FISHERIES

INTRODUCTION

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 conditions 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.

REGULATORY FRAMEWORK

Forest-wide fisheries standards that apply to the project are contained within two documents:

- The Fremont National Forest Land and Resource Management Plan (LRMP) (USDA Forest Service, 1989)
- The Inland Native Fish Strategy (USDA Forest Service, 1995: A-6 to A-13)

The Inland Native Fish Strategy (INFISH) amended the Fremont LRMP in 1995. The INFISH amendment to the LRMP established additional forest-wide fisheries standards. These standards are listed on pages A-6 to A-13 of the INFISH Decision Notice. A copy of the INFISH Decision Notice is available in the Project File.

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),

Fourteen Forest-wide fisheries 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. Refer to pages A-6 to A-13 in the INFISH Decision Notice for the description of the standards.

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. The Fremont-Winema National Forests lies within the geographic range covered by this strategy.

INFISH was not designed to be a landscape scale, long-term conservation strategy. It 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 focuses on riparian areas and does not regulate most activities that occur outside of riparian areas.

INFISH establishes buffers called Riparian Habitat Conservation Areas (RHCAs) around all streams, wetlands, water bodies, and landslide prone areas on the Fremont-Winema National Forests (Table xx). (USDA Forest Service, 1995: A-4 to A-6).

Table xx. RHCA Buffer Widths per Stream Side by Alternative.

Type of RHCA	Alt. C	Alt. D	Alt. E	Alt. G	Alt. H
Category 1 - Fish bearing stream reaches	200’	300’	200’	300’	300’
Category 2 - Perennial, non-fish bearing streams	Not found in project area				
Category 3 - Ponds, lakes, wetlands, >1 acre	75’	150’	75’	75’	150’
Category 4 - Seasonally flowing/ intermittent stream reaches	50’	50’	50’	50’	50’

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.

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 is designed to replace existing management plans such as PACFISH, INFISH and the Eastside Screens.

The theme of ICBEMP focuses 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. An emphasis on conducting analyses, such as Subbasin Review and Ecosystem Analysis at the Watershed Scale prior to conducting management activities is intended to minimize short-term risk from management activities in areas where short-term risks are of most concern and to ensure actions occur in the most appropriate locations in the most appropriate sequence.

Restoration activities are planned and conducted across the project area to effectively and efficiently address the long-term risks associated with disturbance events. Restoration in certain areas is prioritized based on: areas that have high risk to terrestrial or aquatic habitats of unnaturally severe disturbance and high or moderate opportunity to address those risks (for example through the ability to connect and expand scarce aquatic and terrestrial habitats).

In addition to promoting the broad-scale restoration and maintenance of ecosystems, conservative direction is also provided to further promote the protection of specific subwatersheds containing important fish populations and specific watersheds containing important terrestrial source habitats. These are the habitats that have declined the most (in geographic extent) from historical to current periods, and therefore, they are in short supply. Management is designed to conserve these habitats by avoiding short-term risks t them, while expanding theme elsewhere through restoration activities.

The aquatic/riparian/hydrologic component of the integrated ecosystem management strategy was developed to maintain and restore the health of watersheds and aquatic ecosystems on Forest Service and BLM administered lands. It focuses on maintaining and restoring watershed conditions, water quality, and aquatic and riparian habitat by replacing interim strategies (PACFISH and INFISH), and addressing long-term aquatic species viability, recovery of listed species, short- and long-term risks to these resources from management activities, and long-term risks from uncharacteristically severe natural disturbances. Geographically specific areas, such as riparian conservation areas (RCAs), aquatic A1 subwatersheds, and aquatic A2 subwatersheds, are important components of the aquatic strategy.

RCAs, A1 subwatersheds, and A2 subwatersheds were identified because of their importance to fish, riparian-dependent species, water quality, and other aquatic, riparian, or hydrologic resources. The management intent in these areas is to protect these resources in the short-term and improve them in the long-term. Protection and enhancement of these areas is

intended to contribute to a network of connected aquatic/riparian habitats and enhance the long-term persistence of aquatic and riparian-dependent speicies.

A decision by the current administration to complete and implement this project has not been made however, the science that was used to develop 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 environmental 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.

However, interior redband trout are a sensitive species on the Regional Foresters Sensitive Animal list (November 28, 2000). A fisheries 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

The Toolbox Fire Recovery Project consists of two fire areas, Toolbox and Silver. The fisheries analysis will focus on the Silver Fire portion of the project area. This area contains the four fish bearing streams in the Toolbox Fire Recovery project area. These streams are Silver Creek, West Fork Silver Creek, North Fork Silver Creek, and Guyer Creek. In addition, an analysis on stream channel characteristics of significant intermittent streams in both fire areas has been done. These streams include: Strawberry Creek, Indian Creek, Benny Creek, Hawk Creek, Graham Creek, Duncan Creek, East Duncan Creek, McCall Creek, and Willow Creek. There are no fish bearing streams within the Toolbox fire area. Streams within the Toolbox fire area 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.

ANALYSIS METHODS

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 methods were used to assess current conditions:

- Identification of the dominant vegetation types within the riparian area of each measured reach were documented.
- Available shade was measured in each reach using a solar pathfinder.
- The associated bank stability was described and measured. Actively eroding banks, above the bankfull height, were counted as unstable.
- Large woody debris was counted and grouped into three size categories as identified in the Region 6 stream survey protocol.
- Pools were counted and measured as part of the stream surveys.
- Substrate composition was measured using the Wolman Pebble Count method.

- Stream channel characteristics such as gradient, wetted width, bankful width, bankful depth, floodprone width were measured which aides in the delineation of Rosgen Channel Types.

Post-fire data collection on fish bearing streams 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). The Ochoco Bottom Line survey measures percent shade, length of cutbank, which can be translated into percent bank stability, and large woody debris. In addition, measurements were made to determine Rosgen Channel types and the number of potential pools.

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
- Pools
- Spawning Gravel Fines/Substrate Composition
- Rosgen Channel Type
- Stream Temperature and Shade

Stream channel condition assessments for intermittent streams focused on the data collected as part of the Ochoco Bottom Line surveys. The primary parameters collected for evaluation include large woody debris, shade, and the length of actively eroding streambanks. Additional data collected on intermittent streams included gradient, substrate composition, bankfull width, bankfull depth, and floodprone width. These additional parameters for stream channel characteristics aides in the delineation and determination of Rosgen channel types.

Each of the alternatives have been analyzed for its potential to influence these key habitat characteristics. A short description of these key habitat characteristics follows:

1) *Riparian vegetation and bank stability*: 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.

Water which escapes interception and use from trees, shrubs, and grasses becomes surface or subsurface flow, eventually making its way through the soil to narrow strips of land called riparian areas along creeks and rivers and other bodies of water. Riparian areas occupy a small percentage of the watershed, about 5%, 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. Because of their close proximity to water, plant species within riparian zones differ significantly from those of adjacent uplands. Found in riparian areas within the watersheds 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*). These riparian plants play a significant role in retaining water received from the uplands. The stems of these plants provide roughness and resistance to dissipate floodwater energy and act as a filter to trap sediment transported by the stream and to the stream (the sediment that is captured provides microsites for the germination and establishment of new plants within riparian areas). The strong root systems of these plants also provide resistance to a stream's erosive power, holding the soil mantle together, which minimizes stream bank erosion. 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 increased subsurface flow, resulting from water storage in the riparian area, may be greater than the amount of water used by willow, cottonwood, alder, sedge, and rush (Elmore and Beschta 1987). In addition, low-gradient

areas with willow attract beaver, resulting in impoundments that expand riparian zones and hold water, further ensuring stream flow during summer months (Olson and Hubert 1994). Conifer species such as ponderosa pine, white fir, and lodgepole pine also occur along the edges of the riparian areas and within active floodplains.

2) *Large woody debris*: 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.

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 in the relatively long stretches between debris steps and increases where water falls over the logs. A straight stream will be converted into a more sinuous or meandering stream with the LWD (Swanson 1991). These alterations in flow patterns may either protect or erode banks, but in general, this energy distribution reduces the streams ability to erode banks and enhances sediment storage (Zimmerman et al. 1967). Wood also serves as an important agent in pool formation. For instance, in southeast Alaska streams, LWD accounted for up to 75% of all pools (Robison and Beschta 1990). The resulting effect on fish habitat is significant. Large wood, in the low energy segments; traps organic matter such as leaves, which remains in the stream longer, providing food for aquatic organisms (Speaker et al. 1984). Reeves et al. (1991) notes that low velocity areas required by fish--during floods--increase with additional LWD. Bjornn and Reiser (1991) cited several studies that documented an increase in fish densities with higher levels of LWD. It should be noted that the role of LWD decreases as streams become larger, because greater currents will carry the wood out of the active channel and onto the banks (Murphy and Meehan 1991).

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 is determined using the table below, and the formula for 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 and 45 pieces at the 75th percentile. Values less than the 50th percentile are rated as functioning inappropriately, values between the 50th and 75th percentiles are rated as functioning appropriately but at risk, and values above the 75th percentile are rated as functioning appropriately.

Table xx. Natural or Near Natural Frequency of LWD in Northern Great Basin Streams (USDA & USDI 1997).

	Large Woody Debris/Mile	
Slope Class	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

3) *Pools (quantity/quality):* 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.

Pools are considered one of the most important fish habitat features, and for most fish, pools are the preferred habitat type (Bestcha 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. Furthermore, the majority of trout spawning occurs at pool tailouts, where spawning gravel is deposited (Bjornn and Reiser 1991, Reeves et al. 1991). In addition, pools provide rearing habitat for juvenile fish and resting habitat for adult fish (Bjornn and Reiser 1991), and refugia from drought, fire, winter icing and other disturbances (Sedell et. al. 1990). 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). When pool numbers, volume, and complexity increases, the stream's capacity to support a diversity of species and life stages/history types increases (Bisson et. al. 1992; Bjornn and Reiser 1991). Decker and Erman (1992) found that rainbow trout numbers were more abundant with an increase in pool habitat. In addition, an increase in pool numbers and complexity produces conditions for increased fish numbers and biomass (Fausch and Northcote 1992).

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). All three areas were used to simply provide a much larger sample size of streams in a natural condition. The number of large pools (those

with depths ≥2.6 feet), however, is only evaluated against the 50th and 75th percentile for natural and near natural streams in the northern Great Basin (USDA & USDI 1997). This is because large portions of the Blue and Central Idaho Mountain regions receive larger amounts of precipitation, and thus larger streamflow and runoff events (more energy to scour deeper pools).

The natural or near natural frequency is determined using the table below, and the formula for 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 14 pools/mile at the 50th percentile and 28 pools/mile of at the 75th percentile.

Table xx. Natural or Near Natural Frequency of Pools in Northern Great Basin Stream* (USDA & USDI 1997).

	Pools/Mile	
Slope Class	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

Table xx. Natural or Near Natural Frequency for Large Pools in Northern Great Basin Streams (USDA & USDI 1997).

	Pools/Mile	
Slope Class	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

4) *Substrate composition/percent fines in spawning gravel*: 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.

Willers (1991), describes the effects of spawning gravel size on egg and alevin survival (hatched fish that have not emerged from spawning gravels). In general, he states 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). Bjornn and Reiser (1991) documented rainbow trout embryo survival as it related to substrate fines <6.4 mm: 90% embryo survival with fines at 10%, 75% embryo survival with fines at 20%, and 50% embryo survival with fines at 30%. In general, habitat guidelines for incubation of salmonid embryos require less than 25% volume of fines. Sieve analysis of potential spawning substrate has been conducted forest-wide in a broad range of geologic types. 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.

5) *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.

Stream classification systems are an attempt to simplify complex relationships between streams and associated watersheds. Anderson et al. (1998) suggests that a purpose of classification systems is to describe a stream's position in the landscape and the range of variability for parameters related to channel size, shape, and pattern. Channel morphology measurements associated with a particular classification system provide a great deal of information in determining whether or not the width-to-depth ratio, sinuosity, and gradient of a stream are in balance with the landscape setting. A stream's ability to dissipate energy is closely tied to its sinuosity, width-to-depth ratio, and gradient. When one of these parameters is altered, the stream becomes out of balance in terms of the shape and size expected for its setting. For example, a decrease in sinuosity (stream length relative to valley length) results in a higher stream gradient, which in-turn increases velocities. Increased velocities lead to accelerated erosion, which may further alter channel shape and gradient.

For this analysis, 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.

6) *Water temperature*: 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.

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 (flyfishing) 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.

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.

INFORMATION COMMON TO ALL GEOGRAPHIC AREAS

EXISTING CONDITION

Effects of fire on streams/watersheds

Four fish bearing streams were significantly impacted by this fire. These streams include: Silver Creek, West Fork Silver Creek, North Fork Silver Creek, and Guyer Creek. In addition, non-fish bearing, intermittent streams were also significantly impacted within the fire boundary and include Strawberry Creek, Indian Creek, Benny Creek, Hawk Creek, Graham Creek, Duncan Creek, East Duncan Creek, McCall Creek, and Willow Creek. High burn severity was documented along 7.4 miles of fish bearing streams, moderate severity along 9.8 miles, and low severity along 5.7 miles.

The effects of wildfire on watersheds are well documented. The magnitude of the effects on the watershed is dependent on a variety of factors. These factors include fire intensity/severity; burn intensity/severity, topography, fuels, soil types, and aspect to name a few. Concern for the effects of the fire will focus on the risk of accelerated erosion from the burned slopes along Silver Creek, West Fork Silver Creek, North Fork Silver Creek, and Guyer Creek. The potential for increased inputs of fine sediment could adversely affect downstream aquatic life. The specific areas of concern lie within the Silver Fire portion of the Toolbox Complex Fire, which consists of the Toolbox and Silver fires. The combination of moderate to high

burn severity wildfire in riparian areas and subsequent loss of vegetation increases the risk that heavy precipitation or spring runoff may induce stream bank sloughing, gullying or mass movement of soil into the streams.

Wildfire can have several effects on a watershed and its ability to function properly. These effects include: alteration of soil properties which can result in the development of a water repellent or hydrophobic layer, decrease the infiltration rate of water, increase surface erosion, alter hillslope and stream hydrology, change stream channel morphology and aquatic habitat conditions, change the composition of riparian/floodplain and upland vegetation, and alter aquatic ecosystems. The degree of impact to a watersheds ability to function is dependent on these factors and local environmental conditions. Typically fire intensity, fire residence time, type of fuels, and size of the burn area determine the severity of the impacts to the watershed.

The greatest impact to a watershed from wildfire is the effect it has on soils. The loss of vegetative ground cover and soil organics leads to increased surface erosion via various avenues (splash, rill/sheet, frost heaving, etc.). Increased surface erosion removes available soil, seed banks, organics, and nutrients required by plant species that will eventually re-vegetate the area. Additionally, soil erosion can work its way into stream channels and affect fish and aquatic macroinvertebrate populations and distribution.

Although wildfire can be detrimental to a watershed, its overall impacts are generally on the positive side. The positive effects of wildfire are the removal of non-native vegetation, re-establishes different seral stages of vegetation thus creating a variety of habitats, and a reduction of fuel loads. The suppression of wildfire over the past 80 years has altered the function of ecosystems in both forested and non-forested watersheds. This has created even aged forested stands, increased the likelihood of a catastrophic fire by creating elevated fuel loads, and allowed the expansion of certain plant species (both native and non-native). The latter has probably had the greatest effect on semi-arid watersheds (hydrology and erosion) by allowing juniper expansion and loss of native grasses.

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. Additionally, the changing light levels will cause a shift in the benthic flora from diatoms and moss to green algae with occasional formations of filamentous algal mats. 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. Minshall, Brock, and Varley (1989) state that during recovery from a fire, shredder populations are expected to be almost entirely absent due to the destruction of quality leaf litter sources by the fire. They also noted that grazer density should increase after fire, following a pattern similar to that of primary production, on which they directly feed. 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 a year following a fire that aquatic macroinvertebrate diversity was reduced by 25% to 70%.

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. Permeability of spawning gravel has been related to salmonid fry survival. In addition, water flowing through salmonid redds supplies oxygen to developing embryos within the gravel. Therefore, increased fine sediment in spawning substrates can reduce streambed permeability and egg to emergence survival.

Fish populations have been found to respond in a variety of ways to the effects of large wildfires (Reiman and Clayton 1997). 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). Refugia are known to be a key component in the recovery of salmonid populations. When salmonids are severely depressed by the effects of fires, a migratory life history may aid in the recovery and persistence of a population (Reiman and Clayton 1997). Gresswell (1999) presents an overview of direct an indirect effect of fire on aquatic ecosystem processes and biological communities. 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).

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.

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.

Fish mortality resulting from delayed fire effects was observed following the Yellowstone fires in 1988. Bozek and Young (1994) observed fish kills after storm events in two streams in Yellowstone two years after the fires. High suspended sediment concentrations were the cause of mortality. Other factors that may have led to the fish mortality were high or fluctuating water temperatures that would increase the susceptibility level of fish and a reduction in dissolved oxygen.

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. Robinson and Minshall (1996) noted that burned watersheds exhibited significant changes in stream channel morphology compared to unburned watersheds. The morphological changes observed included channel widening, deepening, and lateral movement because of increased spring runoff and increased runoff from summer/fall storm events.

Interior Redband Trout

Habitat Requirements

Interior redband trout are non-anadromous rainbow trout that occur in six desert basins throughout southeast Oregon and northeast California. These basins are Malheur, Catlow Valley, Fort Rock, Chewaucan, Goose Lake, and Warner Lakes (Behnke 1992). The redband trout is a USDA Forest Service Region 6 sensitive species.

Redband trout require four basic habitat types to accommodate life history requirements: spawning, rearing, adult and overwintering (Behnke 1992). Kunkel (1976) documented that redband trout in a southeastern Oregon stream spawned in April and May, with the highest spawning intensities occurring in the first part of May. In rainbow trout, eggs typically hatch in 4 to 6 weeks and alevins take about 3 to 7 days to absorb the yolk sac before emergence. At a water temperature of 50 degrees F, eggs hatch in approximately 31 days (Leitritz and Lewis 1980). Gravels free of sediments are optimum for spawning since sediment can smother eggs by impeding the free flow of oxygenated water and can trap alevins (Willers 1991). According to Bjornn and Reiser (1991), spawning is adversely affected when substrate fines (<6.4mm) exceed 25%.

