%, of the subwatershed is characterized by very stable mass wasting characteristics. One percent of the subwatershed is at risk for rotational slumps and one percent at risk for debris slides. The sensitivity index for mass wasting was **moderate**. All subwatersheds receive limited amounts of precipitation on average, which yields a less sensitive watershed on the whole. A rain-on-snow event is of particular concern any area with substantial snow pack. Upper Silver Creek is located midway in the system and on average holds snow in the upper elevations well into the spring. According to the estimated rain-on-snow range for the Silver Creek 5th field watershed of 4500-6000 feet, approximately 95% of the subwatershed is within this range. The sensitivity index for this element was rated as **high**.

Upper Silver Creek has low drainage density of 1.24 mi/mi^2, which is well below the low class 3 to 4 mi/mi^2 (Strahler, 1964). In comparison to the other subwatersheds in the analysis area Upper Silver Creek was rated as **high**. Subwatershed relief for Upper Silver Creek is high amongst the eight subwatersheds being analyzed and was rated as **high**. Over approximately 5.2 miles, an elevation of 2760 feet is lost for a resultant subwatershed relief ratio of 0.10 ft/ft. The centroid elevation of Upper Silver Creek is 5300 feet and is **moderate** for the analysis area. A higher centroid elevation value tends toward a more sensitive subwatershed.

Overall, Upper Silver Creek has limited precipitation, one perennial stream, low sensitivity for streamflow generation areas, moderate sensitivity for mass wasting, and high sensitivity for rain-on-snow potential. The channel information rated as high for drainage density and subwatershed relief and moderate for centroid elevation. This information leads one to conclude that East Duncan Creek subwatershed has **high** sensitivity when compared to the other subwatersheds within the analysis area.

Functionality

Upper Silver Creek is dominated by low-severity burn. Approximately 34% of the subwatershed burned with 0.4%, 1.9% and 31.4% of the subwatershed burned at high, moderate and low-severity, respectively.

The roads, canopy and soils within the subwatershed will be used to characterize the uplands of Upper Silver Creek. According to the transportation layer in Geographical Information Systems (GIS) there are 90 miles of road within Upper Silver Creek subwatershed equating to an open road density of 3.54 mi/mi^2, which places the subwatershed **functioning at unacceptable risk**. The Riparian Habitat Conservation Area (RHCA) for an intermittent stream is 50 feet on each side of the stream and 300 feet on each side of a perennial fish-bearing stream. Of the 90 miles of road approximately 2.0 miles are located within the RHCA for intermittent streams and 2.6miles are located with the RHCA for perennial fish-bearing streams. There are 14 miles or 16% are located within 300 feet of intermittent or perennial streams. Roads cross channels at 30 locations (3 perennial stream crossings and 27 intermittent stream crossings), sites where direct sediment introduction occurs. The road impact index (RII) was calculated to be 0.36. Along with the 32 miles of stream channels, an estimated 54 of the 90 miles of road are hydrologically integrated with the stream network, thus increasing the drainage network by 171%—using study results from Wemple (1994).

The capability areas within Upper Silver Creek were rated as having 50% of the area as low potential for erosion, 81% of the area as high potential for compaction, 94% of the area as low potential for displacement, and 94% as low potential for

mass movement. Transects used to measure compaction were measured after the fire took place and were only measured on Forest Service land within the fire perimeter. Upper Silver Creek was rated as having 58% and 42% of the inventoried subwatershed area as low and moderate compaction, respectively. No transect within Upper Silver Creek was found to have high compaction and therefore is rated as **functioning appropriately**.

The canopy analysis showed that approximately 29% and 51% of Ponderosa Pine and White Fir, respectively, were within the historic range of variability. Sixty percent of the Ponderosa Pine acres were found to be below HRV. Overall, 68% of the subwatershed is outside of HRV, which places the subwatershed at **functioning at unacceptable risk**.

Stream information for Upper Silver Creek subwatershed is only available for a Silver Creek, the perennial stream within the Upper Silver Creek subwatershed. The majority of Silver Creek is within the Upper Silver Creek subwatershed. Approximately 9.3 miles of Silver Creek are in the project area. The entire 9.3 miles of Silver Creek burned at some level during the Silver Fire. Mortality in RHCAs varied from low to moderate with pockets ranging up to very high. Along Silver Creek, the riparian vegetation immediately adjacent to the channel was lightly to moderately burned. Numerous overstory ponderosa pines in the RHCAs and adjacent uplands were burned to the crowns or suffered significant heat scorch. Some large woody debris in the stream channel and adjacent floodplain was consumed throughout the affected stream reaches.

Reach 5 of Silver Creek begins at forest boundary and extends upstream 1.5 miles to the 2917 Road. Reach 6 begins at the 2917 Road and extends upstream 1.8 miles to the confluence of an intermittent stream entering from the east. Reach 7 begins at the confluence of this intermittent stream, extends upstream 2.3 miles, and ends approximately 0.3 miles upstream of the Auger Valley Dispersed Campsite. Reach 8 begins at this point and extends upstream 1.2 miles to the forest boundary.

The dominant plant types in reaches 5-8 (willow, dogwood, alder, sedge, and grass) are highly similar to late-seral species in composition and structure, resulting in adequate cover to protect stream banks and dissipate energy during high flows. There is evidence, however, of pine encroachment into the riparian area over much of the streams length in reaches 5 through 8. There are also small, localized areas of bank instability, mainly in reaches 5 and 7. Overall, late-seral species dominate and bank stability exceeds 98% in all surveyed reaches; consequently, this element is **functioning appropriately**. The dominance of late-seral species in all reaches promotes their high bank stability values. Past livestock practices have likely influenced vegetative conditions but current grazing strategies are allowing riparian areas to be near their potential. Grazing strategies were changed in 1992 with all reaches being in a pasture that receives early-season grazing (livestock are off the pasture by August 15th). The altered fire regime in the region continues to promote higher densities of young pine in riparian areas, creating a minor shift in relative species abundance.

Aquatic Habitat Condition

The table below summarizes the data collected on aquatic habitat conditions for Silver Creek during the summer of 2000. It is used to reference discussion on the following aquatic habitat parameters: large woody debris, pools, spawning gravel fines, and Rosgen channel type. **Rating** refers to how that parameter is functioning, relative to desired condition for natural and near-natural by ICBEMP. ICBEMP criteria for evaluating functionality of aquatic habitats represents the best available science.

Table 3.xx. Aquatic Habitat Ratings in Silver Creek, Summer 2000

Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Rosgen Channel Type
						50% / 75%	50% / 75%	50% / 75%		
1	0.7	USFS	17	1	1 Desired	**	17 / 30	3 / 7	< 20	C
					1 Current	0	49	38	NA	C
					1 Rating	FA	FA	FA		FA
2		Private			2 Desired				<20	
					2 Current				NA	
					2 Rating					
3		Private			3 Desired				<20	
					3 Current				NA	
					3 Rating					
4	1.6	BLM	22	1	4 Desired	1 / 6	13 / 23	3 / 6	<20	C, B_c
					4 Current	1	29	6	NA	C, B_c
					4 Rating	FAR	FA	FAR		FA

Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Rosgen Channel Type
5	1.5	USFS	22	1	5 Desired	1 / 6	13 / 23	3 / 6	<20	C, B_c
					5 Current	2	42	5	NA	C, B_c
					5 Rating	FAR	FA	FAR		FA
6	1.8	USFS	23	1	6 Desired	1 / 6	13 / 22	3 / 6	<20	C, B_c
					6 Current	2	43	6	NA	C, B_c
					6 Rating	FAR	FA	FAR		FA
7	2.3	USFS	23	1	7 Desired	1 / 6	13 / 22	3 / 6	<20	B_c, C
					7 Current	7	40	3	36	B_c, C
					7 Rating	FA	FA	FAR	FUR	FA
8	1.2	USFS	23	1	8 Desired	1 / 6	13 / 22	3 / 6	<25	B_c, C
					8 Current	7	49	3	NA	B_c, C
					8 Rating	FA	FA	FAR		FA
9	1.3	USFS	23	2	9 Desired	5 / 20	14 / 23	2 / 6	<25	B, B_c
					9 Current	9	44	3	NA	B, B_c

FA – Functioning Appropriately, FAR – Functioning At Risk, FUR – Functioning At Unacceptable Risk, NA – Information Not Available; Habitat Abbreviations and Explanations: LWD – Large Woody Debris at 12" diameter by 35' in length; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

The pool frequency is greater than the 75th percentile in the surveyed reaches of Silver Creek within the subwatershed. This information yields a **functioning appropriately** rating. All of the reaches of Silver Creek in terms of the large pool component received a **functioning appropriately but at risk** ratings for the large pool habitat element. The large wood per mile for almost all reaches surveyed is between the 50th and 75th percentile and rates as **functioning at risk**. Fine sediment data was collected for Silver Creek in 1996 and 36% fines were measured. Measurement of fines greater than 30% places any stream into **functioning at unacceptable risk** for sediment.

Silver Creek is on the 303(d) list from the mouth to Thompson Valley Reservoir (see 303(d) listed waters section). The seven-day average daily maximum temperature for Silver Creek is collected at two sites. Silver Creek at 4530 feet elevation has documented seven-day average daily maximum temperatures of 22.8°C, 24.1°C, 23.9°C, 24.4°C and 26.2°C for 1993, 1997, 1998, 2000 and 2002, respectively. Silver Creek at 4920 feet elevation has documented seven-day average daily maximum temperatures of 20.2°C, 22.0°C and 24.3°C for 1993, 2000 and 2002, respectively. There is no known data for temperature on any other stream within this subwatershed. The seven-day average daily maximum for the years of record is greater than 17.8°C at Silver Creek and is therefore **functioning at unacceptable risk**. There is one inventoried culvert located on an intermittent tributary to Silver Creek in the upper reaches of the system outside of the fire perimeter. The culvert was found to impede fish passage and therefore the fish passage condition in Upper Silver Creek subwatershed is **functioning at risk**.