Intermittent streams are sometimes used for spawning and are effective and most productive when flow continues through emergence and downstream migration of juveniles into perennial tributaries (Behnke 1992). Within forested systems, large wood provides storage of sediment in the tributaries and contributes to the maintenance of water quality and productive fish habitat (Duncan et al. 1987) by both slowing water velocity upstream and trapping transported sediment. In low gradient systems, sediment is trapped on active floodplains during high flow events. After young trout emerge from the spawning gravel, they often rear in low velocity areas associated with stream margin habitats, high cover areas and interstitial spaces. Adults require habitat for resting and feeding and thus are generally found in areas of abundant cover associated with deep pools, large organic material, undercut stream banks and overhanging vegetation. Over-winter sites, characterized by low velocity areas with cover, including large woody debris, are important to all age classes (Bjornn and Reiser 1991). Generally, water temperatures in excess of 21°C (70°F) are unfavorable and may cause stress to all age classes (Sigler and Sigler 1991). Temperatures of about 15°C, or 58-60°F, are ideal for optimum growth of rainbow trout (Leitritz and Lewis 1980). Temperatures exceeding 29.4 degrees C (84.9 degrees F) can be fatal to rainbow trout (Bjornn and Reiser 1991). Behnke (1992) states that redband possess a hereditary basis to persist at higher water temperatures (greater than 21°C (70°F)) than other species of trout, and has captured (fly fishing) live redband in streams with temperatures of 28.3 degrees C (82.9 degrees F).

Interior Redband Trout Population Viability

Population viability addresses the continued existence of well-distributed populations or sub-populations over specific time periods (Marcot and Murphy 1996). High genetic variability will help ensure the viability of populations. Meffe (1996) states that genetic variability of a population determines its fitness or ability to respond and adapt to environmental changes, and low genetic variability may result in decreased adaptability. This variability, Meffe continues, can be maintained by managing for a hierarchy of habitat types across a geographical area and uses stream order as an example for stratification. Salmonids within first order streams may contain subtle genetic differences from fish in the second and third order streams of the watershed; however, the genetic constitution of these fish can diverge genetically from fish in other first order streams in different watersheds. Applying this concept to the Silver Creek Watershed, redband trout occupying the upper reaches of the West Fork Silver Creek sub-watershed will possess subtle genetic differences with redband trout in the upper reaches of the Guyer Creek sub-watershed. It is important to manage for a diversity of high-quality habitat types to maintain genetic diversity (Meffe 1996).

A reserve is an area of high-quality habitat, which can sustain a viable sub-population. In this document, reserves in the context of a sub-watershed will be assessed. Several principals should be considered when evaluating an individual reserve or network of reserves. First, reserves should be well distributed across the landscape; the idea being widely distributed sub-populations will not experience a catastrophe or adverse impact across its entire range. Some sub-populations will escape the impact, and eventually re-colonize the affected area, and sustain the population as a whole. Second, large reserves are better than small ones, because there is a greater opportunity for habitat diversity and larger population size. As a result, genetic variability within the subpopulation will be optimized, promoting increased adaptability to environmental change. Thirdly, reserves, which are close together, are better than those far apart. A short travel distance between reserves promotes dispersion and genetic interchange. If enough interchange occurs between reserves, fish are functionally united into a larger population that can better avoid extinction. In other words, connectivity between reserves is required. Finally, the above three principles can be achieved by managing at the landscape level, managing for watershed conditions which are within the natural range of variability (Noss et al. 1997).

Meffe's concept fits within the context of metapopulation theory. Noss et al. (1997) defines a metapopulation as a group of subpopulations, spatially distinct but connected by at least occasional dispersal. Because the Silver Creek redband trout are geographically isolated from other Great Basin populations, they are considered a metapopulation. Applying the metapopulation concept to the watershed, we will assume that each sub-watershed hosts a separate sub-population.

Specific inventories and stream surveys conducted by the Oregon Department of Fish and Wildlife in 1999 (Dambacher 1999) determined redband trout densities in the Fort Rock Basin to be 0.171 fish/m^2. Dambacher and Jones (in press) have analyzed numerous redband trout densities within the Great Basin over the past 30 years enabling them to make qualitative ranges (low, moderate, and high) for population densities. From this information, they have concluded that a low-density population of redband trout has less than 0.059 fish/m^2, a moderate-density has 0.06 to 0.19 fish/m^2, and a high-density population has more than 0.2 fish/m^2. Based on this analysis, the Fort Rock Basin redband trout population abundance estimates are considered moderate and pushing the high range as compared to other streams in the Great Basin of Oregon.

All Geographic Areas

Environmental Consequences

Direct and indirect effects

The Watershed report predicted no measurable change in stream flow resulting from the fire and subsequent salvage logging. All alternatives would remove dead and dying trees, which will have no additional effect on streamflow. Green trees within the burn will be left. Road drainage under all alternatives will be improved. BMPs will be applied to all temporary roads constructed. Road improvements will reduce hydrological effects cause by roads.

The Toolbox Fire Recovery Project Soils report determined that soils in the project area are currently below Regional standards for compaction. Minimal sediment transport from the soil profile is also predicted from the burned area and logging is not expected to significantly increase transport rates. Since sediment loss from the project area is expected to be minimal, nutrients that bind themselves to sediment (phosphorus and calcium) are apt to be minor. The major input of fine sediments to stream channels for this project will come from roads. Sediment input will vary from ___ tons per year to ___ tons per year.Significant changes in water quality due to sedimentation or nutrient loading is not expected to occur. All alternatives will have no effect on stream temperatures.

Aquatic habitat conditions within all potentially affected fish bearing stream reaches will 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. 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 will 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 will include deferment of grazing until vegetation seed-set. Close adherence to these standards is critical for improvements in upland vegetative condition. This will aide in the maintenance of stream channel conditions across the affected sub-watersheds.

Conifer planting within RHCAs associated with the Toolbox Fire Recovery Project will help to accelerate the recovery of shade producing vegetation within RHCAs. It is considered a critical component to accelerating restoration of aquatic habitat conditions within the burned area.

Cumulative effects

Common to All Alternatives

For fisheries the cumulative effects analysis area consists of Silver Creek, West Fork Silver Creek, North Fork Silver Creek and Guyer Creek. The cumulative effects analysis will also consider effects to intermittent stream channels in the project area as they relate to potential impacts to fisheries resources. The cumulative effects analysis area includes all land ownerships in the project area. The reason that these drainages were chosen for cumulative effects analysis is that portions of these watersheds burned during the 2002 Toolbox Complex Fire. Any activity in these drainages, regardless of land ownership, has the potential to cumulatively affect the fish populations and aquatic habitat in the burned drainages.

Described below are several activities and natural events within the cumulative effects analysis area that already have, or will likely occur in or near the project area in the next three years. The past activities and natural events have contributed to create the existing condition, and are incorporated into the existing condition description. These activities may produce environmental effects on aquatic resources relevant to the proposal.

In assessing cumulative effects on water quality, past and reasonably foreseeable future activities, both within the project area and within adjacent areas, including fire suppression activity are factors to be considered. Past activities in the affected sub-watersheds, including grazing, timber harvest, road construction, and recreational activities are assumed to have negatively affected erosion rates, peak and base flows, channel shape and pattern and water quality, as has been

documented in nearby watersheds (USDA 1998, USDA 1996). Erosion rates from road construction and timber harvest have likely increased over what would be predicted within an undisturbed watershed. Changes in peak flow are believed to be not measurable due to the presence of overstocked stands within the watershed that have mitigated past harvest activities. Drainage efficiency needs to be reduced through aggressive road treatments that hydrologically disconnect roads within the affected sub-watersheds. Livestock grazing at the turn of the century likely decreased or altered streamside vegetation by removing woody shrubs and channel stabilizing sedges. Because of these changes, width-to-depth ratios increased on affected stream channels compromising instream habitat conditions and increasing late summer water temperatures.

Reasonably foreseeable activities include timber harvest outside of the fire area, pre-commercial thinning of overstocked green stands within the fire perimeter, and conifer planting in burned areas to improve upland vegetation conditions in the affected sub-watersheds, road maintenance, road drainage improvements, road decommissioning, trail reconstruction, stream channel restoration, and a wide range of recreational uses. All of these activities will be designed to maintain or improve the resiliency of the watershed by improving vegetation conditions, reducing sedimentation, restoring base flows, improving in-channel habitat conditions and increasing the health and vigor of stream-side vegetation where and when possible. Improvements in watershed and stream channel conditions will increase the abundance of sensitive fish species within the affected sub-watersheds.

Sediment, by its incremental nature, usually affects aquatic habitat and fish populations in a cumulative manner. In most cases, the direct and indirect effects of sediment are impossible to clearly separate out from the cumulative effects. This is particualary true following a wildfire, when natural sediment increases are much higher for the first several years following the burn (Minshall et al. 1990). For those reasons, the direct, indirect, and cumulative effects of sediment are analyzed together in the following cumulative effects section for each of the alternatives.

A complete list of cumulative effects can be found in Appendix A of this document. This list was thoroughly reviewed and it was determined that the following activities have the potential to have an effect on fish and aquatic habitats:

Past Activities

National Forest Timber Management

The Silver and Toolbox Geographic areas have been heavily harvested and roaded over the past 50 years, on both National Forest and private lands. Aproximately 84,183 acres of timber harvest have occurred in the Silver Geographic Area while 67,404 acres of timber harvest have been implemented in the Toolbox Geographic area. 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 of timber harvest operations have been significant because riparian areas have had some harvest, the amount of road construction which has resulted in elevated sediment in spawning substrates, and fish passage barriers in the form of improperly installed culverts.

Private Timber Management

Industrial Forestland: The parcels of industrial forestland have been logged numerous times in the past. From the 1940s through 1960s, Weyerhaeuser primarily prescribed partial cutting of large ponderosa pine. In the 1970s ponderosa pine above 24 inches dbh were harvested. Most of the relatively pure ponderosa pine stands were logged resulting in a mosaic of clear cuts and partial cuts. There was an increase in reforestation by planting in this decade. In the 1980s through 1990s, the diameter limit was lowered to an average of 15 inches dbh. When market conditions were favorable to harvest white fir and lodgepole pine, those stands were also entered. By 2000, almost all commercial forest stands were logged at least once. Just prior to the fires in the summer of 2002, the Wasser and Winters Company harvested the remaining merchantable timber from their holdings near the 500 Reload. A fully stocked pole stand remained after the logging. Also, UST reentered approximately 6,000 acres of the stands that contained commercial volume.

Non-Industrial Forestland: Past logging activities on non industrial forestland were sporadic and generally involved partial harvesting of a limited number of large ponderosa pine and other trees affecting the health of the stand. No plantations resulting from clear cutting were evident prior to the fires. Approximately 59 percent is commercial forest and 41 percent is non-commercial forestland. The commercial forest areas were similar in appearance and structure as adjacent Forest Service System land managed with uneven aged silviculture systems. The non-commercial areas include meadows, lakebeds, scab flats, grassy riparian areas, and marginal timberland with widely scattered trees. Cattle grazing was the primary use of the land prior to the fires. Several homestead sites are on the private land in the fire areas.

Road and Trail Maintenance
Sediment produced by road and trail maintenance in the Silver and Toolbox Geographic areas is insignificant. Annual maintenance benefits fisheries resources and aquatic habitats by preventing larger inputs of sediment to stream channels.

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 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 in 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 streamflow 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 streamflow, with redband trout, either becoming trapped in residual pools and die or they migrate downstream to the Diversion Reservoir and overwinter 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. The Oregon Department of Fish and Wildlife discontinued stocking of streams in the Silver Lake watershed in 1998?.

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 Geographic Areas: Yamsay, Foster Butte, Winter Rim. None of these allotments have had a significant impact on fisheries resources and aquatic habitats in the burned area as a result of changes in management plans for these allotments which does not impact riparian vegetation, streambank stability, or sediment inputs to fish bearing streams.

The Yamsay Allotment: One thousand sheep grazed open season (July 1 – Sept 30) from 1944 and 1945. From 1946 through 1960, open season grazing continued with 172 head of cattle from mid May/early June – Sept 15. From 1961 through 1966, 323 head were permitted. Between 1967-1978 100 head of cattle were turned out May 21 with and off date of Sept 20. The 1979 and 1989 permits increased to 200 head of cattle. No grazing occurred 1992 through 1996. In 1994, the permit was waived back to the USFS by the permittee. From 1997 through 1999, a large portion of the allotment was closed to grazing; other parts were not used or became part of the Buck Creek Allotment. In 2000, a new permit was issued. It is for 200 head from July 16 through August 31. Completion of the Guyer Riparian fence allows this allotment 2 pasture management. One pasture will be grazed as a riparian pasture and the other will be grazed to complement it. In 2003, 100 head of cattle will graze. Management beyond 2003 will be based on monitoring and is expected to be the system with 200 head.

The Foster Butte Allotment: Sheep were primary class of livestock with conversion to cattle probably taking place by the late 1940's. Between 1966 through 1979, 1,602 head of cattle were permitted to graze from May 21 – Sept 20. A rest rotation grazing system was in place. In 1980, the Silver Creek pasture became part of the allotment, and a 6-pasture rotation system with rest, deferment and early season use, was introduced. The number of AUMs permitted was 6,807. An early season grazing system started in 1993 and continues today. Turn on/off dates vary pasture-to-pasture and year-to-year but on dates are generally late May and off dates are from late July to the first week of August. A total of 6297 AUMs are permitted. In 2003, the Hagar, Foster and Dead Indian pastures will have reduced numbers/AUMs and a shorter season in

2003. No changes will be made in other pastures. Management decisions beyond 2003 will be based on monitoring and the current Range NEPA.

Winter Rim Allotment: Between 1966 and 1980, 1500-2000 sheep grazed open season (July through Aug/Sept). No use occurred in 1978. The allotment was converted to cattle by the 1981 season. Three hundred head were permitted open season (July 1 through Sept 30). In 1990, use changed to 282 cattle using two pastures in a rotation system June 25 through Sept 24. In 2001 and 2002, 660 cattle used the allotment June 15-July 25, early season. The use in 2003 will go back to the two-pasture rotation with 282 head. Management decisions beyond 2003 will be based on monitoring and the current Range NEPA.

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) was 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 will remain relatively constant.

Bureau of Land Management
Grazing in 2003 and beyond in these allotments will continue as permitted in all but the Dead Indian-Duncan Allotment. These BLM Allotments are scheduled for Rangeland Health Assessments and any changes identified will be determined at that time.

Silver Bridge Creek 700: Prior to the early 1980's, this allotment has a rest rotation grazing system with a season of use from mid April through mid January. Two hundred and sixty-two AUMs were permitted. From the early 1980's to present, the allotment has been managed with three pastures under a rest rotation grazing system and one riparian pasture. Two hundred and sixty-two AUMs are permitted mid April through mid June.

Dead Indian/Duncan 709: Prior to the early 1980's, this allotment had a deferred grazing system with a season f use from early May through late June. Five hundred and eighty-six AUMs were permitted. The current management has changed little. Recently an increase in pastures was achieved through additional fencing. Periods of rest have been incorporated. Pastures within the sub watersheds will be rested in 2003 and 2004. Decisions on grazing beyond 2004 will be made based on monitoring of the pastures in the next couple of years.

Silver Creek 713: Prior to the early 1980's, this allotment had a spring/summer grazing system with a season of use from mid April through late May. Two hundred AUMs were permitted. Management in this allotment has not significantly changed.

Private Land fenced out of the Allotments
T30S R15E Section 28 NE1/4 (160 acres) and T30S R15E Section 33 NE1/4 and N1/2SE1/4 (240 acres)
Prior to 1985, these acres were not fenced out of the Foster Butte Allotment. From about 1985 to 1989, an average of 100 head grazed these two fenced areas May through Sept. For the past 12 years (1990 to present), both fenced areas are used by the ZX Ranch to gather straggler cattle from the Foster Butte Allotment. This use varies depending on the success of the initial gather and move off each pasture in July/August. This is how the areas are will be used in 2003 and in the future.

T29S R13E Section 36 E1/2SW1/4, NW1/4SE1/4 and SE1/4SE1/4 (200 acres)
USFS: T21S R13E Section 36 SW1/4SE1/4 (40acres) through a Special Use Permit
For the past 12 years, 200 pairs total have used these areas May thru June for approximately 2 months and in the fall for approximately 2 weeks. Use prior to this was similar with numbers varying. Both areas will be rested in 2003. Use planned for 2004 will be similar to the past 12 years.

Fire Suppression and Prescribed Fire
As evidenced by the 2002 fire, 50 plus years of successful fire suppression has allowed the watersheds in the Silver and Toolbox Geographic Areas to become more vulnerable to high severity fire as fuels continue to accumulate. This is evidenced by the high percentage of moderate and high intensity 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 Geographic areas. Approximately 20,190 acres of prescribed fire in the Silver Geographic Area has been implemented since 1985 while 4,410 acres of prescribed fire have been implemented in the Toolbox Geographic area. 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 Fire – Retardant Drops
Approximately 120,000 gallons of retardant were used during suppression of the Toolbox Complex. This would be considered a relatively small amount for a fire of this size. The primary area that received retardant was the Dead Indian Mountain communications site within the Toolbox Fire area, which occurs in the Lower Duncan Creek sub-watershed. Retardant was also used in the on Silver Fire in and around Silver Creek, West Fork Silver Creek and Thompson Reservoir. The majority of the drops were generally 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 on Silver Creek downstream from Bunyard Crossing and 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. The Silver Geographic Area had 100 miles of dozer line and 3 miles of hand line while 103 miles of dozer line were constructed in the Toolbox Geographic Area. In all but a few instances, 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 recontoured, waterbarred, and covered with slash in the fall of 2002. The majority of the dozer lines were rehabilitated with and excavator and a Forest Service resource advisor. The 3 miles of hand line had the soil raked back into the prism, were waterbarred, 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
Two relief culverts were installed on West Fork Silver Creek at the 27 Road. These culverts were installed because several areas upstream of the 27 Road experienced 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 streamflows. The sediment into West Fork Silver Creek from these installations occurred as short pulses during and immediately following the installation process. A large drainage dip was constructed at the 2914 Road crossing of Duncan Creek, an intermittent stream, to alleviate likely increased streamflows 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 on pages __ to __ in this document.

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 Geographic Areas.

Culvert Replacements and Road Decommissioning
Three culverts on fish bearing streams were replaced in order to provide fish passage. 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 Silver and Toolbox Geogrpahic areas between 1995 and 2001. Both of 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 considerd 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

The "present" is defined for the purposes of this report 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.

Industrial Forestland—UST began salvage logging operations as soon as the fires were controlled. They plan to salvage approximately 16,000 acres as long as there is a market for small timber. Apparently, the 6,000 acres harvested just before the fires had enough commercial volume to enter again during salvage operations. The diameter limit is 12 inches dbh to an 8-inch top for all species. 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. Wasser and Winters Company does not feel there is enough remaining commercial volume to conduct salvage on their lands. Wasser and Winters Company is tentatively relying on natural regeneration by lodgepole pine.

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. Approximately 8,400 acres will be planted in 2003 and the remainder will be planted in 2004. The acreages are gross figures since non-commercial land was included in the estimates.

Non-Industrial Forestland—The owners of non industrial forest land have individual goals for their properties but in general, they plan to salvage fire killed timber, trees that affect stand health, and some large green timber to make the salvage operations economical. The owners intend to plant areas that do not meet State stand density requirements. The stands will appear to be a mosaic of seedlings through large saw timber. The appearance of non-industrial forestland will be similar to most of the adjacent Forest Service System lands.

Livestock Grazing

In three pastures of the Foster Butte Allotment, numbers have been reduced and dates have been adjusted for the upcoming razing 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. Beyond this grazing season, numbers, systems and seasons of use in the Foster Butte, Sycan and Winter Rim Allotments will be looked at in the Range NEPA currently in the works. 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.

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 Geographic Areas.

Reasonably Foreseeable Future Activities

517 East Forest Recovery 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, apsen 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, apsen 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 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, apsen 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.

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. Brush and trees will close roads not continuously used or maintained for access. Grazing by cattle is likely to continue as long as plantations are not damaged sufficiently to retard tree growth and stem quality. Grazing may be curtailed in plantations until seedlings are established.

Non-Industrial Forestland—Because the holdings will contain uneven aged stands with trees that range from seedlings to large saw timber, the land owners are likely to occasionally conduct light partial harvests. Harvests are not scheduled. The entries will generally be governed by the opportunity for extra income and/or the need to reduce stocking levels of larger trees in the stands. Capturing mortality from fire, insects, or disease may also trigger harvest in the future. Areas that are planted following salvage logging will be rested until seedlings are established. Plantations may be fenced to exclude cattle while seedling establishment is taking place. In general, access will be controlled by fences and locked gates. Roads not used by the owners will close naturally by the encroachment of trees and brush.

Livestock Grazing
Beyond the 2003 grazing season, head numbers, systems and seasons of use in the Foster Butte, Sycan and Winter Rim Allotments will be looked at in the Range NEPA currently in progress. The Yamsay Mt. allotment will continue to be managed within the terms and conditions of the grazing permits currently issued. The Yamsay Mt. Allotment is scheduled to be part of NEPA analysis in 2007.

Road and Trail Maintenance
Sediment produced by road and trail maintenance in the Silver and Toolbox Geographic areas 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 Geographic Areas.

Silver Fire Geographic Area

Existing Condition

There are four fish bearing streams in the Silver Fire Geographic area: Silver Creek, West Fork Silver Creek, North Fork Silver Creek, and Guyer Creek. In addition, two intermittent stream channels were surveyed within the fire boundary, Strawberry Creek and Indian Creek. The Silver Fire burned a significant portion of the occupied fish habitat within the geographic area. Table xx summarizes the miles of riparian area burned by severity type along fish bearing and surveyed intermittent streams within the project area.

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

Stream	Miles in Area	Low Severity	Moderate Severity	High Severity	Percent of Stream Miles Burned at Moderate & High Severity
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	

Silver Creek

Approximately 9.3 miles of Silver Creek are in the project area. The entire 9.3 miles of Silver Creek burned at some level of severity during the Silver Fire. Fire intensity in RHCAs varied from low to moderate with pockets of high intensity. 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.

Data used to describe the current stream channel conditions were 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) and the 50th and 75th percentiles for natural and near-natural streams in the Northern Great Basin as modified by the Fremont National Forest (USDA & USDI 1997). 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.

In the following discussions, 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.

Riparian Ecosystems and Bank Stability

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**.

Table xx. Riparian Vegetation and Associated Bank Stability for Silver Creek.

Reach	Length (miles)	Owner	Wetted Width (ft)	Gradient %	Riparian Vegetation Species and Class			Upland Vegetation Species and Class		Bank Stability (%)
					Dom.	Sub-Dom. 1	Sub-Dom. 2	Dom	Sub-Dom. 1	
5	1.5	USFS	22	1	HD 1	HW 1-4	SE	CP 1-5	MM 1	98
6	1.8	USFS	26	1	HA 1-4	HD 1	SE	CP 1-5	CJ 1-3	99
7	2.3	USFS	24	1	SE	GR	HW 1-4	CP 1-5	CL 1-4	99
8	1.2	USFS	24	1	SE	GR	HA 1-4	CP 1-4	CL 1-4	100

Conifers: CP-Ponderosa, CW-White Fir, CL-Lodgepole, CJ-Juniper, MH-Mountain Hemlock; Class (diameter breast height): 1-Shrub/Seedling (1”-4.9”), 2-Sapling/Pole (5”-8.9”), 3-Small Trees (9”-20.9”), 4-Large Trees (21”-31.9”), 5-Mature Trees (>32”): *Riparian Hardwoods and Shrubs:* HA-Alder, HW-Willow, HC-Cottonwood, HQ-Quaking Aspen, HD-Dogwood, HB-Bog Birch, SP-Spirea, SR-Ribes, HX-Other, Class (height): 1 – (0-2ft.), 2 – (2-5ft.), 3 (5-10ft.), 4 (>10ft.) *Shrubs & Grass/Forb:* SB-Big Sage, SS-Silver Sage, MM-Mountain Mahogany, RB-Rabbit Brush, GR-Grass, SE-Sedge, RU-Rush, LK-Larkspur, LC-Lupine

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

Table xx summarizes the data collected on aquatic habitat conditions for Silver Creek. This data was obtained 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. The **desired** rating is the natural and near-natural frequencies at the 50th and 75th percentiles as obtained from ICBEMP, **current** relates to the results of the stream surveys conducted during the summer of 2000, and **rating** refers to how that parameter is functioning.

Table xx. Aquatic Habitat Conditions in Silver Creek, Summer 2000.

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%		
5	1.5	USFS	22	1	5 Desired	1 / 6	13 / 23	3 / 6	<20	C, B
					5 Current	2	42	5	NA	C, B
					5 Rating	FAR	FA	FAR		FA
6	1.8	USFS	23	1	6 Desired	1 / 6	13 / 22	3 / 6	<20	C, B
					6 Current	2	43	6	NA	C, B
					6 Rating	FAR	FA	FAR		FA
7	2.3	USFS	23	1	7 Desired	1 / 6	13 / 22	3 / 6	<20	B, C
					7 Current	7	40	3	36	B, C
					7 Rating	FA	FA	FAR	FI	FA
8	1.2	USFS	23	1	8 Desired	1 / 6	13 / 22	3 / 6	<25	B, C
					8 Current	7	49	3	NA	B, C
					8 Rating	FA	FA	FAR		FA

FA – Functioning Appropriately, FAR – Functioning At Risk, FI – Functioning Inappropriately, 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

Large Woody Debris (LWD)

The INFISH standard for large woody debris in streams is 20 pieces of wood per mile that is greater than 12 inches in diameter at the small end and at least 35 feet long. The ICBEMP found that natural or near natural frequency of large wood (> 20" dbh and 35' long) in ponderosa pine and mixed conifer sites in Northern Great Basin streams, for a stream the size and slope of Silver Creek, to have 1 pieces per mile at the 50th percentile and 6 pieces per mile at the 75th percentile. Reach 5 contains 2 pieces of large wood per mile in the large size classes, reach 6 contains 2 pieces of large wood per mile and reach 7 contains 7 pieces of large wood per mile and reach 8 contains 7 pieces of large wood per mile (Table xx). Large woody debris for Reaches 5 and 6 of Silver Creek are considered to be **functioning appropriately but at risk** because large wood numbers fall between the 50th and 75th percentiles for natural and near natural streams while 7 Reaches and 8 of Silver are considered to be **functioning appropriately**. During the Silver Fire, Silver Creek experienced some loss of large woody debris (Table xx). The majority of the loss occurred in the small size class with smaller amounts of loss documented in the medium and large size classes.

Table xx. Large Woody Debris in Silver Creek, Summer 2002.

Reach	Length	2002 Total Counts of LWD by Size Class			Total LWD/mile	Key pieces LWD/mile*	Change from 2000 Total Counts of LWD by Size Class			Change from 2000 Key LWD Numbers	
		Small	Medium	Large			Small	Medium	Large	Medium	Large
5	1.5	0	2	2	2.65	2.65	Nc	Nc	1	Nc	1
6	1.8	1	1	4	3.37	2.81	-1	-1	1	-1	1
7	2.3	23	9	4	15.79	5.7	-9	-2	NC	-2	NC
8	1.2	15	7	1	20	6.96	-6	-1	1	-1	NC

*Key pieces of large woody debris equals 12" diameter at the small end by 35' in length.

Reaches 5-8 are all appropriate sites for LWD, with ponderosa pine being the main source of instream wood. Within these reaches, LWD recruitment potential was determined to be adequate, yet LWD loadings were below desired numbers in all but two of the reaches. In reaches 5-8, even though existing LWD numbers are either below or only slightly above their desired levels, recruitment potential is adequate to meet or exceed these numbers. A possible reason for the slightly reduced LWD numbers within these reaches could be attributed to Silver Creek (at its outflow of Thompson Reservoir)

having enough energy during high flow events to move some of the smaller pieces of woody debris, making it more difficult to retain wood within the channel. Existing LWD within these reaches primarily occurs where debris jams have been created, or where pieces have been caught, or locked in place, by boulders.

Pools

All of the reaches surveyed within Silver Creek were found to be **functioning appropriately**, with pool numbers exceeding the 75th percentile. All of the reaches in terms of the large pool component received a **functioning appropriately but at risk** ratings for the large pool habitat element.

Pool frequencies reflect near-natural numbers in part because stream channels and riparian vegetation are highly similar to desired conditions. The lowest reaches of Silver Creek downstream of the project area appear to be providing adequate large pool habitat with pool complexity occurring through depth, structure and undercut banks along meander bends. This same type of complexity does not seem to exist among the pools in the reaches within the project area, even though stream channels and riparian vegetation are highly similar to desired conditions. A primary influencing factor is that the channel morphology of Silver Creek has had to adjust to the regulated flows out of Thompson Reservoir, resulting in channels that are fairly wide and shallow. Thus, within many of these reaches, the number of deep pools may remain low until numbers of LWD and beaver (dams) increase within the system.

Spawning Gravel Fines

Thirty-six percent fine sediments were documented at the sampling site located in Reach 7, promoting 31% embryo survival. This element was therefore given a **functioning inappropriately** rating. Sampling did not occur in any of the other reaches.

The channel morphology of Silver Creek has adjusted to regulated flows out of Thompson Reservoir. Consequently, flushing flows that are able to move sediment out of stream substrates do not occur as often as they did historically (before the construction of the dam), leading to the higher levels of fine sediments that were found in spawning substrates of Reach 7. A report by Reiser and Ramey (1985) identifies that large releases of water from regulated reservoirs are necessary to dislodge fine sediments in downstream reaches. Without these larger flushing flows, and the fact that beaver dams are not playing a significant role in trapping fine sediment within the system, Silver Creek may be unable to meet the recommended sediment levels. Otherwise, the high bank stability, abundance of late-seral vegetation, and appropriate stream types has a positive influence on maintaining lower sediment levels.

Rosgen Channel Type

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, bankful width, bankful depth, and floodprone area. The data was analyzed and calculations made to determine the channel type. Results are displayed in the following table for each stream reach within the Silver Fire perimeter.

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. Reaches 5 and 6 are a mix of C and B stream types that typically have low gradients (1% or less), gentle sideslopes, gravel/cobble substrates, and some level of floodplain development – although some portions of these reaches are more confined due to the adjacent sideslopes. Reaches 7-8 are primarily B stream types (reaches 7 and 8 have inclusions of C stream types) that are characterized by slightly higher stream gradients (but still less than 2%), more confined floodplains, and higher width-to-depth ratios.

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.

Stream Temperatures and Shade

Based on stream temperature recordings in reaches 6 and 9, it is assumed that reaches 7-9 are **functioning appropriately but-at-risk**, because the 7-day average maximum temperatures were within, or assumed to be within the 17.8-24.0°C range. In contrast, reaches 1-6 are believed to be **functioning inappropriately**, based on the 7-day average maximum temperatures being above 24.0°C. Although it is assumed that stream temperatures were historically lower than they are today, it is highly unlikely that Silver Creek can meet current state standards since the outflow of Thompson Reservoir is so warm (monitoring shows that temperatures exceed 20°C during the warmest summer period).

Table xx. Maximum 7-Day Average Temperatures for Silver Creek.

Elevation (ft)	Maximum 7-day Average Temperature (C)			
	1997	1998	2000	2002
4530	24.1	23.9	24.4	26.2

As mentioned previously, the channel morphology of Silver Creek has adjusted to regulated flows out of Thompson Reservoir with wetted channel widths that are wide, ranging from 17-23 feet. Given these adjusted channel dimensions, shade values (shade information was collected within the surveyed reaches of Silver Creek using a solar pathfinder), however, were still found to be near their desired conditions. Shading values for each reach were compared to data collected for reaches determined to be near their desired or potential condition within the Sprague River system (data from information collected for the Sprague River TMDL – unpublished). Comparisons were made utilizing information from streams of the same width and riparian community group. Shading levels within Silver Creek were found to be within the range of values for similar sites that are at or near their potential condition within the Sprague River System. Shading values for Silver Creek in 2000 were as follows: (R5) 30%, (R6) 43%, (R7) 40%, and (R8) 44%. Stream shading values were collected using a Solar Pathfinder during the summer of 2002 following the fire to determine the amount of shading lost. Results were as follows: (R5) 29%, (R6) 41%, (R7) 38%, and (R8) 44%. Minimal loss of shade occurred along Silver Creek even though the fire burned in the riparian areas. This can be attributable to the predominance of the stream being confined within a canyon, the mosaic pattern of the burn, and high percentage of low severity burn.

West Fork Silver Creek

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 experienced some degree of burning during the Silver Fire. Fire intensity in RHCAs varied from low to moderate with pockets of high intensity. Along West Fork Silver Creek, the riparian vegetation immediately adjacent to the channel was lightly to moderately burned with several areas that experienced 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.

Data used to describe the current stream channel conditions were 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) and the 50th and 75th percentiles for natural and near-natural streams in the Northern Great Basin as modified by the Fremont National Forest (USDA & USDI 1997). 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.

In the following discussions, 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.

Riparian Ecosystems and Bank Stability

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).

Table xx. Riparian Vegetation and Associated Bank Stability for West Fork Silver Creek.

Reach	Length (miles)	Owner	Wetted Width (ft)	Gradient (%)	Riparian Vegetation Species and Class			Upland Vegetation Species and Class		Bank Stability (%)
					Dom	Sub-Dom 1	Sub-Dom. 2	Dom.	Sub-Dom. 1	
4	3.0	USFS	11	1	HA 1-4	SE	HX 1-2	CP 3-5	CL 2-4	99
5	1.2	USFS	9	<1	SE	GR	HA 2-3	CP 3-5	CL 2-4	95
6	1.2	USFS	8	<1	SE	HA 4	HW 2-4	CP 3-4	SB	99
7	2.0	USFS	8	3	HA 1-4	HD 2-3	HX 1	CP 3-4	CW 2-3	99
8	3.0	USFS	8	1-2	HA 1-4	SP 1	GR	CL 1-4	CW 1-4	100

Conifers: CP-Ponderosa, CW-White Fir, CL-Lodgepole, CJ-Juniper, MH-Mountain Hemlock; Class (diameter breast height): 1-Shrub/Seedling (1”-4.9”), 2-Sapling/Pole (5”-8.9”), 3-Small Trees (9”-20.9”), 4-Large Trees (21”-31.9”), 5-Mature Trees (>32”): *Riparian Hardwoods and Shrubs:* HA-Alder, HW-Willow, HC-Cottonwood, HQ-Quaking Aspen, HD-Dogwood, HB-Bog Birch, SP-Spirea, SR-Ribes, HX-Other, Class (height): 1 – (0-2ft.), 2 – (2-5ft.), 3 (5-10ft.), 4 (>10ft.) *Shrubs & Grass/Forb:* SB-Big Sage, SS-Silver Sage, MM-Mountain Mahogany, RB-Rabbit Brush, GR-Grass, SE-Sedge, RU-Rush, LK-Larkspur, LC-Lupine

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.

Aquatic Habitat Condition

Table xx summarizes the data collected on aquatic habitat conditions for West Fork Silver Creek. This data was obtained 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. The **desired** rating is the natural and near-natural frequencies at the 50th and 75th percentiles as obtained from ICBEMP, **current** relates to the results of the stream surveys conducted during the summer of 2000, and **rating** refers to how that parameter is functioning.

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

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%		
4	3.0	USFS	11	1	4 Desired	3 / 12	27 / 46	0 / 2	<25	C, E, B
					4 Current	33	116	6	NA	C, E, B
					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
6	1.2	USFS	8	<1	6 Desired	4 / 17	37 / 63	0 / 3	<20	C, E, B
					6Current	7	111	18	NA	C, E, B
					6 Rating	FA	FA	FA		FA
7	2.0	USFS	8	3	7 Desired	13 / 56	40 / 67	1 / 3	<25	B, E
					7 Current	20	115	1	35	B, E
					7 Rating	FAR	FA	FAR	FI	FA
8	3.0	USFS	8	1-2	8 Desired	4 / 17	37 / 63	0 / 3	<25	E, B
					8 Current	27	96	0	NA	E, B
					8 Rating	FA	FA	FAR		FA

FA – Functioning Appropriately, FAR – Functioning Appropriately but-at-Risk, FI – Functioning Inappropriately NA – Information Not Available;

Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

Large Woody Debris

The INFISH standard for large woody debris in streams is 20 pieces of wood per mile that is greater than 12 inches in diameter at the small end and at least 35 feet long. The ICBEMP found that natural or near natural frequencies of large wood (> 20" dbh and 35' long) in ponderosa pine and mixed conifer sites in Northern Great Basin streams, for a stream the size and slope of West Fork Silver Creek, varies from between 3 and 12 pieces per mile up to 13 to 56 pieces per mile at the 50th percentile and 75th percentiles (Table xx). The data indicates that large woody debris for Reaches 4, 5, 6, and 8 of West Fork Silver Creek are considered to be **functioning appropriately** because large wood numbers are above the 75th percentiles for natural and near natural streams. Reach 7 of West Fork Silver Creek is considered to be **functioning appropriately but at risk** because the large wood numbers are between the 50th and 75th percentiles for natural and neaer natural streams. During the Silver Fire, Silver Creek experienced some loss of large woody debris (Table xx). The majority of the loss occurred in the small size class with moderate amounts of loss documented in the medium and large size classes.

Table xx. Large Woody Debris in West Fork Silver Creek, Summer 2002.