Measurements were made during the summer of 2000 to determine Rosgen Stream Channel Types for Silver Creek. Data was collected in each delineated stream reach and included channel gradient, substrate composition, channel sinuosity, bankfull width, bankfull depth, and floodprone area. The data was analyzed and calculations made to determine the channel type. All reaches of Silver Creek are **functioning appropriately** in terms of their potential stream type as the shape and size of the stream channel is in balance with its setting. The dominance of sedge, alder, willow and dogwood in these reaches promotes high bank stability and channels that are resistant to the erosive energy associated with high flows. In addition, management activities appear to be conducive to maintaining vegetation in the floodplains, which are able to dissipate energy associated with larger flow events. Although upland vegetation and road density both received functioning appropriately but-at-risk ratings, any modification to the magnitude and timing of stream flows has not shifted channels from their natural potential. The reason for this is primarily associated with Thompson Reservoir, which has modified the flow characteristics in Silver Creek – the reservoir collects the larger early spring runoff events and releases the water later in the year. Accordingly, the channel dimensions of Silver Creek have adjusted (become wider and shallower) to accommodate these regulated flows.

The current condition of Upper Silver Creek, with the functionality ratings for each element considered under Cumulative Watershed Effects, is shown in the summary table under "Environmental Consequences – Cumulative Watershed Effects". Generally, Upper Silver Creek was rated as having high subwatershed sensitivity when compared to the other subwatersheds analyzed. It was rated as high sensitivity with respect to rain-on-snow, drainage density and subwatershed relief. The roads category, canopy, large wood frequency and fish passage were rated as functioning at risk. Soil condition,

bank stability and pool frequency were rated as functioning appropriately. Temperature and sediment were rated as functioning at unacceptable risk.

Past Activities

- Fuels reduction: Under-burning: 1985-1989: 1530 acres, 1990-1994: 2250 acres, 1995-1999: 6200 acres. Pile burning: 1990-1994: 4 piles, 1995-1999: 17 piles, 2000-2002: 7 piles. Post harvest burning 1990-1994: 50 acres, 2000-2002: 100 acres. Crushing 190 acres 1995-1999. *Underburning and pile burning is typically at low severity and had little impact on the subwatershed. Crushing may increase compaction but most likely had little impact on the subwatershed.*
- Silvicultural activities have included timber stand improvement or the thinning of sub-merchantable trees and merchantable harvest of timber. Timber stand improvement occurred on 3,565 acres. Timber harvest activities on forest service land have focused on modifying structure and composition of stand while generating merchantable products. This subwatershed has seen 4,745 acres of harvest varying from intermediate, regeneration of both even aged and uneven aged, and salvage harvest. *Past timber harvest activities have been the main reason for high road densities within the subwatershed and the problems associated with high road densities. Timber harvest can also caused compaction and other detrimental soil conditions, expose areas to increased surface erosion, and may modify streamflow regimes. General watershed effects of timber removal on watersheds are well documented (Meehan, 1991, Troendle and Leaf, 1981) though no specific studies have been completed on the Fremont National Forest .*
- Personal use firewood: Approximately 300 personal use firewood permits sold at district with 2.5% occurring in this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*
- Grazing has occurred in the Yamsay Mountain allotment as early as 1944 with sheep then transitioned to cattle in 1946. Numbers of animals have drastically reduced from 1000 in 1944, 172 cattle in 1946, 323 cattle in 1961, 100 cattle in 1967, 200 cattle in 1979 on a rest/rotation, not used in 1992 through 1999, 50-100 short duration cattle from 2000 to 2002, and currently 100 cattle early deferred. Use on the Silver Bridge Allotment was prior to early 1980 to 2003 with 232 AUMS. Thompson Valley Allotment was through the summer months of 1946-1955 by 220 cattle. Foster Butter Allotment was used in 1966 by 1602 cattle on a rest rotation, 1980-1992 by 6807 AUMS on rest rotation by pasture and 1993-2002 by 6297 AUMS early season. *Clearly the use in the past has been heavy, but current management of livestock has limited their impacts on the subwatershed.*
- Powerline and communications facilities consist of 3 miles of Midstate Electric powerline. *No known problems with these facilities exist with respect to soil and water.*
- NRT and dispersed recreational sites. *Activities associated with the trail and recreational areas at isolated or concentrated locations near streams may cause limited resource damage in the form of compaction or trampling.*
- The diversion dam may or may not provide for fish movement through the infrastructure. *Ponding of water exposes more surface area to radiant heat and causes increases in water temperature.*
- Non-industrial private land has partially harvested a limited number of ponderosa pine. *Little impact on soil and water has occurred as a result of this activity.*
- Any noxious weed treatment has followed BMP for application of chemical agents near stream channels. *The hand pulling of weeds would cause no detectable impact to soil and water. There are no knows problems associated with this activity.*
- Past fire activity shows there have been 67 fires since 1948, of which 98% of the acres burned were caused by lightning and the largest fire was 2,110 acres. *The intense fire suppression has resulted in more dense stands throughout the area and may help lead to more intense fires that would have historically occurred.*
- 2002 Fire Suppression. 27 miles of dozer line and 1 mile of hand line were constructed within the subwatershed and trees were fallen for safety or suppression objectives. *The additional compacted surface of dozer lines add to the road density and sedimentation problems associated with roads/trails. It is assumed that dozer lines were rehabilitated with waterbars and drainage according to BMPs and have reduced sediment production to background levels.*
- Juniper thinning. 60 acres in 2000. *The thinning of this aggressive species that has well surpassed historic stocking has a positive effect on the subwatershed.*
- BAER projects. *Drainage ditches were cleaned throughout subwatershed. This activity facilitated proper movement of moisture off of roads.*
- Industrial forest lands. Throughout the analysis area have logged extensively throughout the 20th century. By 2000, almost all stands were logged at least once. *The extensive use on private lands has increased ground disturbance and increased erosion.*

Toolbox Fire Recovery Project Activities (on a subwatershed basis)

Direct and indirect effects *on a project area basis* were discussed early in the Watershed section. This section concerns itself with how those direct and indirect effects apply to a cumulative effects finding, on a *subwatershed* basis.

The elements discussed under direct and indirect effects as they pertain to the Upper Silver Creek subwatershed are found below.

Table 3-XX. Upper Silver Creek Direct and Indirect Effects by Alternative

UPPER SILVER CREEK	ALT. A	ALT. C	ALT. D	ALT. E	ALT. G	ALT. H
TOTAL COMMERCIAL SALVAGE (acres)	0	1,386	407	869	1,376	1,277
GROUND BASED COMMERCIAL SALVAGE (acres)	0	1,357	407	869	1,356	1,277
AERIAL COMMERCIAL SALVAGE (acres)	0	29	0	0	21	0
PERCENT OF SUBWATERSHED AREA SALVAGE	0%	9%	3%	5%	8%	8%
TOTAL RHCA COMMERCIAL SALVAGE (acres)	0	134	49	102	125	70
RHCA 1 (acres)	0	13	4	5	4	4
RHCA 3 (acres)	0	121	65	97	121	66
RHCA 4 (acres)	0	0	0	0	0	0
TEMPORARY ROADS (mi)	0	2.12	0	1.63	2.12	1.86
RE-OPEN UNCLASSIFIED ROADS (mi)	0	6.18	1.58	5.02	6.18	5.92
PRESCRIBED FIRE (acres)	0	0	0	0	0	0
ROADS						
OPEN ROAD DENSITY (mi/mi^2)	3.54	3.01	3.01	3.23	3.23	3.01
CLOSE ROADS (mi)	0.0	6.7	6.7	4.9	1.1	6.7
DECOMMISSION ROADS (mi)	0.0	6.8	6.8	3.0	6.8	6.8
OPEN ROADS (mi)	89.9	76.5	76.5	82.1	82.1	76.5
SEDIMENT SAVINGS FROM ROAD ACTIONS (tons/yr)	0.00	0.08	0.08	0.07	0.07	0.08
SEDIMENT LOSS FROM OPEN ROADS (tons/yr)	0.60	0.52	0.52	0.53	0.53	0.52
OPEN ROADS within 300 ft of STREAM (mi)	6.2	3.7	3.7	3.9	3.9	3.7
CLOSE ROADS within 300 ft of STREAM (mi)	0.0	0.4	0.4	0.9	0.2	0.4
DECOMISSION ROADS within 300 ft of STREAM (mi)	0.0	2.1	2.1	1.4	2.1	2.1