Reach	Length	2002 Total Counts of LWD by Size Class			Total LWD/mile	Key pieces LWD/mile	Change from 2000 Total Counts of LWD by Size Class			Change from 2000 Key LWD Numbers	
		Small	Medium	Large			Small	Medium	Large	Medium	Large
4	3.0	94	74	17	61.87	30.43	-16	-6	-2	-6	-2
5	1.2	28	12	8	39.67	16.53	-7	-4	-1	-4	-1
6	1.2	30	5	2	30.58	5.79	-9	-2	1	-2	1
7	2.0	40	20	7	32.84	13.24	-15	-8	-5	-8	-5
8	3.0	127	55	10	64.43	21.81	-35	-12	-4	-12	-4

*Key pieces of large woody debris equals 12" diameter at the small end by 35' in length.

Reaches 4-8 are all appropriate sites for LWD, with ponderosa pine being the main source of in-stream wood. Within these reaches, LWD recruitment potential was determined to be adequate in reaches 4, 5, and 7. As mentioned above, Reach 6 occurs in an area of limited LWD recruitment potential where only a portion of the channel is lined with conifers and/or tree densities are low within the stream corridor. For this reason, LWD ratings within this reach are questionable since calculations that lead to desired numbers of LWD assume that nearly all areas along the stream are forested. Professional judgment, based primarily on adequate LWD recruitment potential was used to determine that this reach has appropriate levels of LWD.

Pools

All of the reaches surveyed within West Fork Silver Creek were found to be **functioning appropriately**, with pool numbers exceeding the 75th percentile. It should be noted that Reach 5 received functioning appropriately ratings even though riparian vegetation and channel morphology received functioning appropriately but-at-risk ratings. Of the reaches surveyed, 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.

Pool frequencies reflect near-natural numbers in part because stream channels and riparian vegetation are similar to desired conditions. Reaches 4, 5, and 6 appear to be providing adequate large pool habitat, with pool complexity occurring through depth, structure and undercut banks. An important insight for both Reach 6 and the rest of the watershed is the role beaver dams play in creating many of the deep pools within the reach. This same type of complexity does not seem to exist among the pools in the remaining reaches, 7 and 8, even though stream channels and riparian vegetation are similar to desired conditions. Thus, the number of deep pools within many of these reaches is likely to remain low with the absence of beaver dams.

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 inappropriately** 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. Mean values of fine sediment and embryo survival for the reaches sampled in 2001 are 26% and 60%, respectively. These levels of fines are not only limiting embryo survival, but are likely influencing the food supply and habitat for adult fish. Species of macroinvertebrates and macroinvertebrate ratings vary greatly depending on the chemical and biological conditions and amount of sediment in the stream. Aquatic macroinvertebrate sampling in West Fork Silver Creek during 1989, 1990 and 1994, shows an overall decline in habitat conditions since monitoring began. Overall habitat condition ratings have gone from an excellent rating (BCI 94) in 1989, to good and fair ratings (BCI 86 & 75) in 1990, to a poor rating (BCI 65) in 1994. It is worth noting, however, that 1994 was a very dry year, with extremely low stream flows, which likely influenced BCI ratings.

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 logging in the adjacent uplands, which, along with associated roading may be influencing sediment levels. It should be noted, however, that 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. Thus, 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. The decrease in beaver dams has resulted in an even distribution of sediment throughout the entire length of the stream channel and higher levels of fines in spawning substrates than existed historically. Under reference conditions, sediment would be trapped behind beaver dams and cleaner spawning substrate would be found below these beaver dams. A note of interest from the sediment sampling that has occurred within this stream is the overall average decrease in values (10%) 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.

Rosgen Channel Type

Reaches 4, 5, 6, and 8 are primarily C and E stream types (with small portions of B stream types intermixed) characterized by low gradients, active floodplains and low width-to-depth ratios. The remaining reach 7 is primarily a B stream type (with small sections exhibiting E stream types) that have moderately steep gradients, gentle sideslopes, and larger stream substrates that aid in channel stability. All surveyed reaches, 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 of are still showing signs of a recovering stream, one that is still moving along the evolutionary path for degraded low-gradient systems. 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. An additional factor that may be influencing stream channel morphology within the lower reaches of this stream might be the increased drainage network associated with roads throughout the subwatershed, possibly influencing the timing and magnitude of stream flows and their effects on channel scouring.

Stream Temperatures and Shade

Based on stream temperature recordings in reaches 7, it is assumed that reaches 7 and 8 are **functioning appropriately**, because the 7-day average maximum temperatures were all below 17.8°C. In contrast, reaches 4, 5, and 6 are believed to be **functioning appropriately but-at-risk**, based on the 7-day average maximum temperatures that were within, or assumed to be within, the 17.8-24.0°C range.

Table xx. Maximum 7-Day Average Temperatures for West Fork Silver Creek.

Elevation (ft)	Maximum 7-day Average Temperature (C)			
	1996	1998	2000	2002
4740	22.6	21.6	27.6	NA
5050	NA	13.2	15.3	17.8

The relatively low stream temperatures found throughout the upper seven reaches of West Fork Silver Creek are a result, in part, of upstream riparian vegetation and stream channels being near their desired state. For this reason, stream temperatures may also be near their potential. In contrast, the relatively open forest/meadow and meadow reaches found throughout the rest of the system allow temperatures to increase, being close to 24.0°C. As discussed in previous watershed evaluations, several sections of the low-gradient reaches in West Fork Silver Creek have been affected by at least one factor influencing stream temperatures – stream channels that are slightly wider than desired, loss of riparian shade, lower stream flows caused by increased evapotranspiration, etc. Although this has occurred, current shade values (shade information was collected within the surveyed reaches of West Fork Silver Creek using a solar pathfinder) were still found to be near their desired conditions. Shading values for each reach were compared to data collected for reaches determined to be near their desired or potential condition within the Sprague River system (data from information collected for the Sprague River TMDL – unpublished). Comparisons were made utilizing information from streams of the same width and riparian community group. Shading levels within West Fork Silver Creek were found to be within the range of values for similar sites that are at or near their potential condition within the Sprague River System. Shading values for West Fork Silver Creek were as follows: (R4) 65%, (R5) 35%, (R6) 51%, (R7) 77%, and (R8) 77%. Stream shading values were collected using a Solar Pathfinder during the summer of 2002 following the fire to determine the amount of shading lost. Results were as follows: (R4) 63%, (R5) 32%, (R6) 42%, (R7) 63%, and (R8) 62%. Minimal loss of shade occurred along West Fork Silver Creek in Reaches 4 and 5, which are in a canyon and meadow. Reaches 6, 7, and 8 experienced a significantly greater loss of shade. This can be attributable to the predominance of the stream being confined within a U-shaped valley, the mosaic pattern of the burn, and high percentage of moderate to high severity burn.

North Fork Silver Creek

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. Fire intensity in RHCAs varied from low to moderate with pockets of high intensity. Along North Fork Silver Creek, the riparian vegetation immediately adjacent to the channel was lightly to moderately burned with an area of high intensity 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.

Data used to describe the current stream channel conditions were 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) and the 50th and 75th percentiles for natural and near-natural streams in the Northern Great Basin as modified by the Fremont National Forest (USDA & USDI 1997). 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. In the following discussions, 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

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.

Table xx. Riparian Vegetation and Associated Bank Stability for North Fork Silver Creek.

Reach Information					**Riparian Area Vegetation and Associated Bank Stability**					
Reach	Reach Length (miles)	Owner	Wetted Width (ft)	Gradient (%)	Riparian Vegetation Species and Class			Upland Vegetation Species and Class		Bank Stability (%)
					Dom.	Sub-Dom. 1	Sub-Dom. 2	Dom	Sub-Dom. 1	
1	2.3	USFS	5	1-4	HA 1-4	SE	GR	CL 1-3	CP 1-5	99

Conifers: CP-Ponderosa, CW-White Fir, CL-Lodgepole, CJ-Juniper, MH-Mountain Hemlock; Class (diameter breast height): 1-Shrub/Seedling (1”-4.9”), 2-Sapling/Pole (5”-8.9”), 3-Small Trees (9”-20.9”), 4-Large Trees (21”-31.9”), 5-Mature Trees (>32”): *Riparian Hardwoods and Shrubs:* HA-Alder, HW-Willow, HC-Cottonwood, HQ-Quaking Aspen, HD-Dogwood, HB-Bog Birch, SP-Spirea, SR-Ribes, HX-Other, Class (height): 1 – (0-2ft.), 2 – (2-5ft.), 3 (5-10ft.), 4 (>10ft.) *Shrubs & Grass/Forb:* SB-Big Sage, SS-Silver Sage, MM-Mountain Mahogany, RB-Rabbit Brush, GR-Grass, SE-Sedge, RU-Rush, LK-Larkspur, LC-Lupine

Aquatic Habitat Condition

Table xx summarizes the data collected on aquatic habitat conditions for Silver Creek. This data was obtained 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. The **desired** rating is the natural and near-natural frequencies at the 50th and 75th percentiles as obtained from ICBEMP, **current** relates to the results of the stream surveys conducted during the summer of 2000, and **rating** refers to how that parameter is functioning.

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

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
					1 Current	78	108	0	NA	B, E
					1 Rating	FA	FA	FI		FA

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

Large Woody Debris

The INFISH standard for large woody debris in streams is 20 pieces of wood per mile that is greater than 12 inches in diameter at the small end and at least 35 feet long. The ICBEMP found that natural or near natural frequency of large wood (> 20” dbh and 35’ long) in ponderosa pine and mixed conifer sites in Northern Great Basin streams, for a stream the size and slope of North Fork Silver Creek, to have 21 pieces per mile at the 50th percentile and 90 pieces per mile at the 75th percentile. Reach 1 contains 78 pieces of large wood per mile in the large size class (Table xx). Large woody debris for Reaches 1of North Fork Silver Creek is considered to be **functioning appropriately but at risk** because large wood numbers fall between the 50th and 75th percentiles for natural and near natural. During the Silver Fire, North Fork Silver Creek experienced some loss of large woody debris (Table xx). The majority of the loss occurred in the small size class with smaller amounts of loss documented in the medium and large size classes.

Table xx. Large Woody Debris in North Fork Silver Creek, Summer 2002.

Reach	**Length**	**2002 Total Counts of LWD by Size Class**			**Total LWD/mile**	**Key pieces LWD/mile**	**Change from 2000 Total Counts of LWD by Size Class**			**Change from 2000 Key LWD Numbers**	
		Small	**Medium**	**Large**			**Small**	**Medium**	**Large**	**Medium**	**Large**
1	2.3	109	23	0	57.89	10.09	-12	-4	-1	-4	-1

*Key pieces of large woody debris equals 12” diameter at the small end by 35’ in length.

Reach 1 of North Fork Silver Creek occurs within lodgepole pine vegetation type, with some areas exhibiting meadow/forest characteristics. Ample large woody debris, as well as large woody debris potential, was noted during stream surveys, but numerous pieces were found to be just above the bankfull dimensions and thus were not counted in the current condition numbers shown in the table above. North Fork Silver Creek flows through both lodgepole forests and

meadow/forested areas, which helps to explain the slightly reduced numbers of LWD found within the reach. For this reason, LWD ratings within the reach are questionable since calculations that lead to desired numbers of LWD assume that nearly all areas along the stream are forested. Professional judgment, based primarily on LWD recruitment potential including the numerous pieces lying just above the bankfull dimensions, was used to determine that all reaches have appropriate levels of LWD.

Pools

The reach surveyed was found to be **functioning appropriately**, with pool numbers exceeding the 75th percentile. In terms of the large pool component, however, no deep (large) pools could be found in the reach, and thus received a **functioning inappropriately** rating for the large pool habitat element.

Pool frequencies reflect near-natural numbers in part because stream channels and riparian vegetation are highly similar to desired conditions. Of particular importance for this stream is that large woody debris numbers are at desired levels – LWD is such an important structural agent in forming pools in small streams like North Fork Silver Creek. However, complexity of these pools, with reference to depth, appears to be lacking. This may simply be a function of the size of the stream, or as with other smaller streams in the Silver Lake Watershed, the number of deep pools within North Fork Silver Creek may remain low with the absence of beaver dams.

Spawning Gravel Fines

No sediment sampling has occurred in Reach 1 in the project area. However, 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 inappropriately** rating.

The relatively high sediment levels recorded in Reach 2 are most likely attributed to the depositional nature of the sampling site – it is likely that the sample was taken within the depositional influence zone of a large road fill/crossing. Also, natural high erosion rates associated with soils and geomorphology of this area could be another reason for the high sediment in spawning substrates. A note of interest from the sediment sampling that has occurred within this stream is the lower values found in 2000. 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.

Rosgen Channel Type

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. This reach comprise a mix of stream types that typically have moderate gradients, gentle sideslopes, gravel/cobble substrates, and some level of floodplain development, although some portions of this reach are more confined due to the adjacent sideslopes. Small sections of the reach are typical “E” stream types characterized by low gradients, developed floodplains, and low width-to-depth ratios.

The dominance 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. 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.

Stream Temperatures and Shade

Based on stream temperature recordings at the lower end of Reach 1 (7-day average maximum temperatures of 14.3°C) this Reach was rated as **functioning appropriately**.

Table xx. Maximum 7-Day Average Temperatures for North Fork Silver Creek.

Elevation (ft)	Maximum 7-day Average Temperature (C)			
	1996	1998	2000	2002
5050	12.9	13.0	14.3	17.4

The low stream temperatures found throughout North Fork Silver Creek are a function of upstream riparian vegetation and stream channels being at their desired state. This has led to shading levels (shade information was collected within both

reaches of North Fork Silver Creek using a solar pathfinder) also being at or near their desired conditions. Shading values for each reach were compared to data collected for reaches determined to be near their desired or potential condition within the Sprague River system (data from information collected for the Sprague River TMDL – unpublished). Comparisons were made utilizing information from streams of the same width and riparian community group. Shading levels within North Fork Silver Creek were found to be within the range of values for similar sites that are at or near their potential condition within the Sprague River System. Shading values for North Fork Silver Creek were as follows: (R1) 76%. Stream shading values were collected using a Solar Pathfinder during the summer of 2002 following the fire to determine the amount of shading lost. Results were as follows: (R1) 68%. A moderate loss of shade occurred along North Fork Silver Creek in Reach 1. This can be attributable to the predominance of the stream being confined within a U-shaped valley, the mosaic pattern of the burn, and high percentage of moderate to high severity burn the occurred in the first 0.5 miles of the reach at near its confluence with West Fork Silver Creek.

Guyer Creek

Approximately 2.99 miles of Guyer Creek are in the project area, 1.9 on National Forest System Lands and 1.09 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 2.99 miles of Guyer Creek burned during the Silver Fire. Fire intensity in RHCAs varied from low to moderate with pockets of high intensity. 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.

Data used to describe the current stream channel conditions were 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) and the 50th and 75th percentiles for natural and near-natural streams in the Northern Great Basin as modified by the Fremont National Forest (USDA & USDI 1997). 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.

In the following discussion, Reach 2 of Guyer Creek begins at the forest boundary located approximately 2.0 miles upstream from Thompson Reservoir and extends upstream 1.9 miles to the 3038 Road.

Riparian Ecosystems and Bank Stability

The dominant plant types in the reach are highly similar to late-seral species in composition and structure, resulting in bank stability values of 99% of greater. For these reasons, the surveyed reach is **functioning appropriately.** Again, there is evidence of lodgepole pine encroachment into the riparian area in every reach.

Table xx. Riparian Vegetation and Associated Bank Stability for Guyer Creek.

Reach Information					**Riparian Area Vegetation and Associated Bank Stability**					
Reach	Reach Length (miles)	Owner	Wetted Width (ft)	Gradient (%)	Riparian Vegetation Species and Class			Upland Vegetation Species and Class		Bank Stability (%)
					Dom	Sub-Dom. 1	Sub-Dom. 2	Dom.	Sub-Dom. 1	
1		Private								
2	1.9	USFS	8	2	HA 1-4	SP 1	GR	CL 1-4	CP 1-5	99

Conifers: CP-Ponderosa, CW-White Fir, CL-Lodgepole, CJ-Juniper, MH-Mountain Hemlock; Class (diameter breast height): 1-Shrub/Seedling (1”-4.9”), 2-Sapling/Pole (5”-8.9”), 3-Small Trees (9”-20.9”), 4-Large Trees (21”-31.9”), 5-Mature Trees (>32”): *Riparian Hardwoods and Shrubs:* HA-Alder, HW-Willow, HC-Cottonwood, HQ-Quaking Aspen, HD-Dogwood, HB-Bog Birch, SP-Spirea, SR-Ribes, HX-Other, Class (height): 1 – (0-2ft.), 2 – (2-5ft.), 3 (5-10ft.), 4 (>10ft.) *Shrubs & Grass/Forb:* SB-Big Sage, SS-Silver Sage, MM-Mountain Mahogany, RB-Rabbit Brush, GR-Grass, SE-Sedge, RU-Rush, LK-Larkspur, LC-Lupine

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 remain ungrazed 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.

Aquatic Habitat Condition

The following table summarizes the data collected on aquatic habitat conditions for Guyer Creek. This data was obtained during the summer of 2000 and the fall of 2002. It is used to reference discussion on the following aquatic habitat parameters: large woody debris, pools, spawning gravel fines, and Rosgen channel type. The **desired** rating is the natural and near-natural frequencies at the 50th and 75th percentiles as obtained from ICBEMP, **current** relates to the results of the stream surveys conducted during the summer of 2000, and **rating** refers to how that parameter is functioning.

Table xx. Aquatic Habitat Conditions in Guyer Creek, Summer 2000.

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%		
2	1.9	USFS	8	2	2 Desired	13 / 56	40 / 67	1 / 3	<20	B, E
					2 Current	52	107	0	NA	E_b, E, B_c, B
					2 Rating	FA	FA	FI		FA

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

Large Woody Debris

The INFISH standard for large woody debris in streams is 20 pieces of wood per mile that is greater than 12 inches in diameter at the small end and at least 35 feet long. The ICBEMP found that natural or near natural frequency of large wood (> 20" dbh and 35' long) in ponderosa pine and mixed conifer sites in Northern Great Basin streams, for a stream the size and slope of Guyer Creek, to have 13 pieces per mile at the 50th percentile and 56 pieces per mile at the 75th percentile. Reach 2 contains 52 pieces of large wood per mile in the large size class (Table xx). Large woody debris for Reach 2 of Guyer Creek is considered to be **functioning appropriately** because large wood numbers are near the 75th percentile for natural and near natural streams. During the Silver Fire, North Fork Silver Creek experienced some loss of large woody debris (Table xx). The majority of the loss occurred in the small size class with smaller amounts of loss documented in the medium and large size classes.

Table xx. Large Woody Debris in Guyer Creek, Summer 2002.

Reach	Length	2002Total Counts of LWD by Size Class			Total LWD/mile	Key pieces LWD/mile	Change from 2000 Total Counts of LWD by Size Class			Change from 2000 Key LWD Numbers	
		Small	Medium	Large			Small	Medium	Large	Medium	Large
2	1.9	42	32	8	43.62	21.28	-9	-4	-3	-4	-3

*Key pieces of large woody debris equals 12" diameter at the small end by 35' in length.

Like the upper reaches of West Fork Silver Creek and both reaches of North Fork Silver Creek, the surveyed reach of Guyer Creek occurs within lodgepole pine vegetation types, with some segments exhibiting meadow/forest characteristics. Ample large woody debris, as well as large woody debris potential, was noted during stream surveys, but numerous pieces were found to be just above the bankfull dimensions and thus were not counted in the current condition numbers shown in the table above. Guyer Creek flows through both lodgepole forests and meadow-shrub/forested areas, which helps to explain the slightly reduced numbers of LWD found within these reaches. For this reason, LWD ratings within these reaches are questionable since calculations that lead to desired numbers of LWD assume that nearly all areas along the stream are forested. Professional judgment, based primarily on adequate LWD recruitment potential including the numerous pieces lying just above the bankfull dimensions, was used to determine that all reaches have appropriate levels of LWD.

Pools

Reach 2 was found to be **functioning appropriately**, with pool numbers exceeding the 75th percentile. In terms of the large pool component, however, no deep (large) pools could be found in the reach. Thus, reach 2 received **functioning inappropriately** ratings for the large pool habitat element.

Pool frequencies reflect near-natural numbers in part because stream channels and riparian vegetation are highly similar to desired conditions. As with West Fork Silver and North Fork Silver Creeks, of particular importance for this stream is that

large woody debris numbers are at desired levels – LWD is such an important structural agent in forming pools in small streams like Guyer Creek. However, complexity of these pools, with reference to depth, appears to be lacking. This may simply be a function of the size of the stream, or as with other smaller streams in the Silver Lake Watershed, the number of deep pools within Guyer Creek may remain low with the absence of large beaver dams.

Spawning Gravel Fines
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 inappropriately** 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.

Rosgen Channel Type
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. Similar to both West Fork Silver and North Fork Silver Creeks, the abundance of late-seral vegetation, primarily alder, willow, and sedge, promotes high bank stability and stable stream channels. Reach 2 is comprised of a mix of stream types that typically have moderate gradients, gentle sideslopes, gravel/cobble substrates, and some level of floodplain development. Portions of each reach are typical "E" stream types characterized by low gradients, developed floodplains, and low width-to-depth ratios. A larger proportion of Reach 2 was classified as a B stream type with larger width-to-depth ratios and more confinement due to the adjacent sideslopes.

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.

Stream Temperatures and Shade

Based on the stream temperature sensor located at Reach 2 (7-day average maximum temperatures of 16.2°C), it is assumed that reaches 2-6 are below 17.8°C, and thus are **functioning appropriately**.

Table xx. Maximum 7-Day Average Temperatures for Guyer Creek.

Elevation (ft)	Maximum 7-day Average Temperature (C)			
	1996	1997	2000	2002
5360	15.6	15.0	16.2	NA

The relatively low stream temperatures found throughout Guyer Creek are a function of upstream riparian vegetation and stream channels being near or at their desired state. This has led to shading levels (shade information was collected within all reaches of Guyer Creek using a solar pathfinder) that are also close to their desired conditions. For each surveyed reach, measured shading values were compared to data collected for reaches determined to be near their desired or potential condition within the Sprague River system (data from information collected for the Sprague River TMDL – unpublished). Comparisons were made utilizing information from streams of the same width and riparian community group. Shading levels within Guyer Creek were found to be within the range of values for similar sites that are at or near their potential condition within the Sprague River System. Shading values for Guyer Creek were as follows: (R2) 80%. Stream shading values were collected using a Solar Pathfinder during the summer of 2002 following the fire to determine the amount of shading lost. Results were as follows: (R2) 78%. A minimal loss of shade occurred along Guyer Creek in Reach 2. This can be attributable to the predominance of the stream being confined within a U-shaped valley, the mosaic pattern of the burn, and high percentage of low to moderate severity burn.

Strawberry Creek

Approximately 4.6 miles of Strawberry Creek are in the project area, 3.4 miles on National Forest System Lands and 1.2 on private lands. No data is available for the private portions of Strawberry Creek and all discussions regarding Strawberry Creek will be regarding that portion on National Forest System Lands. Portions of the 3.4 miles of Strawberry Creek burned during the Silver Fire. Fire intensity in RHCAs varied from low to moderate with pockets of high intensity. Along Strawberry 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.

Data used to describe the current stream channel conditions were collected in the fall of 2002. No stream channel condition data prior to the fire had been collected. Stream functionality calls are made based on whether habitat objectives are being met. Habitat, in particular larger woody debris, is compared to INFISH Riparian Management Objectives (USDA 1995) and the 50th and 75th percentiles for natural and near-natural streams in the Northern Great Basin as modified by the Fremont National Forest (USDA & USDI 1997). Other habitat elements such as bank stability and substrate composition were established by examination of the scientific literature and/or obtained through monitoring of natural or near natural streams on the Fremont National Forest.

Stream Channel Condition

The following table summarizes the data collected on stream channel conditions for Strawberry Creek. This data was obtained during the fall of 2002 as part of the Ochoco Bottom Line surveys. Reach 1 of Strawberry Creek is located on private land and was not surveyed.

Table xx. Summary of Stream Channel Conditions for Strawberry Creek, Summer 2002.

Reach	Length (miles)	Large Wood/Mile			Substrate		Active Erosional Surface		Bank Stability (%)
		Small	Medium	Large	Dom.	Sub-Dom.	Length (ft)	Percent of reach	
2	1.48	128	16	5	Sand	Gravel	1,645	10.5	89.5
3	1.55	33	6	4	Gravel	Sand	380	2.3	97.7
4	0.38	18	0	8	Gravel	Boulder	48	1.2	98.8

*Reach 1 is located on private land and was not surveyed.

Large Woody Debris

Large woody debris in streams is an important roughness element influencing stream channel morphology, sediment distribution, and water routine (Swanson and Lienkaemper 1978, Bisson et al 1987). Wood in streams is an important agent in the formation of pools, which are important in the trapping of sediments and maintaining stream channel stability.

The INFISH standard for large woody debris in streams is 20 pieces of wood per mile that is greater than 12 inches in diameter at the small end and at least 35 feet long. The ICBEMP found that natural or near natural frequency of large wood (> 20" dbh and 35' long) in ponderosa pine and mixed conifer sites in Northern Great Basin streams, for a stream the size and slope of Strawberry Creek, to have 4 pieces per mile at the 50th percentile and 16 pieces per mile at the 75th percentile. Reach 1 contains 5 pieces of large wood per mile in the large size classes, reach 2 contains 4 pieces of large wood per mile and reach 3 contains 8 pieces of large wood per mile (Table xx). Large woody debris for Strawberry Creek is considered to be **functioning appropriately but at risk** because large wood numbers fall between the 50th and 75th percentiles for natural and near natural streams.

Substrate Composition

Substrate composition for Strawberry Creek is dominated by gravel in reaches 3 and 4 with boulder, cobble and sand as the sub-dominants while in reach 1 sand is the dominant while gravel is sub-dominant (Table xx). The higher percentage of bank erosion in reach 1 would explain sand being the dominant substrate in this reach. Overall, substrate composition for Strawberry Creek is considered to be **functioning appropriately but at risk** because of the presence of sand as a dominant and sub-dominant substrate in reaches 2 and 3.

Bank Stability

Bank stability in Strawberry Creek within the project area was measured in the fall of 2002 as part of the Ochoco Bottom Line surveys and is summarized in Table xx. None of the reaches surveyed exhibited streambank stability values that were considered functioning inappropriately (less than 80 percent). Streambank stability in Strawberry Creek varied from 89.5 percent to 98.8 percent in all three surveyed reaches. Therefore, Strawberry Creek is considered to be **functioning appropriately** for bank stability.

Indian Creek

Approximately 2.7 miles of Indian Creek are in the project area, 1.7 miles on National Forest System Lands and 1.0 on private lands. No data is available for the private portions of Indian Creek and all discussions regarding Indian Creek will be regarding that portion on National Forest System Lands. The majority of the 1.7 miles of Indian Creek burned during the Silver Fire. Fire intensity in RHCAs varied from low to moderate with pockets of high intensity. Along Indian 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.

Data used to describe the current stream channel conditions were collected in the fall of 2002. No stream channel condition data prior to the fire had been collected. Stream functionality calls are made based on whether habitat objectives are being met. Habitat, in particular larger woody debris, is compared to INFISH Riparian Management Objectives (USDA 1995) and the 50th and 75th percentiles for natural and near-natural streams in the Northern Great Basin as modified by the Fremont National Forest (USDA & USDI 1997). Other habitat elements such as bank stability and substrate composition were established by examination of the scientific literature and/or obtained through monitoring of natural or near natural streams on the Fremont National Forest.

Stream Channel Condition

The following table summarizes the data collected on stream channel conditions for Indian Creek. This data was obtained during the fall of 2002 as part of the Ochoco Bottom Line surveys. Reach 2 of Indian Creek is located on private land and was not surveyed.

Table xx. Summary of Stream Channel Conditions for Indian Creek, Summer 2002.

Reach	Length (miles)	Large Wood/Mile			Substrate		Active Erosional Surface		Bank Stability (%)
		Small	Medium	Large	Dom.	Sub-Dom.	Length (ft)	Percent of reach	
1	0.38	34	0	0	Gravel	Sand	106	2.7	97.3
3	0.95	52	0	0	Grass	Silt/Clay	1,035	10.4	89.6
4	0.40	0	68	0	Sand	Gravel	95	1.3	98.7

*Reach 2 is located on private land and was not surveyed.

Large Woody Debris

Large woody debris in streams is an important roughness element influencing stream channel morphology, sediment distribution, and water routine (Swanson and Lienkaemper 1978, Bisson et al 1987). Wood in streams is an important agent in the formation of pools, which are important in the trapping of sediments.

The INFISH standard for large woody debris in streams is 20 pieces of wood per mile that is greater than 12 inches in diameter at the small end and at least 35 feet long. The ICBEMP found that natural or near natural frequency of large wood (> 20" dbh and 35' long) in ponderosa pine and mixed conifer sites in Northern Great Basin streams, for a stream the size and slope of Indian Creek, to have 4 pieces per mile at the 50th percentile and 17 pieces per mile at the 75th percentile. None of the reaches surveyed contain wood in the large size class. Only Reach 4 contains contains woody debris of any functional size, 68 pieces per mile in the medium size class (Table xx). Large woody debris for Indian Creek is considered to be **functioning inappropriately** because large wood numbers are below the 50th percentile for natural and near natural streams.

Substrate Composition
Substrate composition for Indian Creek varies from grass to gravel with gravel, silt/clay, and sand as the sub-dominants (Table xx). Overall, substrate composition for Indian Creek is considered to be **functioning appropriately but at risk** because of the presence of grass and sand as a dominant substrate in reaches 2 and 3.

Bank Stability
Bank stability in Indian Creek within the project area was measured in the fall of 2002 as part of the Ochoco Bottom Line surveys and is summarized in Table xx. None of the reaches surveyed exhibited streambank stability values that were considered functioning inappropriately (less than 80 percent). Streambank stability in Indian Creek varied from 89.6 percent to 98.7 percent in all three surveyed reaches. Therefore, Indian Creek is considered to be **functioning appropriately** for bank stability.

EVALUATION OF ISSUES AND ALTERNATIVES

Effects of the fire and subsequent salvage logging to soils and hydrology (amount of flow, timing of flow, and water quality) are discussed in the soils and watershed reports for this project. 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. In addition, 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 by watershed (miles per square mile), road miles within 300 feet of stream channels, and the amount of harvest within RHCAs (acres).

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.

Sediment Yield
Tons of sediment per year delivered to stream channels was used as a primary indicator to evaluate the effects of roads and timber harvest on fisheries and aquatic habitat. By evaluating trends in this indicator, qualitative inferences can be made about changes to other fish habitat features such as the riparian management objectives identified in INFISH. A predictive model, the Watershed Erosion Prediction Project (WEPP), was used to predict sediment delivery to stream channels.

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.

Road Density/Location
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 flows (Furniss et al. 1991). Wemple (1994) focused on the interaction of forested roads with stream networks and found that nearly 60% of the road network drained into streams and gullies, and are therefore, hydrologically integrated with the stream network. Sediment entering streams from roads is delivered by mass soil movements, surface erosion, failure of stream crossings, and accelerated scour at culvert outlets (Furniss et al. 1991). A study on the Medicine Bow National Forest showed that fine sediment increased as culvert density increased (Eaglin 1991).

To reduce the adverse effects of roads on aquatic resources, road miles should be progressively decreased through permanent closure or obliteration in sub-watersheds with high (1.7 - 4.7 road mi/mi^2) and extreme (>4.7 road mi/mi^2) road

densities (USDA & USDI 1997). 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.

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

RHCA Harvest
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.

Alternative A (No Action)

Direct and Indirect Effects

Sediment Yield
Under Alternative A, sediment inputs from roads would continue to occur in streams within the Silver Geographic Area. 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
- Any private salvage sales
- Sediment producing activities on private land, primarily grazing and roads
- Sediment produced by 2002 fire suppression and future fire suppression activities.

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 was burned at a high intensity and 14.5 percent at moderate intensity. The majority of fire-derived sediments are expected in the West Fork Silver Creek drainage, which experienced a higher percentage of moderate and high severity 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 Geographic Area.

Road Density/Locations
Under Alternative A, existing road densities and miles of open roads within Category 1 and 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. This would include harvest associated with hazard tree removal.

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 intensity fire, 14.5 percent was moderate, and 1.3 percent high (USDA Forest Service 2002-BAER report). Approximately 800 acres in the Silver and Toolbox fire areas 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, 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.

Cumulative Effects

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 RHCA's that was cut down during suppression efforts are aiding 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 during the 2003-2006 period include, natural sediment increases caused by the 2002 fire, road maintenance activities within RHCA's, private salvage sales, sediment producing activities on private lands (primarily grazing and roads), sediment produced by 2002 fire suppression and future fire suppression activities.

Alternatives C and E

Direct and Indirect Effects

Sediment Yield

Alternatives C and E are predicted to deliver between 3.7 and 3.8 tons of sediment per year to streams in the Silver Geographic Area (Table xx). 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 soil section of this environmental impact statement. 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 xx. Estimates of Sediment Yield from Roads for the Silver Geographic Area.

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 yields to stream channels may exceed the streams 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 form outside the channel and/or increases in water yields that result in channel erosion. Significant increases in sediment yield are not expected with the Alternatives C and E due to riparian protection measures and adherance to Forest BMP's.

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.

Road Density/Location

Road density, miles of new temporary road, and miles of re-opened road was calculated for the Toolbox Project area and not on individual fire areas but are reported in the following table. Road data for Category 1 RHCAs is only for the Silver Fire as there are no Category 1 RHCAs in the Toolbox Fire however; the data for Category 4 is for both fire areas. In Alternative C, 16.0 miles of new temporary roads would be constructed and 21.4 miles of existing unclassified road would be re-opened while in Alternative E, 13.3 miles of new temporary roads would be constructed and 15.8 miles of existing unclassified road would be re-opened (Table xx). Approximately 9.5 miles of road reconstruction would occur in both alternatives.

Table xx. Road Management by Alternative for the Silver Geographic Areas.

Alternative	Existing Open Road Density (mi/mi^2)	Post Project Open Road Density (mi/mi^2)	Miles of Road Closed	Miles of Road Decommissioned	Miles of New Temporary Roads	Miles of Existing Unclassified Roads Re-Opened
C	3.68	1.76	27.0	32.6	16.0	21.4
E	3.68	2.57	29.0	11.6	13.3	15.8

In Alternatives C and E, road miles within 300 feet of fish bearing stream channels totals 3.05 miles and 16.38 miles for intermittent streams. Table xx shows the miles of proposed closed and decommissioned road by alternative with the resulting miles of open road within Category 1 and 4 RHCAs. Maintaining a buffer between the road and stream channel provides a filter that minimizes thee 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 xx. Road Activity within RHCAs for the Silver Geographic Areas.

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

Under Alternatives C and E, open road densities in the Silver and Toolbox Geographic Areas would decrease from the current level of 3.68 mi/mi2 to 1.76 mi/mi2 and 2.57 mi/mi2, respectively. Alternative C and E would be considered to be **functioning appropriately but at risk** for road densities within the proposed project area. In addition, open road miles within 300 feet of fish bearing streams would decrease from 3.05 miles to 1.15 miles for Alternative C and 1.84 miles for Alternative E while open road miles within 300 feet of intermittent streams would decrease from 16.38 miles to 12.27 miles for Alternative C and 13.07 miles for Alternative E. Sediment inputs from roads into stream channels is 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
Twenty-two acres are proposed for harvest in Category 1 RHCAs in Alternative C and 4 acres in Alternative E (Table xx). An additional 15 acres of Roadside Hazard harvest is proposed for Category 1 RHCAs. This would occur in both alternatives thus increasing the overall proposed harvest in Category 1 RHCAs to be 37 acres for Alternative C and 19 acres for Alternative E. An additional 186 acres in Category 3 and 15 acres of Category 4 RHCAs would be included throughout both the Silver and Toolbox Geographic Areas.

Table xx. Proposed RHCA for Alternative C and E for the Silver Geographic Area.

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

Harvest would occur in the outer 100 feet of the RHCA (which are typically 300 feet wide, or wider, in slope distance beyond the active edge of the stream channel, on each side of the stream) salvage harvest of selected trees or clumps. Helicopter yarding would be used while retaining a feathered forest edge. No salvage would occur in the first 200 feet of the RHCA. In addition, no mechanized ground-based equipment would be allowed within the entire width of the RHCA. For harvest within Category 3 RHCAs the outer 75 feet of the RHCA (which are typically 150 feet wide slope distance beyond the edge of the wetland, pond, lake or reservoir) salvage harvest of selected trees or clumps would be allowed. Helicopter yarding would be used where topography warrants. "Line-pulling" from ground-based equipment would be used otherwise. A feathered forest edge would be retained. No mechanized ground-based equipment would be allowed within the entire width of the RHCA, except at existing classified road crossings. For Category 4 RHCAs, site selective salvage harvest can occur within this RHCA (which are typically 50 feet wide in slope distance beyond the edge of the active stream channel, on each side of the stream). Between 20 and 80 trees per mile of stream, including all green and sufficient dead trees to provide long-term attainment of Riparian Management Objectives, would be retained. Retained trees would have a minimum dbh of 12 inches and a minimum height of 35 feet. No mechanized ground-based equipment would be allowed within the entire width of RHCA.