Present and Future Activities

- Grazing in the Yamsay Mountain Allotment is currently at 100 cattle early deferred from July 16 to August 31 and planning under NEPA is scheduled for 2007. Foster Butter Allotment is expected to have a NEPA decision before 2004 grazing season. Current use is based on 2003 monitoring and NEPA decision. Silver Bridge-BLM-Allotment has 262 AUMS on rest rotation with riparian pasture. Recently burned areas compared to unburned areas produce more aboveground biomass (Tracy and McNaughton, 1996). This in concert with the active control of livestock in burned areas to keep cattle off of riparian area should be effective. *The NEPA analysis or Rangeland Health Assessments (BLM) will allow for thorough review of the grazing within this allotment.*
- Personal use firewood: In 2002, an estimated 981 cords were removed from this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*
- Some removal of timber from private non-industrial forest lands. *This is a small portion of the subwatershed and should have little impact on soil and water within the subwatershed.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. The hand pulling of weeds would cause no detectable impact to soil and water. *There are no knows problems associated with this activity.*
- Several more NRT miles would be reconstructed. *There would be short-term effects from the trail construction and isolated areas of compaction as a result of the trail but these activities would have limited effect on the subwatershed.*
- Juniper treatment-BLM. 1000 acres. *The thinning of this aggressive species that has well surpassed historic stocking has a positive effect on the subwatershed.*
- Seeding-BLM. 200 acres. *This activity will allow for more rapid recovery of subwatershed.*
- Seedling planting-BLM. 250 acres. *This activity will allow for more rapid recovery of subwatershed.*
- 517 East Forest Recovery Project/Triad Restoration Project: These treatments include reintroduction of fire where fire historically played a role, commercial and pre-commercial thinnings, aspen enhancements, and large woody debris additions to Silver Creek. *Any sediment input to these streams because of this project is predicted to have an insignificant effect on redband trout because of the minimal quantities and low risk of entering fish habitat because of riparian buffers, mitigation measures, and Forest BMP's. This project would have beneficial affects on the subwatershed.*

Cumulative Watershed Effects

See also "Summary Table – Upper Silver Creek Subwatershed Cumulative Watershed Effects" that follows discussion.

Alternative A

The number of roads that remain open under this alternative and the number of open roads within 300 feet of stream channels are of concern. The road density under this alternative is the fourth highest of the eight subwatersheds analyzed. No ground disturbing activity as a result of salvage harvest and fuels reduction would occur under this alternative. However, the number of miles of road would allow a chronic sediment source and allow for a maximum increase in the drainage network to continue. The calculation of sediment loss from roads equates to 0.07 pound of sediment per acre within this subwatershed.

Action Alternatives

Approximately 34% of the subwatershed burned in 2002 and activity on only 34% of the subwatershed is within the analysis area. The salvage harvest and associated fuels reduction accounts for activity on 3% to 9% of the subwatershed area. The minor amount of sediment associated with the harvest and the very limited amount of the subwatershed affected by the harvest should have little impact on the subwatershed. There is no prescribed burn planned in this subwatershed. The temporary and unclassified roads would temporarily increase the miles of road by 9.2% for Alternatives C and G, by 8.7% for Alternative H, by 7.4% for Alternative E and by 1.8% for Alternative D. The increase in road miles would be short term and proper decommissioning of the roads would occur after the activity is complete. The unclassified road density would decrease from 0.93 mi/mi^2 to 0.64 mi/mi^2, 0.85 mi/mi^2, 0.71 mi/mi^2, 0.64 mi/mi^2 and 0.66 mi/mi^2. Sedimentation from salvage harvest is expected to be similar and minor for all action alternatives.

Due to only 34% of the subwatershed being inside of the analysis area, the roads management activities within the subwatershed are somewhat limited. Approximately 6.7 miles of road would be closed and 6.8 miles of road would be decommissioned under Alternatives C, D and H. Alternative E would close 4.9 miles of road and decommission 3.0 miles of road. Under Alternative G 1.1 miles would be closed and 6.8 miles would be decommissioned. The reduction in road

density is approximately 15% in Alternatives C, D and H compared to the original road density. The reduction in road density compared to the original for Alternative E and G is 9%. The closure and decommissioning of between 2.3 and 2.5 miles of road within 300 feet of intermittent and perennial streams would be an improvement to the health of the subwatershed under all alternatives. The sediment savings from road actions is generally the same in all alternatives as is the sediment loss from roads within this subwatershed. The road density would remain high for the subwatershed under all alternatives. Alternatives C, D and H are the most aggressive with respect to road activity and would result in the most benefit of the action alternatives.

Temperature characteristics in the streams of the subwatershed, including those on the 303(d) list, are not expected to change as a result of any of the action alternatives.

Aspen enhancement, large wood placement and deciduous planting in perennial riparian areas would be implemented in Alternatives C, D, G and H. The enhancement of riparian vegetation, particularly where conifer encroachment occurs, has a positive effect on the subwatershed. Large wood placement would take place within the subwatershed and provide for hiding cover and stream variability that would enhance fish habitat. Deciduous planting in riparian areas of the perennial stream in the subwatershed would occur in areas that burned particularly hot.

The subwatershed sensitivity was high. Temperature and fine sediment were rated as functioning at unacceptable risk. It is understood that all alternatives would generate minor amounts of sediment from salvage harvest and fuel reduction. The sediment in the streams and stream temperature should not increase as a result of the action alternatives. This is less likely to occur in alternatives with fewer acres in RHCA harvest. Therefore, the subwatershed is rated moderate for cumulative watershed affects. In addition, the recovery on private land salvage harvest, the effective rehabilitation of the suppression activities, monitoring and management of livestock use and allotment condition should not adversely affect the subwatershed.

Table 3.xx Summary Table – Upper Silver Creek Subwatershed Cumulative Watershed Effects

	NAME - HUC								
WATERSHED	SILVER CREEK - 1712000502								
SUBWATERSHED	**UPPER SILVER CREEK -** 171200050206								
	LOW		MODERATE			HIGH			
SUBWATERSHED SENSITIVITY						X			
Characteristic(s) rated HIGH	Rain on snow, drainage density, subwatershed relief								
	CURRENT CONDITION - FUNCTIONALITY			**Alt A**	**Alt C**	**Alt D**	**Alt E**	**Alt G**	**Alt H**
ELEMENTS	FUNCTIONING APPROPRIATELY	FUNCTIONING AT RISK	FUNCTIONING AT UNACCEPTABLE RISK	RESTORE (**R**), MAINTAIN (**M**) or DEGRADE (**D**). Improvement as a result of the project? – **Yes** or **No**					
UPLANDS									
Roads			**X**	**D**	**R - Yes**	**R - Yes**	**M - Yes**	**M - Yes**	**R - Yes**
Canopy			**X**	**M**	**M**	**M**	**M**	**M**	**M**
Soil	**X**			**M**	**M**	**M**	**M**	**M**	**M**
RIPARIAN VEGETATION / BANK STABILITY	**X**			**M**	**M**	**M**	**M**	**M**	**M**
CHANNEL CONDITIONS									
Pool frequency	**X**			**M**	**M**	**M**	**M**	**M**	**M**
Large wood frequency		**X**		**M - No**	**R - Yes**	**R - Yes**	**M – No**	**R - Yes**	**R - Yes**
Temperature			**X**	**M**	**M**	**M**	**M**	**M**	**M**
Fine sediment			**X**	**M**	**M**	**M**	**M**	**M**	**M**
Fish passage		**X**		**M**	**M**	**M**	**M**	**M**	**M**

West Fork Silver Creek

Existing Condition

Sensitivity

West Fork Silver Creek 6th field watershed (subwatershed) (HUC 171200050207) is approximately 38 square miles and is part of the Silver Creek 5th field watershed. There are two perennial streams within the subwatershed and several intermittent streams. The perennial streams in the West Fork Silver Creek subwatershed are the West Fork Silver Creek and North Fork Silver Creek. The headwaters of both West Fork and North Fork Silver Creek are off of the east face of Yamsay Mountain. North Fork Silver Creek flows for approximately 5.9 miles before it flows into West Fork Silver Creek. West Fork Silver Creek continues through the subwatershed flowing through some high meadows and eventually flows into Silver Creek at the mouth of the subwatershed.

Hydrologic soil group C, which is characterized by slow rates of infiltration and water transmission, characterizes nine percent of the subwatershed. Hydrologic soil group D, which is characterized by very slow rates of infiltration and water transmission, characterizes nineteen percent of the subwatershed. Twenty-eight percent of the subwatershed area is characterized by hydrologic soil group C and D. The total index percent of hydrologic group C and D was rated as **moderate**. The majority, 79%, of the subwatershed is characterized by very stable mass wasting characteristics. However, thirteen percent of the subwatershed is at risk for rotational slumps. The sensitivity index for mass wasting was **high** for this subwatershed. All subwatersheds receive limited amounts of precipitation on average, which yields a less sensitive watershed on the whole. A rain-on-snow event is of particular concern any area with substantial snow pack. West Fork Silver Creek is located high in the system and on average holds snow in the West Fork elevations well into the spring. According to the estimated rain-on-snow range for the Silver Creek 5th field watershed of 4500-6000 feet, approximately 70% of the subwatershed is within this range. The sensitivity index for this element was rated as **high**.

West Fork Silver Creek has low drainage density of 1.27 mi/mi^2, which is the highest drainage density of the analysis area. In comparison to the other subwatersheds in the analysis area, West Fork Silver Creek was rated as **high**. However, this value is well below the low class drainage density of 3 to 4 mi/mi^2 (Strahler, 1964). Subwatershed relief for West Fork Silver Creek is low amongst the eight subwatersheds being analyzed and rated as **low** sensitivity. Over approximately 15 miles, an elevation of 3245 feet is lost for a resultant subwatershed relief ratio of 0.04 ft/ft. The subwatershed shape is long and relatively narrow which is characteristic of a more sensitive subwatershed. The centroid elevation of West Fork Silver Creek is 5060 feet and is **moderate** for the analysis area. A higher centroid elevation value tends toward a more sensitive subwatershed.