Under Alternatives C and E, harvest would occur within Categories 1, 3, and 4 RHCAs. Harvest would occur within 200 feet of 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 within 200 feet of fish bearing streams as opposed to 300 feet. Harvest would also occur within the entire 50-foot buffer width along intermittent streams, thus increasing the potential for sediment transport to downstream fish bearing streams. In addition, the loss of future large wood recruitment to riparian areas would be lost. 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 inappropriately** using ICBEMP criteria.

Under Alternatives C and E, harvest would occur within RHCAs (outer 100 feet of all buffers 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 Geographic Area are 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 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 inappropriately** 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 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. 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 will 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 retention of riparian buffers (RHCAs) will ameliorate most sediment reaching stream channels. Road related activities (road maintenance and construction of temporary road) will 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 salvage logging 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.

Cumulative Effects

In assessing cumulative effects on water quality, past and reasonably foreseeable future activities, both within the project area and within adjacent areas, including fire suppression activity are factors to be considered. Past activities in the affected subwatersheds, including grazing, timber harvest, road construction, and recreational activities are assumed to have negatively affected erosion rates, peak and base flows, channel shape and pattern and water quality, as has been documented in nearby watersheds, Upper Chewaucan and Upper Sycan Rivers. Erosion rates from road construction and timber harvest have likely increased over what would be predicted within an undisturbed watershed. Changes in peak flow are believed to be not measurable due to the presence of overstocked stands within the watershed that have mitigated past harvest activities. Drainage efficiency needs to be reduced through aggressive road treatments that hydrologically disconnect roads within the affected subwatersheds. Livestock grazing at the turn of the century likely decreased or altered streamside vegetation by removing woody shrubs and channel stabilizing sedges. Because of these changes, width-to-depth ratios increased on affected stream channels compromising instream habitat conditions and increasing late summer water temperatures.

Reasonably foreseeable activities include timber harvest outside of the fire area, pre-commercial thinning of overstocked green stands within the fire perimeter, and conifer planting in burned areas to improve upland vegetation conditions in the affected subwatersheds, road maintenance, road drainage improvements, road decommissioning, trail reconstruction, stream channel restoration, and a wide range of recreational uses. All of these activities will be designed to maintain or improve the resiliency of the watershed by improving vegetation conditions, reducing sedimentation, restoring base flows, improving in-channel habitat conditions and increasing the health and vigor of streamside vegetation where and when possible. Improvements in watershed and stream channel conditions will increase the abundance of sensitive fish species within the affected sub-watersheds.

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 than Alternative E, while Alternative E has less commercial salvage in RHCA's than Alternative C.

The short-term sediment inputs produced by Alternatives C and E, although not considered to be significant, are likely to combine with pre-existing sediment sources to produce short-term impacts to 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 towards 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 alternatives) and the natural riparian vegetation recovery that will have occurred by 2004 are the primary factors that should contribute to a long-term reduction of sedimentation into redband trout habitat.

The cumulative effects 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.

Alternative 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 large pools. In headwater areas above the fire instream habitat conditions are expected to remain static or improve over time.

Alternative D, G, and H

Direct and Indirect Effects

Sediment Yield

Alternatives D, G, and H are predicted to deliver between 3.7, 3.8, and 3.7 tons of sediment per year to streams in the Silver Geographic Area (Table xx). 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 soil section of this environmental impact statement. These sediment inputs 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 xx. Estimated Sediment Yield from Roads for the Silver Geographic Area.

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 yields to stream channels may exceed the streams 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 form outside the channel and/or increases in water yields that result in channel erosion. Significant increases in sediment yield are not expected with the Alternatives D, G, and H due to riparian protection measures and adherance to Forest BMP's.

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.

Road Density/Location

Road density, miles of new temporary roads, and miles of re-opened roads was calculated for the Toolbox Project area and not on individual fire areas but are reported in the following table. Road data for Category 1 RHCAs is only for the Silver Fire as there are no Category 1 RHCAs in the Toolbox Fire however; the data for Category 4 is for both fire areas. New temporary road construction would be 16.0 miles for Alternative G and 14.9 miles for Alternative H while no new temporary road construction would occur with Alternative D (Table xx). The amount of existing unclassified roads that would be opened for this project would be 5.7 miles in Alternative D, 21.4 miles in Alternative G, and 19.7 miles in Alternative H (Table xx).

Table xx. Road Management by Alternative for the Silver and Toolbox Geographic Areas.

Alternative	Existing Open Road Density (mi/mi^2)	Post Project Open Road Density (mi/mi^2)	Miles of Road Closed	Miles of Road Decommissioned	Miles of New Temporary Roads	Miles of Existing Unclassified Roads Re-Opened
D	3.68	1.68	29.7	35.2	0.0	5.7
G	3.68	2.57	6.2	35.2	16.0	21.4
H	3.68	1.72	27.0	35.2	14.9	19.7

In Alternatives D, G, and H, road miles within 300 feet of fish bearing stream channels totals 3.05 miles and 16.38 miles for intermittent streams. Table xx shows the miles of proposed closed and decommissioned road by alternative with the resulting miles of open road within Category 1 and 4 RHCAs. Maintaining a buffer between the road and stream channel provides a filter that minimizes thee 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 xx. Road Activity within RHCAs for the Silver Geographic Areas.

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

Under Alternatives D, G, and H, open road densities in the Silver and Toolbox Geographic Areas would decrease from the current level of 3.68 mi/mi^2 to 1.76 mi/mi^2, 2.57 mi/mi^2, and 1.72 mi/mi^2, respectively. Alternatives D and E would be considered to be **functioning appropriately** for road densities within the proposed project area while Alternative G would be **functioning appropriately but at risk for road densities**. In addition, open road miles within 300 feet of fish bearing streams would decrease from 3.05 miles to 1.15 miles for Alternatives D, G, and H while open road miles within 300 feet of intermittent streams would decrease from 16.38 miles to 11.93 miles for all three alternatives. Sediment inputs from roads into stream channels is 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

No harvest is proposed for Category 1 RHCAs in Alternatives D, G, and H (Table xx). However, 15 acres of Roadside Hazard harvest is proposed for Category 1 RHCAs and this would occur in all three alternatives. An additional 186 acres in Category 3 and 15 acres of Category 4 RHCAs would be included throughout both the Silver and Toolbox Geographic Areas.

Table xx. Proposed RHCA by Alternatives D, G, and H for the Silver Geographic Area.

Altenative	RHCA Harvest in Units by Category (Acres)		
	C1	C3	C4
D	0	0	0
G	0	132	45
H	0	5.67	0

For harvest within Category 3 RHCAs the outer 75 feet of the RHCA (which are typically 150 feet wide slope distance beyond the edge of the wetland, pond, lake or reservoir) salvage harvest of selected trees or clumps would be allowed. Helicopter yarding would be used where topography warrants. "Line-pulling" from ground-based equipment would be used otherwise. A feathered forest edge would be retained. No mechanized ground-based equipment would be allowed within the entire width of the RHCA, except at existing classified road crossings. For Category 4 RHCAs, site selective salvage harvest can occur within this RHCA (which are typically 50 feet wide in slope distance beyond the edge of the active stream channel, on each side of the stream). Between 20 and 80 trees per mile of stream, including all green and sufficient dead trees to provide long-term attainment of Riparian Management Objectives, would be retained. Retained trees would have a minimum dbh of 12 inches and a minimum height of 35 feet. No mechanized ground-based equipment would be allowed within the entire width of RHCA.

Under Alternatives D, G, an H, commercial harvest would occur within Categories 3 and 4 RHCAs only. Harvest would occur within the entire 50-foot buffer width along intermittent streams, thus increasing the potential for sediment transport to downstream fish bearing streams. In addition, the loss of future large wood recruitment to riparian areas would be lost. 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 D, G,

and H no significant increases in water yield or sedimentation are predicted. Riparian vegetation and bank stability will improve over time as natural vegetation recovers 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 inappropriately** using ICBEMP criteria.

Under Alternatives D, G, and H, harvest would not occur within Category 1 RHCAs, but would occur in Alternatives G and H in Category 3 and 4 RHCAs. 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 Geographic Area are 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 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
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 inappropriately** using ICBEMP criteria.

Under Alternatives D, G, and H, RHCAs have been established on all streams with some harvest occurring in the outer edges of Category 3 and within Category 4 RHCAs, with specific guidelines (see RHCA Harvest above). No change is expected in the number of pools or large pools 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. 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 will 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 retention of riparian buffers (RHCAs) will ameliorate most sediment reaching stream channels. Road related activities (road maintenance and construction of temporary road) will 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 salvage logging 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.

Cumulative Effects

In assessing cumulative effects on water quality, past and reasonably foreseeable future activities, both within the project area and within adjacent areas, including fire suppression activity are factors to be considered. Past activities in the affected subwatersheds, including grazing, timber harvest, road construction, and recreational activities are assumed to have negatively affected erosion rates, peak and base flows, channel shape and pattern and water quality, as has been documented in nearby watersheds (USDA 1998, USDA 1996). Erosion rates from road construction and timber harvest have likely increased over what would be predicted within an undisturbed watershed. Changes in peak flow are believed to be not measurable due to the presence of overstocked stands within the watershed that have mitigated past harvest activities. Drainage efficiency needs to be reduced through aggressive road treatments that hydrologically disconnect roads within the affected subwatersheds. Livestock grazing at the turn of the century likely decreased or altered streamside vegetation by removing woody shrubs and channel stabilizing sedges. As a result of these changes, width-to-depth ratios increased on affected stream channels compromising instream habitat conditions and increasing late summer water temperatures.

Reasonably foreseeable activities include timber harvest outside of the fire area, pre-commercial thinning of overstocked green stands within the fire perimeter, and conifer planting in burned areas to improve upland vegetation conditions in the affected subwatersheds, road maintenance, road drainage improvements, road decommissioning, trail reconstruction, stream channel restoration, and a wide range of recreational uses. All of these activities will be designed to maintain or improve the resiliency of the watershed by improving vegetation conditions, reducing sedimentation, restoring base flows, improving in-channel habitat conditions and increasing the health and vigor of stream-side vegetation where and when possible. Improvements in watershed and stream channel conditions will increase the abundance of sensitive fish species within the affected subwatersheds.

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.

The short-term sediment inputs produced by Alternatives D, G, and H (which include no harvest within the RHCA's of fish bearing streams other than roadside hazard corridors) although not considered to be significant, are likely to combine with pre-existing sediment sources to produce short-term impacts to 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 towards federal listing or loss of viability to the population or species. The road management activities included in all action alternatives and the natural riparian vegetation recovery that will have occurred by 2004 are the primary factors that should contribute to a long-term reduction of sedimentation into redband trout habitat.

The cumulative effects 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 large pools. In headwater areas above the fire instream habitat conditions are expected to remain static or improve over time.

Toolbox Fire Geographic Area

Existing Condition

There are several intermittent streams in the Toolbox Fire Geographic area: Benny Creek, Hawk Creek, Graham Creek, Duncan Creek, East Duncan Creek, McCall Creek, and Willow Creek. The Toolbox Fire burned a significant portion of the of these stream channels in the geographic area. Table xx summarizes the miles of riparian area burned by severity type along intermittent streams within the project area.

Table xx. Miles of Riparian Area Burned along Streams within the Toolbox Fire Geographic Area.

Stream	Miles in Area	Low Severity	Moderate Severity	High Severity	Percent of Stream Miles Burned at Moderate & High Severity
Benny Creek	6.4	1.1	2.7	2.6	83
Hawk Creek	2.6	0.2	1.1	1.3	92
Graham Creek	4.3	3.8	0.5	0.0	11
Duncan Creek	5.2	0.0	1.7	3.5	100
East Duncan Creek	2.3	0.0	0.4	1.9	100
McCall Creek	1.1	0.3	0.3	0.5	73
Willow Creek	1.9	0.0	0.0	1.9	100
Totals	23.8	5.4	6.7	11.7	

Benny Creek

Approximately 10.2 miles of Benny Creek are in the project area, 6.4 on National Forest System Lands and 3.8 on private lands. No data is available for the private portions of Benny Creek and all discussions regarding Benny Creek will be regarding that portion on National Forest System Lands. Portions of the 6.4 miles of Benny Creek burned during the Toolbox Fire. Fire intensity in RHCAs varied from low to moderate with pockets of high intensity. Along Benny 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.

Data used to describe the current stream channel conditions were collected in the fall of 2002. No stream channel condition data prior to the fire had been collected. Stream functionality calls are made based on whether habitat objectives are being met. Habitat, in particular larger woody debris, is compared to INFISH Riparian Management Objectives (USDA 1995) and the 50th and 75th percentiles for natural and near-natural streams in the Northern Great Basin as modified by the Fremont National Forest (USDA & USDI 1997). Other habitat elements such as bank stability and substrate composition were established by examination of the scientific literature and/or obtained through monitoring of natural or near natural streams on the Fremont National Forest.

Stream Channel Condition

The following table summarizes the data collected on stream channel conditions for Benny Creek. This data was obtained during the fall of 2002 as part of the Ochoco Bottom Line surveys. Reaches 3, 5, 7, and 9 of Benny Creek are located on private land and were not surveyed.

Table xx. Summary of Stream Channel Conditions for Benny Creek, Summer 2002.

Reach	Length (miles)	Large Wood/Mile			Substrate		Active Erosional Surface		Bank Stability (%)
		Small	Medium	Large	Dom.	Sub-Dom.	Length (ft)	Percent of reach	
1	1.29	9	2	1	Sand	Cobble	18.6	81.4	18.6
2	2.31	42	13	19	Cobble	Boulder	4.4	95.6	4.4
4	1.70	15	12	9	Cobble	Cobble	9.1	90.9	9.1
6	0.32	37	6	3	Cobble	Cobble	9.0	91.0	9.0
8	0.13	106	15	0	Gravel	Cobble	8.6	91.4	8.6
10	1.29	9	2	1	Sand	Cobble	6.8	93.2	6.8

*Reaches 3,5,7,9 are located on private land and were not surveyed.

Large Woody Debris
Large woody debris in streams is an important roughness element influencing stream channel morphology, sediment distribution, and water routine (Swanson and Lienkaemper 1978, Bisson et al 1987). Wood in streams is an important agent in the formation of pools, which are important in the trapping of sediments.

The INFISH standard for large woody debris in streams is 20 pieces of wood per mile that is greater than 12 inches in diameter at the small end and at least 35 feet long. The ICBEMP found that natural or near natural frequency of large wood (> 20" dbh and 35' long) in ponderosa pine and mixed conifer sites in Northern Great Basin streams, for a stream the size and slope of Benny Creek, to have 4 pieces per mile at the 50th percentile and 18 pieces per mile at the 75th percentile. Large woody debris for Benny Creek varies from 0 to 19 pieces per mile with the majority of the reaches between 0 and 9 pieces per mile (Table xx). Benny Creek is considered to be **functioning appropriately but at risk** for large woody debris because large wood numbers fall between the 50th and 75th percentiles for natural and near natural streams.

Substrate Composition
Substrate composition for Benny Creek is dominated by cobble in reaches 2, 4, and 6 with boulder and cobble as the sub-dominants and Reach 8 is dominated by gravel with cobble as the sub-dominant (Table xx). In Reaches 1 and 10, sand is the dominant while cobble is sub-dominant. The higher percentage of bank erosion in reach 1 would explain sand being the dominant substrate in this reach. Overall, substrate composition for Benny Creek is considered to be **functioning appropriately but at risk** because of the presence of sand as a dominant and sub-dominant substrate in Reaches 1 and 10.

Bank Stability
Bank stability in Benny Creek within the project area was measured in the fall of 2002 as part of the Ochoco Bottom Line surveys and is summarized in Table xx. Only Reach 1 (81.4 percent) is considered to be **functioning appropriately but at risk**. None of the remaining surveyed reaches exhibited streambank stability values that were considered functioning inappropriately (less than 80 percent). These reaches had streambank stability in that varied between 90.9 percent and 95.6 percent. These reaches of Benny Creek are considered to be **functioning appropriately** for bank stability.

Hawk Creek
Approximately 1.5 miles of Hawk Creek are in the project area. Portions of the 1.5 miles of Hawk Creek burned during the Toolbox Fire. Fire intensity in RHCAs varied from low to moderate with pockets of high intensity. Along Hawk 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.

Data used to describe the current stream channel conditions were collected in the fall of 2002. No stream channel condition data prior to the fire had been collected. Stream functionality calls are made based on whether habitat objectives are being met. Habitat, in particular larger woody debris, is compared to INFISH Riparian Management Objectives (USDA 1995) and the 50th and 75th percentiles for natural and near-natural streams in the Northern Great Basin as modified by the Fremont National Forest (USDA & USDI 1997). Other habitat elements such as bank stability and substrate composition were established by examination of the scientific literature and/or obtained through monitoring of natural or near natural streams on the Fremont National Forest.

Stream Channel Condition
The following table summarizes the data collected on stream channel conditions for Hawk Creek. This data was obtained during the fall of 2002 as part of the Ochoco Bottom Line surveys.

Table xx. Summary of Stream Channel Conditions for Hawk Creek, Summer 2002.

Reach	Length (miles)	Large Wood/Mile			Substrate		Active Erosional Surface		Bank Stability (%)
		Small	Medium	Large	Dom.	Sub-Dom.	Length (ft)	Percent of reach	
1	1.48	20	18	5	Cobble	Gravel	49	0.3	99.7

Large Woody Debris
Large woody debris in streams is an important roughness element influencing stream channel morphology, sediment distribution, and water routine (Swanson and Lienkaemper 1978, Bisson et al 1987). Wood in streams is an important agent in the formation of pools, which are important in the trapping of sediments.
The INFISH standard for large woody debris in streams is 20 pieces of wood per mile that is greater than 12 inches in diameter at the small end and at least 35 feet long. The ICBEMP found that natural or near natural frequency of large wood (> 20" dbh and 35' long) in ponderosa pine and mixed conifer sites in Northern Great Basin streams, for a stream the size and slope of Hawk Creek, to have 8 pieces per mile at the 50th percentile and 33 pieces per mile at the 75th percentile. Reach 1 contains 5 pieces of large wood per mile in the large size classes (Table xx). Large woody debris for Hawk Creek is considered to be **functioning inappropriately** because large wood numbers are below the 50th percentile for natural and near natural streams.

Substrate Composition
Substrate composition for Hawk Creek is dominated by cobble with gravel as the sub-dominants (Table xx). Overall, substrate composition for Hawk Creek is considered to be **functioning appropriately.**

Bank Stability
Bank stability in Hawk Creek within the project area was measured in the fall of 2002 as part of the Ochoco Bottom Line surveys and is summarized in Table xx. The surveyed reach did not exhibit streambank stability values that were considered functioning inappropriately (less than 80 percent). This reach of Hawk Creek had streambank stability that was measured as 99.7 percent. Therefore, reach 1 of Hawk Creek is considered to be **functioning appropriately** for bank stability.

Graham Creek
Approximately 4.3 miles of Graham Creek are in the project area. Portions of the 4.3 miles of Graham Creek burned during the Toolbox Fire. Fire intensity in RHCAs varied from low to moderate with pockets of high intensity. Along Graham 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.

Data used to describe the current stream channel conditions were collected in the fall of 2002. No stream channel condition data prior to the fire had been collected. Stream functionality calls are made based on whether habitat objectives are being met. Habitat, in particular larger woody debris, is compared to INFISH Riparian Management Objectives (USDA 1995) and the 50th and 75th percentiles for natural and near-natural streams in the Northern Great Basin as modified by the Fremont National Forest (USDA & USDI 1997). Other habitat elements such as bank stability and substrate composition were established by examination of the scientific literature and/or obtained through monitoring of natural or near natural streams on the Fremont National Forest.

Stream Channel Condition
The following table summarizes the data collected on stream channel conditions for Graham Creek. This data was obtained during the fall of 2002 as part of the Ochoco Bottom Line surveys.

Table xx. Summary of Stream Channel Conditions for Graham Creek, Summer 2002.

Reach	Length (miles)	Large Wood/Mile			Substrate		Active Erosional Surface		Bank Stability (%)
		Small	Medium	Large	Dom.	Sub-Dom.	Length (ft)	Percent of reach	
1	2.42	65	8	3	Cobble	Gravel	210	0.8	99.2
2	1.89	10	2	1	Cobble	Gravel	409	2.1	97.9

Large Woody Debris
Large woody debris in streams is an important roughness element influencing stream channel morphology, sediment distribution, and water routine (Swanson and Lienkaemper 1978, Bisson et al 1987). Wood in streams is an important agent in the formation of pools, which are important in the trapping of sediments.

The INFISH standard for large woody debris in streams is 20 pieces of wood per mile that is greater than 12 inches in diameter at the small end and at least 35 feet long. The ICBEMP found that natural or near natural frequency of large wood (> 20" dbh and 35' long) in ponderosa pine and mixed conifer sites in Northern Great Basin streams, for a stream the size and slope of Graham Creek, to have 7 pieces per mile at the 50th percentile and 30 pieces per mile at the 75th percentile. Reach 1 contains 3 pieces of large wood per mile in the large size class and reach 2 contains 1 piece of large wood per mile (Table xx). Large woody debris for Graham Creek is considered to be **functioning inappropriately** because large wood numbers are below the 50th percentile for natural and near natural streams.

Substrate Composition

Substrate composition for Graham Creek is dominated by cobble with gravel as the sub-dominants in both surveyed reaches (Table xx). Overall, substrate composition for Graham Creek is considered to be **functioning appropriately**.

Bank Stability

Bank stability in Graham Creek within the project area was measured in the fall of 2002 as part of the Ochoco Bottom Line surveys and is summarized in Table xx. The surveyed reaches did not exhibit streambank stability values that were considered functioning inappropriately (less than 80 percent). Reaches 1 and 2 of Graham Creek have streambank stability that was measured as 99.2 percent and 97.9 percent. Therefore, reaches 1 and 2 of Graham Creek are considered to be **functioning appropriately** for bank stability.

Duncan Creek

Approximately 4.2 miles of Duncan Creek are in the project area. All 4.2 miles of Duncan Creek burned during the Toolbox Fire. Fire intensity in RHCAs varied from low to moderate with pockets of high intensity. Along Duncan 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.

Data used to describe the current stream channel conditions were collected in the fall of 2002. No stream channel condition data prior to the fire had been collected. Stream functionality calls are made based on whether habitat objectives are being met. Habitat, in particular larger woody debris, is compared to INFISH Riparian Management Objectives (USDA 1995) and the 50th and 75th percentiles for natural and near-natural streams in the Northern Great Basin as modified by the Fremont National Forest (USDA & USDI 1997). Other habitat elements such as bank stability and substrate composition were established by examination of the scientific literature and/or obtained through monitoring of natural or near natural streams on the Fremont National Forest.

Stream Channel Condition

The following table summarizes the data collected on stream channel conditions for Duncan Creek. This data was obtained during the fall of 2002 as part of the Ochoco Bottom Line surveys.

Table xx. Summary of Stream Channel Conditions for Duncan Creek, Summer 2002.

Reach	Length (miles)	Large Wood/Mile			Substrate		Active Erosional Surface		Bank Stability (%)
		Small	Medium	Large	Dom.	Sub-Dom.	Length (ft)	Percent of reach	
1	4.24	30	22	16	Boulder	Gravel	1446	3.3	96.7

Large Woody Debris

Large woody debris in streams is an important roughness element influencing stream channel morphology, sediment distribution, and water routine (Swanson and Lienkaemper 1978, Bisson et al 1987). Wood in streams is an important agent in the formation of pools, which are important in the trapping of sediments.

The INFISH standard for large woody debris in streams is 20 pieces of wood per mile that is greater than 12 inches in diameter at the small end and at least 35 feet long. The ICBEMP found that natural or near natural frequency of large wood (> 20" dbh and 35' long) in ponderosa pine and mixed conifer sites in Northern Great Basin streams, for a stream the size and slope of Duncan Creek, to have 4 pieces per mile at the 50th percentile and 17 pieces per mile at the 75th percentile. Reach 1 contains 16 pieces of large wood per mile in the large size classes (Table xx). Large woody debris for Duncan

Creek is considered to be **functioning appropriately but at risk** because large wood numbers fall between the 50th and 75th percentiles for natural and near natural streams.

Substrate Composition
Substrate composition for Duncan Creek is dominated by boulder with gravel as the sub-dominant (Table xx). Overall, substrate composition for Duncan Creek is considered to be **functioning appropriately**.

Bank Stability
Bank stability in Duncan Creek within the project area was measured in the fall of 2002 as part of the Ochoco Bottom Line surveys and is summarized in Table xx. The surveyed reach did not exhibit streambank stability values that were considered functioning inappropriately (less than 80 percent). This reach of Duncan Creek has streambank stability that was measured at 96.7 percent. Therefore, reach 1 of Duncan Creek is considered to be **functioning appropriately** for bank stability.

East Duncan Creek

Approximately 2.3 miles of East Duncan Creek are in the project area. All 2.3 miles of East Duncan Creek burned during the Toolbox Fire. Fire intensity in RHCAs varied from low to moderate with pockets of high intensity. Along East Duncan 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.

Data used to describe the current stream channel conditions were collected in the fall of 2002. No stream channel condition data prior to the fire had been collected. Stream functionality calls are made based on whether habitat objectives are being met. Habitat, in particular larger woody debris, is compared to INFISH Riparian Management Objectives (USDA 1995) and the 50th and 75th percentiles for natural and near-natural streams in the Northern Great Basin as modified by the Fremont National Forest (USDA & USDI 1997). Other habitat elements such as bank stability and substrate composition were established by examination of the scientific literature and/or obtained through monitoring of natural or near natural streams on the Fremont National Forest.

Stream Channel Condition

The following table summarizes the data collected on stream channel conditions for East Duncan Creek. This data was obtained during the fall of 2002 as part of the Ochoco Bottom Line surveys.

Table xx. Summary of Stream Channel Conditions for East Duncan Creek, Summer 2002.

Reach	Length (miles)	Large Wood/Mile			Substrate		Active Erosional Surface		Bank Stability (%)
		Small	Medium	Large	Dom.	Sub-Dom.	Length (ft)	Percent of reach	
1	2.31	36	36	18	Gravel	Cobble	0	0	100

Large Woody Debris
Large woody debris in streams is an important roughness element influencing stream channel morphology, sediment distribution, and water routine (Swanson and Lienkaemper 1978, Bisson et al 1987). Wood in streams is an important agent in the formation of pools, which are important in the trapping of sediments.

The INFISH standard for large woody debris in streams is 20 pieces of wood per mile that is greater than 12 inches in diameter at the small end and at least 35 feet long. The ICBEMP found that natural or near natural frequency of large wood (> 20” dbh and 35’ long) in ponderosa pine and mixed conifer sites in Northern Great Basin streams, for a stream the size and slope of East Duncan Creek, to have 6 pieces per mile at the 50th percentile and 27 pieces per mile at the 75th percentile. Reach 1 contains 18 pieces of large wood per mile in the large size class (Table xx). Large woody debris for East Duncan Creek is considered to be **functioning appropriately but at risk** because large wood numbers fall between the 50th and 75th percentiles for natural and near natural streams.

Substrate Composition

Substrate composition for East Duncan Creek is dominated by gravel with cobble as the sub-dominants (Table xx). Overall, substrate composition for East Duncan Creek is considered to be **functioning appropriately**.

Bank Stability

Bank stability in East Duncan Creek within the project area was measured in the fall of 2002 as part of the Ochoco Bottom Line surveys and is summarized in Table xx. The surveyed reach did not exhibit streambank stability values that were considered functioning inappropriately (less than 80 percent). This reach of East Duncan Creek has streambank stability that was measured as 100 percent. Therefore, reach 1 of East Duncan Creek is considered to be **functioning appropriately** for bank stability.

McCall Creek

Approximately 1.1 miles of McCall Creek are in the project area. All 1.1 miles of McCall Creek burned during the Toolbox Fire. Fire intensity in RHCAs varied from low to moderate with pockets of high intensity. Along McCall 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.

Data used to describe the current stream channel conditions were collected in the fall of 2002. No stream channel condition data prior to the fire had been collected. Stream functionality calls are made based on whether habitat objectives are being met. Habitat, in particular larger woody debris, is compared to INFISH Riparian Management Objectives (USDA 1995) and the 50th and 75th percentiles for natural and near-natural streams in the Northern Great Basin as modified by the Fremont National Forest (USDA & USDI 1997). Other habitat elements such as bank stability and substrate composition were established by examination of the scientific literature and/or obtained through monitoring of natural or near natural streams on the Fremont National Forest.

Stream Channel Condition

The following table summarizes the data collected on stream channel conditions for McCall Creek. This data was obtained during the fall of 2002 as part of the Ochoco Bottom Line surveys.

Table xx. Summary of Stream Channel Conditions for McCall Creek, Summer 2002.

Reach	Length (miles)	Large Wood/Mile			Substrate		Active Erosional Surface		Bank Stability (%)
		Small	Medium	Large	Dom.	Sub-Dom.	Length (ft)	Percent of reach	
1	0.64	16	2	2	Cobble	Gravel	785	11.5	89.5
2	0.47	4	2	2	Sand	Cobble	220	4.4	95.6

Large Woody Debris

Large woody debris in streams is an important roughness element influencing stream channel morphology, sediment distribution, and water routine (Swanson and Lienkaemper 1978, Bisson et al 1987). Wood in streams is an important agent in the formation of pools, which are important in the trapping of sediments.

The INFISH standard for large woody debris in streams is 20 pieces of wood per mile that is greater than 12 inches in diameter at the small end and at least 35 feet long. The ICBEMP found that natural or near natural frequency of large wood (> 20” dbh and 35’ long) in ponderosa pine and mixed conifer sites in Northern Great Basin streams, for a stream the size and slope of McCall Creek, to have 12 pieces per mile at the 50th percentile and 50 pieces per mile at the 75th percentile. Reaches 1 and 2 each contain 2 pieces of large wood per mile in the large size class (Table xx). Large woody debris for McCall Creek is considered to be **functioning inappropriately** because large wood numbers are below the 50th percentile for natural and near natural streams.

Substrate Composition

Substrate composition for McCall Creek is dominated by cobble in reach 1 and sand in reach 2 with gravel and cobble as the sub-dominants (Table xx). Overall, substrate composition for McCall Creek is considered to be **functioning appropriately but at risk** because of the presence of sand as a dominant substrate in reaches 2.

Bank Stability

Bank stability in McCall Creek within the project area was measured in the fall of 2002 as part of the Ochoco Bottom Line surveys and is summarized in Table xx. The surveyed reaches did not exhibit streambank stability values that were considered functioning inappropriately (less than 80 percent). These reaches of McCall Creek have streambank stability that was measured as 89.5 percent and 95.6 percent. Therefore, reaches 1 and 2 of McCall Creek are considered to be **functioning appropriately** for bank stability.

Willow Creek

Approximately 1.9 miles of Willow Creek are in the project area. All 1.9 miles of Willow Creek burned during the Toolbox Fire. Fire intensity in RHCAs varied from low to moderate with pockets of high intensity. Along McCall 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.

Data used to describe the current stream channel conditions were collected in the fall of 2002. No stream channel condition data prior to the fire had been collected. Stream functionality calls are made based on whether habitat objectives are being met. Habitat, in particular larger woody debris, is compared to INFISH Riparian Management Objectives (USDA 1995) and the 50th and 75th percentiles for natural and near-natural streams in the Northern Great Basin as modified by the Fremont National Forest (USDA & USDI 1997). Other habitat elements such as bank stability and substrate composition were established by examination of the scientific literature and/or obtained through monitoring of natural or near natural streams on the Fremont National Forest.

Stream Channel Condition

The following table summarizes the data collected on stream channel conditions for Willow Creek. This data was obtained during the fall of 2002 as part of the Ochoco Bottom Line surveys.

Table xx. Summary of Stream Channel Conditions for Willow Creek, Summer 2002.

Reach	Length (miles)	Large Wood/Mile			Substrate		Active Erosional Surface		Bank Stability (%)
		Small	Medium	Large	Dom.	Sub-Dom.	Length (ft)	Percent of reach	
1	1.33	21	10	2	Gravel	Cobble	2051	14.7	85.3
2	0.40	18	0	0	Gravel	Cobble	430	10.2	89.8
3	0.19	37	0	0	Gravel	Cobble	35	1.8	98.2

Large Woody Debris

Large woody debris in streams is an important roughness element influencing stream channel morphology, sediment distribution, and water routine (Swanson and Lienkaemper 1978, Bisson et al 1987). Wood in streams is an important agent in the formation of pools, which are important in the trapping of sediments.

The INFISH standard for large woody debris in streams is 20 pieces of wood per mile that is greater than 12 inches in diameter at the small end and at least 35 feet long. The ICBEMP found that natural or near natural frequency of large wood (> 20" dbh and 35' long) in ponderosa pine and mixed conifer sites in Northern Great Basin streams, for a stream the size and slope of Willow Creek, to have 10 pieces per mile at the 50th percentile and 40 pieces per mile at the 75th percentile. Reach 1 contains 2 pieces of large wood per mile in the large size class while reaches 2 and 3 contains 0 pieces of large wood per mil (Table xx). Large woody debris for Willow Creek is considered to be **functioning inappropriately** because large wood numbers are below the 50th percentile for natural and near natural streams.

Substrate Composition

Substrate composition for Willow Creek is dominated by gravel in all reaches with cobble as the sub-dominant (Table xx). Overall, substrate composition for Willow Creek is considered to be **functioning appropriately**.

Bank Stability

Bank stability in Willow Creek within the project area was measured in the fall of 2002 as part of the Ochoco Bottom Line surveys and is summarized in Table xx. The surveyed reaches did not exhibit streambank stability values that were considered functioning inappropriately (less than 80 percent). Reach 1 (85.3 percent) is considered to be **functioning appropriately but at risk**. Reaches 2 and 3 of Willow Creek have streambank stability that was measured as 89.8 percent

and 98.2 percent. Therefore, reaches 2 and 3 of Willow Creek are considered to be **functioning appropriately** for bank stability.

EVALUATION OF ISSUES AND ALTERNATIVES

Effects of the fire and subsequent salvage logging to soils and hydrology (amount of flow, timing of flow, and water quality) are discussed in the soils and watershed reports for this project. This section will discuss the effects of each alternative on stream channel conditions in potentially affected stream reaches and will document compliance with the INFISH strategy. In addition, effects to sensitive fish will also be discussed. Differences between the five action alternatives on stream channel conditions 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 to the different alternatives on the functional capabilities of intermittent stream channels. These indicators include: Sediment yield from roads and proposed harvest (tons per year), road density by watershed (miles per square mile), road miles within 300 feet of stream channels, and the amount of harvest within RHCAs (acres).

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

Sediment Yield

Tons of sediment per acre delivered to stream channels was used as a primary indicator to evaluate the effects of roads and timber harvest on fisheries and aquatic habitat. By evaluating trends in this indicator, qualitative inferences can be made about changes to other fish habitat features such as the riparian management objectives identified in INFISH. A predictive model, the Watershed Erosion Prediction Project (WEPP), was used to predict sediment delivery to stream channels.

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.

Road Density/Location

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 flows (Furniss et al. 1991). Wemple (1994) focused on the interaction of forested roads with stream networks and found that nearly 60% of the road network drained into streams and gullies, and are therefore, hydrologically integrated with the stream network. Sediment entering streams from roads is delivered by mass soil movements, surface erosion, failure of stream crossings, and accelerated scour at culvert outlets (Furniss et al. 1991). A study on the Medicine Bow National Forest showed that fine sediment increased as culvert density increased (Eaglin 1991).

To reduce the adverse effects of roads on aquatic resources, road miles should be progressively decreased through permanent closure or obliteration in sub-watersheds with high (1.7 - 4.7 road mi/mi^2) and extreme (>4.7 road mi/mi^2) road densities (USDA & USDI 1997). 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.

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.

RHCA Harvest
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.

Alternative A (No Action)

Direct and Indirect Effects

Sediment Yield
Under Alternative A, sediment inputs from roads would continue to occur in streams within the Toolbox Geographic Area. 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
- Any private salvage sales
- Sediment producing activities on private land, primarily grazing and roads
- Sediment produced by 2002 fire suppression and future fire suppression activities.

Fire-derived sediment increases in Benny, Hawk, Graham, Duncan, East Duncan, Willow, and McCall Creeks are likely to be moderate because the loamy soil conditions and that 1.3 percent of the Toolbox Fire area was burned at a high intensity and 21.1 percent at moderate intensity. The majority of fire-derived sediments are expected in the Duncan, East Duncan, and Willow Creek drainages, which experienced a higher percentage of moderate and high severity 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 2.8 tons per year under Alternative A for the Toolbox Geographic Area.

Road Density/Location
Under Alternative A, existing road densities and miles of open roads within Category 1 and 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 by delivering fine sediment to instream habitats and increasing the drainage network.

RHCA Harvest
No harvest would occur under this alternative. This includes harvest as part of hazard tree removal.

Stream Channel 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 intensity fire, 14.5 percent was moderate, and 1.3 percent high (USDA Forest Service 2002-BAER report). Soils were not found to be hydrophobic. 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, although reconstruction activities, including drainage improvements would likely not take place. Fine sediment levels would remain unchanged in affected stream channels.

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 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.