Overall, West Fork Silver Creek has limited precipitation, two perennial streams, low sensitivity for streamflow generation areas, high sensitivity for mass wasting, and high sensitivity for rain-on-snow potential. The channel information rated as high for drainage density, low for subwatershed relief and moderate for centroid elevation. This information leads one to conclude that East Duncan Creek subwatershed has **high** sensitivity when compared to the other subwatersheds within the analysis area.

Functionality

West Fork Silver Creek is dominated by low-severity burn. Approximately 41% of the subwatershed burned with 0.8%, 5.8% and 33.8% of the subwatershed burned at high, moderate and low-severity, respectively.

The roads, canopy and soils within the subwatershed will be used to characterize the uplands of West Fork Silver Creek. According to the transportation layer in Geographical Information Systems (GIS) there are 129 miles of road within West Fork Silver Creek subwatershed equating to an open road density of 3.43 mi/mi^2, which places the subwatershed **functioning at unacceptable risk**. The Riparian Habitat Conservation Area (RHCA) for an intermittent stream is 50 feet on each side of the stream and 300 feet on each side of a perennial fish-bearing stream. Of the 129 miles of road approximately 1.6 miles are located within the RHCA for intermittent streams and 5.5miles are located with the RHCA for perennial fish-bearing streams. There are 15 miles or 12% are located within 300 feet of intermittent or perennial streams. Roads cross channels at 31 locations (5 perennial stream crossings and 26 intermittent stream crossings), sites where direct sediment introduction occurs. The road impact index (RII) was calculated to be 0.36. Along with the 48 miles of stream channels, an estimated 77 of the 129 miles of road are hydrologically integrated with the stream network, thus increasing the drainage network by 162%—using study results from Wemple (1994).

The capability areas within West Fork Silver Creek were rated as having 64% of the area as low potential for erosion, 66% of the area as high potential for compaction, 69% of the area as low potential for displacement, and 98% as low potential for mass movement. Transects used to measure compaction were generated after the fire took place and were only measured on Forest Service land within the fire perimeter. West Fork Silver Creek was rated as having 54% and 46% of the inventoried subwatershed area as low and moderate compaction, respectively. No transect within West Fork Silver Creek was found to have high compaction and therefore will be rated as **functioning appropriately**.

The canopy analysis showed that approximately 62%, 38% and 76% of Lodgepole Pine, Ponderosa Pine and White Fir, respectively, were within the historic range of variability. Fifty percent of the Ponderosa Pine acres were found to be below HRV. Overall, 48% of the subwatershed is outside of HRV, which places the subwatershed at **functioning at unacceptable risk**.

Information regarding the bank stability and riparian vegetation for West Fork Silver Creek subwatershed is available for North Fork Silver Creek and West Fork Silver Creek, the two perennial, fish-bearing streams within the West Fork Silver Creek subwatershed.

West Fork Silver Creek is within the West Fork Silver Creek Subwatershed. Approximately 9.4 miles of West Fork Silver Creek are in the project area. All of the 9.4 miles of West Fork Silver Creek burned at some level during the Silver Fire. Mortality in RHCAs varied from low to moderate with pockets ranging up to very high. Along West Fork Silver Creek, the riparian vegetation immediately adjacent to the channel was lightly to moderately burned, however several areas experienced a complete consumption of riparian vegetation. Numerous overstory ponderosa pines in the RHCAs and adjacent uplands were burned to the crowns or suffered significant heat scorch. Some large woody debris in the stream channel and adjacent floodplain was consumed throughout the affected stream reaches.

North Fork Silver Creek is also within the West Fork Silver Creek subwatershed. Approximately 2.3 miles of North Fork Silver Creek are in the project area with all 2.3 miles experiencing some level of burning during the Silver Fire. Mortality in RHCAs varied from low to moderate with pockets ranging up to very high. Along North Fork Silver Creek, the riparian vegetation immediately adjacent to the channel was lightly to moderately burned with an area of very high mortality at its confluence with West Fork Silver Creek. Some overstory ponderosa pines in the RHCAs and adjacent uplands were burned to the crowns or suffered significant heat scorch. Some large woody debris in the stream channel and adjacent floodplain was consumed throughout the affected reaches.

Reach 4 of West Fork Silver Creek begins at the forest boundary and extends upstream 3.0 miles to where the canyon ends. Reach 5 of Silver Creek begins at this point and extends upstream 1.2 miles to the forest boundary just upstream of the 2917 Road. Reach 6 begins at the forest boundary just downstream of the Silver Creek Marsh Campground and extends upstream 1.2 miles to just upstream of the 27 Road. Reach 7 begins at this point and extends upstream 2.0 miles to the confluence with North Fork Silver Creek. Reach 8 begins at the confluence of North Fork Silver Creek and extends upstream 3.0 miles to the 3038 Road. Reach 1 of North Fork Silver Creek begins at the confluence with West Fork Silver Creek and extends upstream 2.3 miles to the 3038 Road.

Riparian Ecosystems and Bank Stability

West Fork Silver Creek

The dominant riparian vegetation (sedge, alder, dogwood, willow, grass and lodgepole pine) within all surveyed reaches, with the exception of Reach 5, is highly similar to late-seral species composition and structure, and combined with bank stability values, results in a **functioning appropriately** rating for each reach. Reach 5, on the other hand, is **functioning appropriately but-at-risk** due to a higher abundance of grass and the lack of willow in the older age-classes and its lower bank stability values. Additionally, there is evidence of lodgepole pine encroachment into the riparian area over much of the streams length, especially in the upper reaches (reaches 8 and above). The dominance of late-seral species in all reaches promotes their high bank stability values. In Reach 5, banks are continuing to build and recover as riparian vegetation moves closer to its desired condition – grass and wild iris are more common than expected indicating that plant succession in moving towards, but has not yet reached, a late-seral community. Past livestock practices have likely influenced vegetative conditions, especially the lack of mature willow, but current grazing strategies are allowing riparian areas to move towards their potential. Grazing strategies within the lower reaches currently involves early season use, with reaches 6, 7, and 8 receiving short season/early grazing, while the upper reaches are excluded from grazing. In addition, a sizable portion of the stream in the project area (reaches 6-8) was not grazed during the period of 1990-1996. The altered fire regime in the region continues to promote higher densities of lodgepole pine in riparian areas, creating a minor shift in

relative species abundance with fewer shade intolerant species such as willow and aspen. An additional factor affecting bank stability within the lower reaches of this stream might be the increased drainage network associated with roads throughout the sub-watershed, possibly influencing the timing and magnitude of stream flows and their effects on channel scouring.

North Fork Silver

The dominant plant types in Reach 1 – alder, sedge, and grass – is highly similar to late-seral species in composition and structure, resulting in adequate cover to protect streambanks and dissipate energy during high flows. There is evidence, however, of lodgepole pine encroachment into the riparian area over much of the streams length. Overall, late-seral species dominate and bank stability exceeds 98%; consequently, this element is **functioning appropriately**. The abundance of late-seral species in all Reach 1 promotes high bank stability values. The majority of the area did not have authorized livestock use from 1990-1997 (part of a vacant allotment, or received non-use). Current grazing strategies in Reach 1 are conducive to keeping riparian areas in a condition that is near their potential. The altered fire regime in the region continues to promote higher densities of young lodgepole pine in riparian areas, creating a minor shift in relative species abundance with fewer shade intolerant species such as willow and aspen.

Aquatic Habitat Condition

Table 3.xx. Aquatic Habitat Ratings in West Fork Silver Creek, Summer 2000

Reach	Reach Length (miles)	Owner	Desired Wetted Width (‘)	Gradient (%)	Reach	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Rosgen Channel Type
						50% / 75%	50% / 75%	50% / 75%		
1	0.5	BLM	6	1	1 Desired	**	49 / 84	0 / 4	<20	C, E
					1 Current	0	110	7	NA	C, E
					1 Rating	FA	FA	FA		FA
2	0.3	BLM	10	1	2 Desired	3 / 13	30 / 51	0 / 3	<25	C, E
					2 Current	7	109	22	15	C, E
					2 Rating	FA+	FA	FA	FA	FA
3	1.1	BLM	12	1	3 Desired	3 / 11	25 / 42	0 / 2	<25	B_c, C
					3 Current	8	102	2	NA	B_c, C
					3 Rating	FAR	FA	FAR		FA
4	3.0	USFS	11	1	4 Desired	3 / 12	27 / 46	0 / 2	<25	B_c, C, B, E
					4 Current	33	116	6	NA	B_c, C, B, E
					4 Rating	FA	FA	FA		FA
5	1.2	USFS	9	<1	5 Desired	4 / 15	33 / 56	0 / 3	<25	C, E
					5 Current	21	87	5	25	C, E
					5 Rating	FA	FA	FA	FAR	FAR
5a		Private			6 Desired				<20	
					6 Current				NA	
					6 Rating					
6	1.2	USFS	8	<1	7 Desired	4 / 17	37 / 63	0 / 3	<20	C, E, B_c
					7 Current	7	111	18	NA	C, E, B_c
					7 Rating	FA+	FA	FA		FA
7	2.0	USFS	8	3	8 Desired	13 / 56	40 / 67	1 / 3	<25	B, B_c, E, B_a
					8 Current	20	115	1	35	B, B_c, E, B_a
					8 Rating	FAR	FA	FAR	FUR	FA
8	3.0	USFS	8	1-2	9 Desired	4 / 17	37 / 63	0 / 3	<25	E, B
					9 Current	27	96	0	NA	E, B
					9 Rating	FA	FA	FAR		FA
9	1.5	USFS	7	1-2	10 Desired	5 / 19	42 / 72	0 / 4	<20	E, B
					10 Current	45	108	0	30	E, B
					10 Rating	FA	FA	FAR	FUR	FA
10	1.3	USFS	7	<1	11 Desired	5 / 19	42 / 72	0 / 4	<20	E_b, B
					11 Current	21	120	0	NA	E_b, B
					11 Rating	FA	FA	FAR		FA
11	1.7	USFS	5	1-2	12 Desired	6 / 26	59 / 101	0 / 5	<20	E, E_b
					12 Current	34	134	0	NA	E, E_b
					12 Rating	FA	FA	FAR		FA
12	0.7	USFS	5	2-4	12 Desired	21 / 90	63 / 107	0 / 5	<20	B, E_b
					12 Current	56	143	0	28	B, E_b
					12 Rating	FA+	FA	FAR	FAR	FA

Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Rosgen Channel Type
13	1.0	USFS	4	>4	13 Desired	26 / 88	40 / 77	0 / 0	<20	A, B_a
					13 Current	41	122	0	NA	A, B_a
					13 Rating	FA+	FA	FA		FA

FA – Functioning Appropriately, FAR – Functioning Appropriately but-at-Risk, FUR – Functioning At Unacceptable Risk NA – Information Not Available; Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

Table 3.xx. Aquatic Habitat Ratings in North Fork Silver Creek, Summer 2000

Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Rosgen Channel Type
						50% / 75%	50% / 75%	50% / 75%		
1	2.3	USFS	5	1-4	1 Desired	21 / 90	63 / 107	1 / 4	<20	B, E_b, E
					1 Current	78	108	0	NA	B, E_b, E
					1 Rating	FA+	FA	FUR		FA
2	2.6	USFS	5	2-4	7 Desired	21 / 90	63 / 107	1 / 4	<20	B, B_a E_b, E
					7 Current	34	117	0	52	B, B_a E_b, E
					7 Rating	FA+	FA	FUR	FUR	FA

FA – Functioning Appropriately, FAR – Functioning Appropriately but-at-Risk, FUR – Functioning at Unacceptable Risk, NA – Information Not Available; Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

Channel condition will be characterized and rated for functionality with respect to pool frequency, large wood frequency, temperature, fine sediment and fish passage. The pool frequency is greater than the 75th percentile in the surveyed reaches of West Fork and North Fork Silver Creek within the subwatershed. This information yields a **functioning appropriately** rating. Of the reaches surveyed in the West Fork Silver Creek, reaches 4, 5, and 6 are **functioning appropriately** in terms of the large pool component, while fewer deep (large) pools were found in the other reaches, 7 and 8, all of which received **functioning appropriately but-at-risk** ratings for large pools. In terms of the large pool component for North Fork Silver Creek, however, no deep (large) pools could be found in the reach, and thus received a **functioning inappropriately** rating for the large pool habitat element. The large wood per mile for nearly half of the length of reaches surveyed is between the 50th and 75th percentile and the other half of the length of reaches surveyed is above the 75th percentile. The majority of the reaches that are between the 50th and 75th percentile are from North Fork Silver Creek. The majority of the reaches of the main stem of West Fork Silver Creek are above the 75th percentile but just above the 75th percentile. Therefore, the subwatershed is rated as **functioning at risk** for large wood. Sediment data was collected for West Fork Silver Creek in 1996 and 2000 at three locations. At 4450 feet elevation 31% and 15% fines were measured in 1996 and 2000, respectively. At 4740 feet elevation 26% and 25% fines were measured in 1996 and 2000, respectively. At 4850 feet elevation 41% and 35% fines were measured in 1996 and 2000, respectively. The sites at 4460 feet elevation and 4850 feet elevation were measured with one sample in the spring of 2003 and measured 30% and 32% fines, respectively. Measurements of greater than 30% fines places any stream into **functioning at unacceptable risk** for sediment.

Spawning Gravel Fines

Fine sediment in spawning substrates has been sampled at five locations within West Fork Silver Creek. In Reach 5, a C/E stream type, the percent fines were at 25%, promoting 62% embryo survival. Thus, Reach 5 is functioning appropriately but-at-risk. In reach 7, which is a primarily B/E stream type, sampling results showed 35% fine sediment, promoting 34% embryo survival, resulting in a functioning at unacceptable risk rating for Reach 7. Results of monitoring fine sediments in spawning substrates within West Fork Silver Creek indicates that levels of fine sediment are typically higher than recommended. Sediment in potential spawning substrates of West Fork Silver Creek varies between 15% and 35% (26% and 45% in 1996). One of the reasons for these relatively high reported sediment values is likely associated with the naturally high erosion rates associated with soils (located in the pumice zone) and geomorphology of the area. Monitoring in this system shows that in the upper portions of the drainage, where impacts from logging activities are minimal, sediment levels are about 28% (measured only in 1996). Below West Fork Silver Creek Marsh, which is influenced by beaver activity, sediment levels were measured at 25% (26% in 1996). Between these two areas, substrate fines were measured at 35 and 30% (41 and 45% in 1996). Review of aerial photographs of the area reveals impacts from past logging in the adjacent uplands, which, along with associated roading may be influencing sediment levels. However, potential natural

erosion rates are high in the areas where the highest sediment levels occur (also the area where harvesting and roading have occurred), possibly influencing localized sediment levels. The stream system may be unable to meet the recommended sediment levels in the absence of beaver. The connection between beaver dams and the lower levels of sediment measured below the marsh, indicates the importance of maintaining beaver habitat and beaver populations in the stream system. Beaver dams are important for trapping sediment and providing cool water refugia for fish. There has been an overall decrease in average sediment values between 2001 (average of 26%) and 1996 (average of 36%). This difference is likely attributed to the flushing of fine sediments out of the system associated with the flood of 1997, one of the largest on record. One sediment sampling site was located on North Fork Silver Creek. Fifty-two percent fine sediments (60% recorded in 1996) were documented at the sampling site located upstream of the project area, promoting only 7% (3% based on 1996 sample) embryo survival. It is assumed that relatively high sediment levels occur in Reach 1 and was therefore given a functioning at unacceptable risk rating. The data for the entire subwatershed yields a rating of **functioning at unacceptable risk** for spawning gravel fines.

West Fork Silver Creek is on the 303(d) list from the mouth to Silver Creek Marsh (see 303(d) listed waters section). The seven-day average daily maximum temperature in the listed portion of the stream is collected at two sites. West Fork Silver Creek at 4460 feet elevation has documented seven-day average daily maximum temperatures of 27.0°C, 21.2°C, 21.8°C, 21.4°C, 21.1°C and 23.8°C for 1994, 1995, 1996, 1997, 1998, and 2000, respectively. West Fork Silver Creek at 4740 feet elevation has documented seven-day average daily maximum temperatures of 27.0°C, 21.0°C, 27.0°C, 22.6°C, 22.6°C, 22.0°C, 21.6°C, 21.0°C and 27.6°C for 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999 and 2000, respectively. There are three other temperature monitoring sites within the subwatershed and no other known data for temperature on any other stream within this subwatershed. The seven-day average daily maximum for the years of record is greater than 17.8°C in portions of West Fork Silver Creek and is therefore **functioning at unacceptable risk**. As illustrated in the table below, the upper elevation of West Fork Silver Creek and North Fork Silver Creek maintain at much lower temperatures than the lower elevations.

Table 3-XX. Temperature Monitoring Sites in West Fork Silver Creek Subwatershed

SITE	ELEVATION	1993	1994	1995	1996	1997	1998	1999	2000	2002
INSIDE FIRE BOUNDARY										
NORTH FORK SILVER CREEK	5050	12.7	15.4	12.3	12.9	12.5	13.0	12.3	14.3	17.4
WEST FORK SILVER CREEK	5050	13.1	16.4	12.8	13.8	13.3	13.2	12.4	15.3	17.8
OUTSIDE FIRE BOUNDARY										
WEST FORK SILVER CREEK	5580	NA	18.0	12.9	13.3	12.6	12.5	NA	13.9	15.3
ALL TEMPERATURES GIVEN IN DEGREES CELSIUS										

There are four inventoried culvert located on West Fork Silver Creek. One of the two of the culverts located within the fire perimeter was replaced in 2000. The other was inventoried as an impediment to passage but is currently being backwatered by downstream material and is no longer a barrier to upstream movement. The other two culverts impede fish movement and are located in the upper reaches of the system and therefore the fish passage condition in West Fork Silver Creek subwatershed is **functioning at risk**.

Rosgen Channel Type

All surveyed reaches of West Fork Silver Creek, except Reach 5, are functioning appropriately in terms of their potential stream type as the shape and size of the stream is in balance with its geomorphic setting. Although Reach 5 has stream channels that are similar to the stream type expected, segments of the reach have bankfull width-to-depth ratios that are slightly greater than expected and thus the reach is determined to be functioning appropriately but-at-risk. An abundance of late-seral riparian vegetation is essential for maintaining low-gradient stream types, like those found along a good portion of West Fork Silver Creek. All reaches, with the exception of Reach 5, have an abundance of alder, willow, and sedge that promote high bank stability with channels that are resistant to the erosive energy associated with high flows. Management activities appear to be conducive to maintaining this vegetation within the floodplain – which acts to dissipate energy associated with high flow events, trap sediments, and build banks – allowing the stream to maintain or move towards its desired state. Although conditions in Reach 5 are nearing their desired state, small portions are still showing signs of a recovering stream. These areas have less willow and more grass than expected, which are contributing to the unstable stream banks within this reach and the functioning appropriately but-at-risk rating. As late-seral vegetation continues to develop along these reaches, it will act to trap sediment and build banks, causing the channel to continue to narrow and

deepen, moving towards its naturally stable and desired state. Overall, the riparian vegetation is dominated by willow, bog birch, sedge and grass for both North Fork and West Fork Silver Creek. The bank stability was inventoried as greater than 95% stable in all twelve inventoried reaches of West Fork Silver Creek and inventoried as greater than 99% stable in the two reaches of North Fork Silver Creek. This information yields a **functioning appropriately** rating.

Reach 1 of North Fork Silver Creek is **functioning appropriately** in terms of its potential stream type as the shape and size of the stream channel is in balance with its setting. The dominance of alder and sedge promotes high bank stability and narrow and deep channels that are resistant to the erosive energy associated with high flows. Also, management activities appear to be conducive to maintaining vegetation in floodplains, which are able to dissipate energy associated with high flow events. Any modification to the magnitude and timing of stream flows has not shifted channels from their natural potential, even though upland vegetation and road density both received functioning appropriately but-at-risk ratings.

The current condition of West Fork Silver Creek, with the functionality ratings for each element considered under Cumulative Watershed Effects, is shown in the summary table under "Environmental Consequences – Cumulative Watershed Effects". Generally, West Fork Silver Creek was rated as having high subwatershed sensitivity when compared to the other subwatersheds analyzed. It was rated as high sensitivity with respect to mass wasting, rain-on-snow, and drainage density. The roads category, canopy, large wood frequency and fish passage were rated as functioning at risk. Soil condition, bank stability and pool frequency were rated as functioning appropriately. Temperature and sediment were rated as functioning at unacceptable risk.

Past Activities

- Fuels reduction: Under-burning: 1985-1989: 330 acres, 1995-1999: 5000 acres. Pretreatment 1990-1994: 100 acres, 2000-2002: 950 acres. Pile burning: 1990-1994: 420 piles, 1995-1999: 60 piles. Post harvest burning 1990-1994: 240 acres, 1995-1999: 40 acres. Crushing 230 acres 1995-1999. *Underburning and pile burning is typically at low severity and had little impact on the subwatershed. Crushing may increase compaction but most likely had little impact on the subwatershed.*
- Silvicultural activities within the subwatershed have included timber stand improvement or the thinning of sub-merchantable trees and merchantable harvest of timber. Timber stand improvement within this subwatershed occurred on 4,241 acres. Timber harvest activities on forest service land have focused on modifying structure and composition of stand while generating merchantable products. This subwatershed has seen 4,281 acres of harvest varying from intermediate, regeneration of both even aged and uneven aged, and salvage harvest. *Past timber harvest activities have been the main reason for high road densities within the subwatershed and the problems associated with high road densities. Timber harvest can also caused compaction and other detrimental soil conditions, expose areas to increased surface erosion, and may modify streamflow regimes. General watershed effects of timber removal on watersheds are well documented (Meehan, 1991, Troendle and Leaf, 1981) though no specific studies have been completed on the Fremont National Forest .*
- Personal use firewood: Approximately 300 personal use firewood permits sold at district with 2.5% occurring in this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*
- Grazing has occurred in the Yamsay Mountain allotment on the subwatershed as early as 1944 with sheep then transitioned to cattle in 1946. Numbers of animals have drastically reduced from 1000 in 1944, 172 cattle in 1946, 323 cattle in 1961, 100 cattle in 1967, 200 cattle in 1979 on a rest/rotation, not used in 1992 through 1999, 50-100 short duration cattle from 2000 to 2002. Use on the Silver Bridge Allotment was prior to early 1980 to 2003 with 232 AUMS. Upper Bridge Allotment from early 1980 to 2003 has 108 AUMS. *Clearly the use in the past has been heavy, but current management of livestock has limited their impacts on the subwatershed.*
- Powerline and communications facilities consist of 5 miles of Midstate Electric powerline. *No known problems with these facilities exist with respect to soil and water.*
- Recreational trail and dispersed recreational sites. *Activities associated with the trail and recreational areas at isolated or concentrated locations near streams may cause limited resource damage in the form of compaction or trampling.*
- Silver Creek Marsh Campground. Associated paved surfaces limit infiltration and increase running timing minimally. *Compacted areas around campsites and facilities limit infiltration and may increase ponding.*
- Two water impoundments. *Concentrated use by vehicles, livestock and wildlife around pond may cause compaction problems and associated water ponding on the surface.*

- Three diversions divert 1, 3 and 525 cfs. The diversion dam may or may not provide for fish movement through the infrastructure. *Ponding of water exposes more surface area to radiant heat and causes increases in water temperature.*
- Non-industrial private land has partially harvested a limited number of ponderosa pine. *Little impact on soil and water has occurred as a result of this activity.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. *The hand pulling of weeds would cause no detectable impact to soil and water. There are no knows problems associated with this activity.*
- Past fire activity shows there have been 78 fires since 1948, of which 97% of the acres burned were caused by lightning and the largest fire was 1,440 acres. *The intense fire suppression has resulted in more dense stands throughout the area and may help lead to more intense fires that would have historically occurred.*
- 2002 Fire Suppression. 24 miles of dozer line and 1 mile of hand line were constructed within the subwatershed and trees were fallen for safety or suppression objectives. *The additional compacted surface of dozer lines add to the road density and sedimentation problems associated with roads/trails. It is assumed that dozer lines were rehabilitated with waterbars and drainage according to BMPs and have reduced sediment production to background levels.*
- Aspen enhancement. 10 acres in 2000. *The enhancement of riparian vegetation, particularly where conifer encroachment occurs has a positive effect on the subwatershed.*
- Juniper thinning. 150 acres in 2000. *The thinning of this aggressive species that has well surpassed historic stocking has a positive effect on the subwatershed.*
- BAER projects. Drainage ditches were cleaned throughout subwatershed. *This activity facilitated proper movement of moisture off of roads. A relief culvert at Road 2700000 was installed to facilitate expected high water and increased debris after the burn. Log erosion barriers were placed within the subwatershed to capture sediment coming off areas that burned particularly hot.*
- Industrial forest lands. Throughout the analysis area have logged extensively throughout the 20th century. By 2000, almost all stands were logged at least once. *The extensive use on private lands has increased ground disturbance and increased erosion.*

Toolbox Fire Recovery Project Activities (on a subwatershed basis)

Direct and indirect effects *on a project area basis* were discussed early in the Watershed section. This section concerns itself with how those direct and indirect effects apply to a cumulative effects finding, on a *subwatershed* basis.

The elements discussed under direct and indirect effects as they pertain to the West Fork Silver Creek subwatershed are found below.

Table 3-XX. West Fork Silver Creek Direct and Indirect Effects by Alternative

WEST FORK SILVER CREEK	ALT. A	ALT. C	ALT. D	ALT. E	ALT. G	ALT. H
TOTAL COMMERCIAL SALVAGE (acres)	0	2,615	1,430	2,107	2,604	2,448
GROUND BASED COMMERCIAL SALVAGE (acres)	0	2,585	1,430	2,107	2,584	2,448
AERIAL COMMERCIAL SALVAGE (acres)	0	30	0	0	21	0
PERCENT OF SUBWATERSHED AREA SALVAGE	0%	11%	6%	9%	11%	10%
TOTAL RHCA COMMERCIAL SALVAGE (acres)	0	89	30	69	78	30
RHCA 1 (acres)	0	23	12	13	12	12
RHCA 3 (acres)	0	58	18	49	58	18
RHCA 4 (acres)	0	8	0	8	8	0
TEMPORARY ROADS (mi)	0	2.68	0	2.58	2.68	2.03
RE-OPEN UNCLASSIFIED ROADS (mi)	0	9.17	1.97	6.69	9.17	9.04
PRESCRIBED FIRE (acres)	0	0	0	0	0	0
ROADS						
OPEN ROAD DENSITY (mi/mi^2)	3.43	2.74	2.74	3.02	3.02	2.74
CLOSE ROADS (mi)	0.0	13.3	13.3	13.2	3.0	13.3
DECOMMISSION ROADS (mi)	0.0	12.4	12.4	2.3	12.4	12.4
OPEN ROADS (mi)	128.7	102.9	102.9	113.3	113.3	102.9
SEDIMENT SAVINGS FROM ROAD ACTIONS (tons/yr)	0.00	0.11	0.11	0.09	0.09	0.11
SEDIMENT LOSS FROM OPEN ROADS (tons/yr)	0.79	0.68	0.68	0.70	0.69	0.68
OPEN ROADS within 300 ft of STREAM (mi)	6.3	2.9	2.9	3.1	3.1	2.9
CLOSE ROADS within 300 ft of STREAM (mi)	0.0	1.4	1.4	1.8	1.2	1.4
DECOMISSION ROADS within 300 ft of STREAM (mi)	0.0	2.0	2.0	1.46	2.0	2.0

Present and Future Activities

- Grazing in the Yamsay Mountain Allotment is currently at 100 cattle early deferred from July 16 to August 31 and planning under NEPA is scheduled for 2007. Foster Butter Allotment is expected to have a NEPA decision before 2004 grazing season. Current use is based on 2003 monitoring and NEPA decision. Silver Bridge-BLM-Allotment has 262 AUMS on rest rotation with riparian pasture. Upper Bridge-BLM-Allotment has 108 AUMS on rest rotation from early March to early October. Recently burned areas compared to unburned areas produce more aboveground biomass (Tracy and McNaughton, 1996). This in concert with the active control of livestock in burned areas to keep cattle off of riparian area should be effective. *The NEPA analysis or Rangeland Health Assessments (BLM) will allow for thorough review of the grazing within this allotment.*
- Personal use firewood: In 2002, an estimated 981 cords were removed from this subwatershed. *Little cutting occurs within RHCAs and there are no known problem areas associated with this activity.*
- Some removal of timber from private non-industrial forest lands. *This is a small portion of the subwatershed and should have little impact on soil and water within the subwatershed.*
- Any noxious weed treatment in the subwatershed has followed BMP for application of chemical agents near stream channels. *The hand pulling of weeds would cause no detectable impact to soil and water. There are no knows problems associated with this activity.*
- Juniper treatment-BLM. 1000 acres. *The thinning of this aggressive species that has well surpassed historic stocking has a positive effect on the subwatershed.*
- West Fork Silver Creek Watershed Restoration/Enhancement Project: These treatments include reintroduction of fire where fire historically played a role, commercial and pre-commercial thinnings, aspen enhancements, and large woody debris additions to West Fork Silver Creek, riparian vegetation enhancement, various aspen treatments, and beaver reintroductions. *Any sediment input to these streams because of this project is predicted to have an insignificant effect on redband trout because of the minimal quantities and low risk of entering fish habitat because of riparian buffers, mitigation measures, and Forest BMP's. This project would have beneficial impacts on the subwatershed.*

Cumulative Watershed Effects

See also "Summary Table – West Fork Silver Creek Subwatershed Cumulative Watershed Effects" that follows discussion.

Alternative A

The number of roads that remain open under this alternative and the number of open roads within 300 feet of stream channels are of concern. The road density under this alternative is the fifth highest of the eight subwatersheds analyzed. No ground disturbing activity as a result of salvage harvest and fuels reduction would occur under this alternative. However, the number of miles of road would allow a chronic sediment source and allow for a maximum increase in the drainage network to continue. The calculation of sediment loss from roads equates to 0.07 pound of sediment per acre within this subwatershed.

Action Alternatives

Approximately 40% of the subwatershed burned in 2002 and activity on only 40% of the subwatershed is within the analysis area. The salvage harvest and associated fuels reduction accounts for activity on 6% to 11% of the subwatershed area. The minor amount of sediment associated with the harvest and the very limited amount of the subwatershed affected by the harvest should have little impact on the subwatershed. There is no prescribed burn planned for this subwatershed. The temporary and unclassified roads would temporarily increase the miles of road by 9.2% for Alternatives C and G, by 8.6% for Alternative H, by 7.2% for Alternative E and by 1.5% for Alternative D. The increase in road miles would be short term and proper decommissioning of the roads would occur after the activity is complete. The unclassified road density would decrease from 0.93 mi/mi^2 to 0.64 mi/mi^2, 0.85 mi/mi^2, 0.71 mi/mi^2, 0.64 mi/mi^2 and 0.66 mi/mi^2. Sedimentation from salvage harvest is expected to be similar and minor for all action alternatives.

Only 40% of the subwatershed is located inside of the analysis area, however the roads management activities within the subwatershed are significant. Approximately 13.3 miles of road would be closed and 12.4 miles of road would be decommissioned under Alternatives C, D and H. Alternative E would close 13.2 miles of road and decommission 2.3 miles of road. Under Alternative G 3.0 miles would be closed and 12.4 miles would be decommissioned. The reduction in road density is approximately 20% in Alternatives C, D and H compared to the original road density. The reduction in road density compared to the original for Alternative E and G is 11%. The closure and decommissioning of between 3.2 and 3.4

miles of road within 300 feet of intermittent and perennial streams would be an improvement to the health of the subwatershed under all alternatives. The sediment savings from road actions is generally the same in all alternatives as is the sediment loss from roads within this subwatershed. The road density would remain high for the subwatershed under all alternatives. Alternatives C, D and H are the most aggressive with respect to road activity and would result in the most benefit of the action alternatives.

Temperature characteristics in the streams of the subwatershed, including those currently on the 303(d) list, are not expected to change as a result of any of the action alternatives.

Aspen enhancement, large wood placement and deciduous planting in perennial riparian areas would be implemented in Alternatives C, D, G and H. The enhancement of riparian vegetation, particularly where conifer encroachment occurs, has a positive effect on the subwatershed. Large wood placement would take place within the subwatershed and provide for hiding cover and stream variability that would enhance fish habitat. Deciduous planting in riparian areas of the perennial stream in the subwatershed would occur in areas that burned particularly hot.

The subwatershed sensitivity was high. Temperature and fine sediment were rated as functioning at unacceptable risk. It is understood that all alternatives would generate minor amounts of sediment from salvage harvest and fuel reduction. The sediment in the streams and stream temperature should not increase as a result of the action alternatives. This is less likely to occur in alternatives with fewer acres in RHCA harvest. Therefore, Alternative C, G and E are rated as high for cumulative watershed effects. Alternative D and H are rated moderate for cumulative watershed affects. In addition, the recovery on private land salvage harvest, the effective rehabilitation of the suppression activities, monitoring and management of livestock use and allotment condition should not adversely affect the subwatershed.

Table 3.xx Summary Table – West Fork Silver Creek Subwatershed Cumulative Watershed Effects

	NAME - HUC								
WATERSHED	SILVER CREEK - 1712000502								
SUBWATERSHED	**WEST FORK SILVER CREEK** - 171200050207								
	LOW		MODERATE			HIGH			
SUBWATERSHED SENSITIVITY						X			
Characteristic(s) rated HIGH	Mass wasting, rain on snow, drainage density								
	CURRENT CONDITION - FUNCTIONALITY			**Alt A**	**Alt C**	**Alt D**	**Alt E**	**Alt G**	**Alt H**
ELEMENTS	FUNCTIONING APPROPRIATELY	FUNCTIONING AT RISK	FUNCTIONING AT UNACCEPTABLE RISK	RESTORE (**R**), MAINTAIN (**M**) or DEGRADE (**D**). Improvement as a result of the project? – **Yes** or **No**					
UPLANDS									
Roads			**X**	**D**	**R - Yes**	**R - Yes**	**M - Yes**	**M - Yes**	**R - Yes**
Canopy			**X**	**M**	**M**	**M**	**M**	**M**	**M**
Soil	**X**			**M**	**M**	**M**	**M**	**M**	**M**
RIPARIAN VEGETATION / BANK STABILITY	**X**			**M**	**M**	**M**	**M**	**M**	**M**
CHANNEL CONDITIONS									
Pool frequency	**X**			**M**	**M**	**M**	**M**	**M**	**M**
Large wood frequency	**X**			**M - No**	**R - Yes**	**R - Yes**	**M – No**	**R - Yes**	**R - Yes**
Temperature			**X**	**M**	**M**	**M**	**M**	**M**	**M**
Fine sediment	NOT AVAILABLE								
Fish passage		**X**		**M**	**M**	**M**	**M**	**M**	**M**

Cumulative Effects-Fisheries

Alternative A

Minor short-term changes in aquatic habitat of redband trout would be expected with the implementation of Alternative A. Short-term changes include: increased fine sediment from existing roads and to a lesser extent from hill slopes burned in the fire, any large wood in RHCAs that was cut down during suppression efforts are aiding in pool formation and providing cover for redband trout, and late summer stream temperatures may slightly increase due to reduced overstory canopy. In the long-term, numerous snags greater than 12 inches dbh would be recruited to stream channels. Increased large woody debris would substantially increase both the quantity and quality of pool habitat in perennial fish bearing streams.

Fine sediment would continue to be a problem due to extensive road systems. Other potential sediment sources that could combine with these inputs in these streams during the 2003-2006 period include, natural sediment increases caused by the 2002 fire, road maintenance activities within RHCAs, private salvage sales, sediment producing activities on private land, primarily grazing and roads, sediment produced by 2002 fire suppression and future fire suppression activities.

Alternatives C and E

In Silver Creek, West Fork Silver Creek, North Fork Silver Creek and Guyer Creek, fine sediments in spawning substrates are high as a result of past and ongoing activities. These alternatives include a variety of activities that are expected to affect sediment levels in either the short-term or the long-term, including salvage harvest activities, reforestation, road management (especially decommissioning) and instream placement of large wood. Alternative C includes substantially more road decommissioning that Alternative E, while Alternative E has less commercial salvage in RHCAs than does Alternative C.

The short-term sediment inputs produced by Alternatives C and E, although not considered to be significant, are likely to combine with these pre-existing sediment sources to produce short-term impacts on redband trout spawning and rearing habitat in all streams. Based on the tons per year estimates, cumulative effects of sedimentation may cause short-term reductions in pool volumes, reduced quality of spawning areas, and sedimentation of shallow margin areas used for rearing. The Biological Evaluation concludes that this activity may impact individuals or habitat, but would not likely contribute to a trend toward federal listing or loss of viability to the population or species. Alternative C, with RHCA harvest along fish bearing streams, has the potential for increased short-term sedimentation into redband trout habitat. The road management activities included in Alternative C (and the other action alternative) and the natural riparian vegetative recovery that will have occurred by 2004 are the primary factors that should contribute to a long-term reduction in sedimentation into redband trout habitat.

The cumulative effect of Alternatives C and E on water temperatures in Silver, West Fork Silver, North Fork Silver, and Guyer Creeks would be insignificant because these alternatives are unlikely to increase water temperature to a measurable degree. The only event that would potentially increase water temperatures is the loss of riparian vegetation and overstory conifers because of the fire.

Alternatives C and E would not affect large woody debris recruitment. In-channel habitat conditions within all potentially affected stream reaches will see improvements in large wood, number of pools and number of deep pools. In headwater areas above the fire instream habitat is expected to remain static or improve over time.

Alternatives D, G and H

In Silver Creek, West Fork Silver Creek, North Fork Silver Creek and Guyer Creek, fine sediments in spawning substrates are high as a result of past and ongoing activities. These alternatives include a variety of activities that are expected to affect sediment levels in either the short-term or the long-term, including salvage harvest activities, reforestation, road management (especially decommissioning), instream placement of large wood.

The short-term sediment inputs produced by Alternatives D, G, and H (which include no harvest within the RHCAs of fish-bearing streams, other than roadside hazard corridors) although not considered to be significant, are likely to combine with these pre-existing sediment sources to produce short-term impacts on redband trout spawning and rearing habitat in all streams. Based on the tons per year estimates, cumulative effects of sedimentation may cause short-term reductions in pool volumes, reduced quality of spawning areas, and sedimentation of shallow margin areas used for rearing. The Biological Evaluation concludes that this activity may impact individuals or habitat, but would not likely contribute to a trend toward

federal listing or loss of viability to the population or species. Alternative C, with RHCA harvest along fish bearing streams, has the potential for increased short-term sedimentation into redband trout habitat. The road management activities included the action alternatives and the natural riparian vegetative recovery that will have occurred by 2004 are the primary factors that should contribute to a long-term reduction in sedimentation into redband trout habitat.

The cumulative effect of Alternatives D, G, and H on water temperatures in Silver, West Fork Silver, North Fork Silver, and Guyer Creeks would be insignificant because these alternatives are unlikely to increase water temperature to a measurable degree. The only event that would potentially increase water temperatures is the loss of riparian vegetation and overstory conifers because of the fire.

Alternatives D, G, and H would not affect large woody debris recruitment. In-channel habitat conditions within all potentially affected stream reaches will see improvements in large wood, number of pools and number of deep pools. In headwater areas above the fire instream habitat is expected to remain static or improve over time.

Forest Plan Consistency

Watershed and Roads

The following bold statements are taken from the Fremont National Forest Land and Resource Management Plan (LRMP, 1989.

Maintain or improve soil productivity (p. 80) and keep soil erosion levels within tolerable limits (p. 83). Due to the limited amount of expected erosion production from the salvage harvest in all alternatives, all alternatives are consistent with the Forest Plan. The action alternatives would reduce long-term sedimentation from the currently extensive road system. Alternatives A and E would not introduce the short-term sedimentation expected from instream projects that Alternative C, D, G and H would introduce. However, Alternatives A and E would not allow for the expected long-term benefits from instream projects.

Monitor results and impacts of land management activities on soil productivity (p. 83). Monitoring plans are shown in Appendix D. A strong focus will be on soil response to land management activities.

Protect water quality through implementation and enforcement, monitoring and evaluation, and modification of best management practices (BMPs) (p. 88). BMPs, found in Appendix C, will be followed for the land management activities discussed in this document.

Assess the cumulative effects of activities on water quality or stream channels (p. 86). The cumulative effects of the activities were analyzed in this document on a subwatershed (sixth field HUC) basis and no subwatershed has more than 11% of its entire area being treated by commercial salvage under any action alternative.

Overall density for roaded area of the Forest will not exceed 2.5 miles per square mile (p. 116). Within the project area road densities are reduced in all action alternatives. Alternatives C, D and H would a resultant open road density of 1.76 mi/mi^2, 1.68 mi/mi^2 and 1.72 mi/mi^2, respectively. Alternative E and G both result in a road density of 2.57 mi/mi^2, which is a reduction from the current road density of 3.68 mi/mi^2.

All system roads will be operated and maintained to protect the resources, perpetuate the intended road management objective, and promote safety (p. 116). BMPs will be followed for all land management activities. Improvements to drainage (drainage improvement at 2917413 under Alternatives C, D, G, and H) and to several road segments would benefit and further protect resources. Roadside hazard corridors would be treated in all action alternatives to promote safe travel through the forest.

Prescribed fire will be considered for use in meeting management objectives in areas where ecological studies show that fire has played a significant role in ecosystem development (p. 118). Prescribed fire is proposed in Alternatives C, D, G, and H and not proposed in Alternative E.

Applicable state and federal water quality standards will be met. Currently water quality is being monitored and water quality is not expected to degrade as a result of this project. Alternatives C, D, G, and H include riparian restoration projects proposed that would enhance water quality within several reaches of streams within this project.

In cases of irresolvable conflict, soil, fish, water, and wildlife (in MA 15) will receive preferential consideration. At this point, an irresolvable conflict does not exist with regard to this project.

Watershed, wildlife, and fisheries habitat rehabilitation and improvements will be required to meet goals for aquatic/riparian systems. Soil and riparian protection/restoration project are proposed for Alternative C, D, G, and H and not proposed for Alternative E.

Consider soil impacts when planning all ground-disturbing management activities, implement sound soil conservation and management practices, monitor impacts of those practices, and maintain the productive potential of the lands (Soil Productivity Guide, Fremont National Forest, 2000). Soil impacts were considered during project planning, with findings disclosed both in this section and in the Geology, Geomorphology and Soils section. BMPs will be followed, and monitoring of land management activities would take place under all action alternatives.

All alternatives are compliant with LRMP standards and guidelines relating to watershed. No Forest Plan amendment would be required to implement any of the action alternatives.

Fisheries

All of the alternatives were found to be consistent with the applicable Forest-wide fisheries and watershed standards addressed in the Regulatory Framework section. None of the alternatives would hinder the attainment of INFISH Riparian Management Objectives (RMOs) for pool frequency, large woody debris, water temperature, and width to depth ratio, or cause significant harm to native fish and their habitats in the long-term. The short-term effects on pool volume from sediment increases that is expected with the action alternatives would not be significant enough to produce a non-attainment of the pool frequency RMO. In the long-term, the pool frequency RMO would be maintained or improved as natural riparian vegetative recovery occurs and project related sediment gets transported out of the affected pools and larger scale sediment reductions occur from improvements to the road network. The large woody debris RMO would be maintained or improved in all streams with improvements occurring in Silver Creek and West Fork Silver Creek, in all action alternatives. Natural recruitment of large woody debris would occur in all streams over the long-term. The water temperature RMO would be maintained, as measurable increases in stream temperature are unlikely to occur in any perennial stream. The width-to-depth ratio RMO would be maintained because the short-term sediment and peak/base flow increases would not occur on a large enough scale to cause significant channel widening. Several of the RMOs are currently below objective (large woody debris, water temperature, and large pools). Improvement in road drainage within the fire perimeter, as included in all action alternatives, would reduce sediment inputs to stream channels. Large wood within the burn area would increase as trees die and are recruited to the stream channel and/or placed in the channel as part of the aquatic habitat restoration that is included in all action alternatives. Increased large woody debris would provide instream structure to aid in pool formation and complexity. Plantings of deciduous tree species within affected riparian areas will improve water temperatures over the long-term.

Determination of Effects on Sensitive Species

The proposed project **may impact individual redband trout or habitat, but will not likely contribute to a trend toward federal listing or reduced viability for the population or species** (MIIH) for all alternatives (see following table). Redband trout populations in some or all potentially affected stream channels are limited as a result of high levels of fine sediment in spawning gravels, a lack of high quality pool habitat, lack of large woody debris, and water temperatures that may exceed State of Oregon water quality standards. Mitigations identified in this report, reconstruction and or elimination of problem roads or road segments, establishment of adequate RHCA's, close adherence to the Forest Soil Productivity standards, timber sale BMP's, and road BMP's will minimize any potential effects. Implementation of the watershed restoration activities proposed in all action alternatives will help to accelerate recovery of occupied redband trout habitat. At a watershed scale, upgrading of existing roads, decommissioning of unneeded roads, strict adherence to grazing standards and guidelines, and improvements in upland vegetation (a progression towards the Historic Range of Variability) should be considered to improve and/or re-establish functional watershed processes.

Although the redband trout present in the affected sub-watersheds has specific habitat requirements, it is assumed that trending toward the natural or near-natural habitat conditions described by ICBEMP (USDA & USDI 1997), will lead to

properly functioning streams and desired future conditions. A positive trending towards these conditions will ensure species viability and sustainability.

Table 3.xx. Sensitive Species Biological Evaluation Summary for the Toolbox Fire Recover Project

Species	Alt. A	Alt. C	Alt. D	Alt. E	Alt. G	Alt. H
Redband Trout	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH

This Toolbox Fire Recovery Project specialist report was prepared during March, April, and May of 2003. It will be used, along with specialist reports from multiple resource areas, to prepare a Draft Environmental Impact Statement (DEIS) for the Toolbox Fire Recovery project. This specialist report will become a part of the planning record for the project, filed under:

"Toolbx/ Planning Record/ E_Specialists_reports_data_inventory_and_collection"

This report will be filed both in the 'hard-copy' planning record binders, on file at the Silver Lake Ranger District, and on the Fremont National Forest "K-Drive". In the interest of planning process efficiency, particularly in light of time and budget constraints, editing that occurs to the content of this report during the preparation of the DEIS will be reflected in the DEIS and will not necessarily be entered back into the content of this report. To insure the accuracy of such edits, I will review the content of both the DEIS and the (Final) FEIS and certify that their content is consistent with the analytical conclusions in this report. If during DEIS or FEIS editing, substantially different conclusions or interpretations are reached or substantial additional analysis is prepared from that displayed in this report, an addendum to this report will be prepared.

Specialist: /S/ Michele L. Reba Discipline: Hydrology Date: May 12, 2003