Cumulative Effects

Minor short-term changes in stream channel conditions would be expected with the implementation of Alternative A. Short-term changes include: increased fine sediment from roads and to a lesser extent from hillslopes burned in the fire, any large wood in RHCAs that was cut down during suppression efforts are aiding in pool formation and providing stream channel stability. 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 pools within intermittent stream channels. Fine sediment would continue to be a problem due to extensive road systems.

Alternatives C and E

Direct and Indirect Effects

Sediment Yield

Alternatives C and E are predicted to deliver between 2.3 and 2.6 tons of sediment per year to streams in the Silver Geographic Area (Table xx). 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 soil section of this environmental impact statement. These sediment inputs 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 xx. Modeled Long-term Sediment Yield from Roads for the Toolbox Geographic Area.

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	2.8	0.3	2.3	10.7
E	2.8	0.3	2.6	7.2

Significant increases in sediment yields to stream channels may exceed the streams 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 form outside the channel and/or increases in water yields that result in channel erosion. Significant increases in sediment yield are not expected with the Alternatives D, G, and H due to riparian protection measures and adherance to Forest BMP's.

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 intermittent stream channel conditions. However, it is expected that over the long-term, sediment reduction from road closures and decommissioning would help improve intermittent stream channel conditions for each alternative.

Road Density/Location

Road density, miles of new temporary roads, and miles of re-opened roads was calculated for the Toolbox Project area and not on individual fire areas and are reported in the following table. Road data for Category 1 RHCAs is only for the Silver Fire as there are no Category 1 RHCAs in the Toolbox Fire however the data for Category 4 is for both fire areas. In Alternative C, 16.0 miles of new temporary roads would be constructed and 21.4 miles of existing unclassified road would

be re-opened while in Alternative E, 13.3 miles of new temporary roads would be constructed and 15.8 miles of existing unclassified road would be re-opened (Table xx). Approximately 9.5 miles of road reconstruction would occur in both alternatives.

Table xx. Road Management by Alternative for the Toolbox Geographic Areas.

Alternative	Existing Open Road Density (mi/mi^2)	Post Project Open Road Density (mi/mi^2)	Miles of Road Closed	Miles of Road Decommissioned	Miles of New Temporary Roads	Miles of Existing Unclassified Roads Re-Opened
C	3.68	1.76	45.8	36.4	16.0	21.4
E	3.68	2.57	38.4	3.0	13.3	15.8

In Alternatives C and E, road miles within 300 feet of intermittent streams are 14.12 miles. There are no fish bearing streams within the Toolbox Geographic Area. Table xx shows the miles of proposed closed and decommissioned road by alternative with the resulting miles of open road within Category 4 RHCAs. Maintaining a buffer between the road and stream channel provides a filter that minimizes thee 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 xx. Road Activity within RHCAs for the Toolbox Geographic Areas.

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	0.0	14.12	0.0	3.38	0.0	3.94	0.0	10.18
E	0.0	14.12	0.0	5.01	0.0	1.44	0.0	12.68

Under Alternatives C and E, open road densities in the Silver and Toolbox Geographic Areas would decrease from the current level of 3.68 mi/mi2 to 1.76 mi/mi2 and 2.57 mi/mi2, respectively. Alternatives C and E are considered to be **functioning appropriately but at risk** for road densities within the proposed project area. In addition, open road miles within 300 feet of intermittent streams would decrease from 14.12 miles to 10.18 miles for Alternative C and 12.68 miles for Alternative E. Sediment inputs from roads into stream channels is 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

Category 1 RHCAs do not occur in the Toolbox Geographic Area (Table xx). The proposed amount of harvest in Category 3 and Category 4 RHCAs by alternative is provided in the following table. An additional 186 acres in Category 3 and 15 acres of Category 4 RHCAs would be included throughout both the Silver and Toolbox Geographic Areas.

Table xx. Proposed RHCA Harvest for Alternatives C and E for the Toolbox Geographic Area.

Alternative	RHCA Harvest in Units by Category (Acres)		
	C1	C3	C4
C	0	132	86
E	0	107	60

For harvest within Category 3 RHCAs the outer 75 feet of the RHCA (which are typically 150 feet wide slope distance beyond the edge of the wetland, pond, lake or reservoir) salvage harvest of selected trees or clumps would be allowed. Helicopter yarding would be used where topography warrants. "Line-pulling" from ground-based equipment would be used otherwise. A feathered forest edge would be retained. No mechanized ground-based equipment would be allowed within the entire width of the RHCA, except at existing classified road crossings. For Category 4 RHCAs, site selective salvage harvest can occur within this RHCA (which are typically 50 feet wide in slope distance beyond the edge of the active stream channel, on each side of the stream). Between 20 and 80 trees per mile of stream, including all green and sufficient dead trees to provide long-term attainment of Riparian Management Objectives, would be retained. Retained trees would have a minimum dbh of 12 inches and a minimum height of 35 feet. No mechanized ground-based equipment would be allowed within the entire width of RHCA.

Large wood

Benny Creek, Duncan Creek, and East Duncan Creek (in all reaches in the project area) are **functioning appropriately but at risk** for meeting INFISH and ICBEMP standards for large wood. Hawk Creek, Graham Creek, McCall Creek, and Willow Creek are **functioning inappropriately** for meeting INFISH standards and natural and near natural conditions as described in ICBEMP.

Under Alternatives C and E, harvest would occur within Category 3 and 4 RHCAs. No Category 1 RHCAs occur within the Toolbox Geographic Area. 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 intermittent streams in the Toolbox Fire Geographic Area are expected to increase over the next 20 years, which will be sufficient to move to a functional condition. Leave requirements for Category 4 RHCAs will ensure the future recruitment of large woody debris to these stream channels.

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. 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 will be constructed within RHCAs. 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 substrate in intermittent stream channels.

Salvage activities proposed under Alternatives C and E are not expected to add significantly to fine sediment entering intermittent streams. If any project-generated sediment were to reach intermittent 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 retention of riparian buffers (RHCAs) will ameliorate most sediment reaching stream channels. Road related activities (road maintenance and construction of temporary road) will also have minimal effect as long as road BMPs are followed.

Bank Stability

Reach 1 of Benny Creek and Willow Creek are **functioning appropriately but at risk** for bank stability while the remaining reaches of these two streams are **functioning appropriately**. All reaches of Hawk Creek, Graham Creek, Duncan Creek, East Duncan Creek, and McCall Creek 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 over time as areas that experienced moderate and high burn intensities revegetate.

Cumulative Effects

In assessing cumulative effects on water quality, past and reasonably foreseeable future activities, both within the project area and within adjacent areas, including fire suppression activity are factors to be considered. Past activities in the affected subwatersheds, including grazing, timber harvest, road construction, and recreational activities are assumed to have negatively affected erosion rates, peak and base flows, channel shape and pattern and water quality, as has been documented in nearby watersheds (Upper Chewaucan & Upper Sycan Rivers). Erosion rates from road construction and timber harvest have likely increased over what would be predicted within an undisturbed watershed. Changes in peak flow are believed to be not measurable due to the presence of overstocked stands within the watershed that have mitigated past harvest activities. Drainage efficiency needs to be reduced through aggressive road treatments that hydrologically disconnect roads within the affected subwatersheds. Livestock grazing at the turn of the century likely decreased or altered streamside vegetation by removing woody shrubs and channel stabilizing sedges. Because of these changes, width-to-depth ratios increased on affected stream channels compromising instream habitat conditions and increasing late summer water temperatures.

Reasonably foreseeable activities include timber harvest outside of the fire area, pre-commercial thinning of overstocked green stands within the fire perimeter, and conifer planting in burned areas to improve upland vegetation conditions in the affected subwatersheds, road maintenance, road drainage improvements, road decommissioning, trail reconstruction, stream

channel restoration, and a wide range of recreational uses. All of these activities will be designed to maintain or improve the resiliency of the watershed by improving vegetation conditions, reducing sedimentation, restoring base flows, improving in-channel habitat conditions and increasing the health and vigor of stream-side vegetation where and when possible.

Alternatives C and E would not affect large woody debris recruitment. Intermittent stream channel 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.

Alternative D, G, and H

Direct and Indirect Effects

Sediment Yield

Alternatives D, G, and H are predicted to deliver between 2.6, 2.6, and 2.3 tons of sediment per year to streams in the Silver Geographic Area (Table xx). 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 soil section of this environmental impact statement. These sediment inputs 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 xx. Estimated Long-term Sediment Yield from Roads for the Toolbox Geographic Area.

Alternative	Baseline Condition Sediment Yield (tons/yr)	Road Decommission Reductions in Sediment Yield (tons/yr)	Open Road Sediment Yield (tons/yr)	Percent Reduction from Baseline Condition
D	2.8	0.3	2.6	7.2
G	2.8	0.3	2.6	7.2
H	2.8	0.3	2.3	10.7

Significant increases in sediment yields to stream channels may exceed the streams 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 form outside the channel and/or increases in water yields that result in channel erosion. Significant increases in sediment yield are not expected with the Alternatives D, G, and H due to riparian protection measures and adherance to Forest BMP's.

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 intermittent stream channel conditions. However, it is expected that over the long-term, sediment reduction from road closures and decommissioning would help improve intermittent stream channel conditions 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.

Road Density/Location

Road density, miles of new temporary roads, and miles of re-opened road data was calculated for the Toolbox Project area and not on individual fire areas and are reported in the following table. Road data for Category 1 RHCAs is only for the Silver Fire as there are no Category 1 RHCAs in the Toolbox Fire however; the data for Category 4 is for both fire areas. New temporary road construction would be 16.0 miles for Alternative G and 14.9 miles for Alternative H while no new temporary road construction would occur with Alternative D (Table xx). The amount of existing unclassified roads that would be opened for this project would be 5.7 miles in Alternative D, 21.4 miles in Alternative G, and 19.7 miles in Alternative H (Table xx).

Table xx. Road Management by Alternative for the Silver and Toolbox Geographic Areas.

Alternative	Existing Open Road Density (mi/mi^2)	Post Project Open Road Density (mi/mi^2)	Miles of Road Closed	Miles of Road Decommissioned	Miles of New Temporary Roads	Miles of Existing Unclassified Roads Re-Opened
D	3.68	1.68	45.8	36.4	0.0	5.7
G	3.68	2.57	5.0	36.4	16.0	21.4

H	3.68	1.72	45.8	36.4	14.9	19.7

In Alternatives D, G, and H, road miles within 300 feet of intermittent stream channels totals 14.12 miles. There are no fish bearing streams within the Toolbox Geographic Area. Table __ shows the miles of proposed closed and decommissioned road by alternative with the resulting miles of open road within Category 4 RHCAs. Maintaining a buffer between the road and stream channel provides a filter that minimizes thee 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 __. Road Activity within RHCAs for the Toolbox Geographic Areas.

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	0.0	14.12	0.0	3.38	0.0	3.94	0.0	10.18
G	0.0	14.12	0.0	1.92	0.0	3.94	0.0	10.18
H	0.0	14.12	0.0	3.38	0.0	3.94	0.0	10.18

Under Alternatives D, G, and H, open road densities in the Silver and Toolbox Geographic Areas would decrease from the current level of 3.68 mi/mi^2 to 1.76 mi/mi^2, 2.57 mi/mi^2, and 1.72 mi/mi^2, respectively. Alternatives D and H are considered to be **functioning appropriately** for road densities within the proposed project area while Alternative G is **functioning appropriately but at risk** for road densities. In addition, open road miles within 300 feet of intermittent streams would decrease from 14.12 miles to 10.18 miles for all three alternatives. Sediment inputs from roads into stream channels is 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

Category 1 RHCAs do not occur in the Toolbox Geographic Area. in Alternative C and 4 acres in Alternative E (Table xx). An additional 15 acres of Roadside Hazard harvest is proposed for Category 1 RHCAs. This would occur in both alternatives thus increasing the overall proposed harvest in Category 1 RHCAs to be 37 acres for Alternative C and 19 acres for Alternative E. An additional 186 acres in Category 3 and 15 acres of Category 4 RHCAs would be included throughout both the Silver and Toolbox Geographic Areas.

Table xx. Proposed RHCA for Alternative C and E for the Toolbox Geographic Area.

Alternative	RHCA Harvest in Units by Category (Acres)		
	C1	C3	C4
D	0	0	0
G	0	132	86
H	0	132	45

For harvest within Category 3 RHCAs the outer 75 feet of the RHCA (which are typically 150 feet wide slope distance beyond the edge of the wetland, pond, lake or reservoir) salvage harvest of selected trees or clumps would be allowed. Helicopter yarding would be used where topography warrants. "Line-pulling" from ground-based equipment would be used otherwise. A feathered forest edge would be retained. No mechanized ground-based equipment would be allowed within the entire width of the RHCA, except at existing classified road crossings. For Category 4 RHCAs, site selective salvage harvest can occur within this RHCA (which are typically 50 feet wide in slope distance beyond the edge of the active stream channel, on each side of the stream). Between 20 and 80 trees per mile of stream, including all green and sufficient dead trees to provide long-term attainment of Riparian Management Objectives, would be retained. Retained trees would have a minimum dbh of 12 inches and a minimum height of 35 feet. No mechanized ground-based equipment would be allowed within the entire width of RHCA.

Large wood

Benny Creek, Duncan Creek, and East Duncan Creek (in all reaches in the project area) are **functioning appropriately but at risk** for meeting INFISH and ICBEMP standards for large wood. Hawk Creek, Graham Creek, McCall Creek, and Willow Creek are **functioning inappropriately** for meeting INFISH standards and natural and near natural conditions as described in ICBEMP.

Under Alternatives D, G, and H, harvest would occur within Category 3 and 4 RHCAs. No Category 1 RHCAs occur within the Toolbox Geographic Area. 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 intermittent streams in the Toolbox Fire Geographic Area are expected to increase over the next 20 years, which will be sufficient to move to a functional condition. Leave requirements for Category 4 RHCAs will ensure the future recruitment of large woody debris to these stream channels.

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. 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 will be constructed within RHCAs. 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 substrate in intermittent stream channels.

Salvage activities proposed under Alternatives D, G, and H are not expected to add significantly to fine sediment entering intermittent streams. If any project-generated sediment were to reach intermittent 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 retention of riparian buffers (RHCAs) will ameliorate most sediment reaching stream channels. Road related activities (road maintenance and construction of temporary road) will also have minimal effect as long as road BMPs are followed.

Bank Stability
Reach 1 of Benny Creek and Willow Creek are **functioning appropriately but at risk** for bank stability while the remaining reaches of these two streams are **functioning appropriately**. All reaches of Hawk Creek, Graham Creek, Duncan Creek, East Duncan Creek, and McCall Creek 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 over time as areas that experienced moderate and high burn intensities revegetate.

Cumulative Effects
In assessing cumulative effects on water quality, past and reasonably foreseeable future activities, both within the project area and within adjacent areas, including fire suppression activity are factors to be considered. Past activities in the affected subwatersheds, including grazing, timber harvest, road construction, and recreational activities are assumed to have negatively affected erosion rates, peak and base flows, channel shape and pattern and water quality, as has been documented in nearby watersheds (USDA 1998, USDA 1996). Erosion rates from road construction and timber harvest have likely increased over what would be predicted within an undisturbed watershed. Changes in peak flow are believed to be not measurable due to the presence of overstocked stands within the watershed that have mitigated past harvest activities. Drainage efficiency needs to be reduced through aggressive road treatments that hydrologically disconnect roads within the affected subwatersheds. Livestock grazing at the turn of the century likely decreased or altered streamside vegetation by removing woody shrubs and channel stabilizing sedges. Because of these changes, width-to-depth ratios increased on affected stream channels compromising instream habitat conditions and increasing late summer water temperatures.

Reasonably foreseeable activities include timber harvest outside of the fire area, pre-commercial thinning of overstocked green stands within the fire perimeter, and conifer planting in burned areas to improve upland vegetation conditions in the affected subwatersheds, road maintenance, road drainage improvements, road decommissioning, trail reconstruction, stream channel restoration, and a wide range of recreational uses. All of these activities will be designed to maintain or improve the resiliency of the watershed by improving vegetation conditions, reducing sedimentation, restoring base flows, improving in-channel habitat conditions and increasing the health and vigor of stream-side vegetation where and when possible.

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.

POST PROJECT/FIRE MONITORING

Concern for the effects of the fire and the Toolbox Fire Recovery Project on aquatic habitat will focus on the risk of accelerated erosion from the burned slopes, roads, and harvest units adjacent to Silver Creek, West Fork Silver Creek, North Fork Silver Creek, and Guyer Creek, recovery of riparian vegetation, and potential increased sediment effects on aquatic macroinvertebrates. The potential for increased inputs of fine sediment could adversely affect downstream aquatic life. The specific areas of concern lie within the Silver Fire portion of the Toolbox Complex Fire. The combination of moderate to high burn severity in riparian areas increases the risk that heavy precipitation or spring runoff may induce stream bank sloughing, gullying or mass movement of soil into the streams.

In order to determine if potential adverse impacts to riparian and aquatic habitats on fish bearing streams resulting from the Toolbox Complex Fire, the North Zone Fisheries Program of the Fremont National Forest proposes the following monitoring program to document any potential changes in key physical and biological watershed indicators.

Substrate and Fine Sediments
Wolman pebble counts and McNeil core sampling are proposed to monitor potential changes in substrate composition and intrusion of fine sediments into spawning gravels for redband trout. Wolman pebble counts and McNeil core samples will occur in 2003, 2005, and 2008. McNeil samples will be compared to data obtained from samples taken in 1995, 1996, and 2001.

Wolman pebble counts will be performed twice in each surveyed stream reach. Several transects will be sampled across the stream bankfull channel, perpendicular to stream flow, until a minimum of 100 points have been sampled. Pebbles will be selected from the toe of the boot in a toe to heel transect and measured along the intermediate axis. Peebles to 2 mm in size will be directly measured while sand, silt, and clay particles will be tallied as less than 2 mm. The total number of pebbles in each size class will be tabulated and converted into percentages and cumulative percent distributions for each sampled site.

McNeil core samples will be located at potential spawning habitat, primarily in pool tailouts. A McNeil core sampler will be inserted 15 to 20 cm into the streambed. Two core samples will be taken at each sampling location. Core samples will be oven dried and sieved using the following sieve sizes: 102.0 mm, 64.0 mm, 32.0 mm, 16.0 mm, 8.0 mm, 6.4 mm, 4.0 mm, 2.0 mm, 1.0 mm, 0.85 mm, 0.50 mm, 0.25 mm, 0.125 mm, and 0.064 mm.

Aquatic Macroinvertebrates
The primary emphasis for sampling aquatic macroinvertebrates will be to monitor changes in redband trout prey abundance and composition and to use as indicators for changes in fine sediments. Sampling will consist of three representative riffle habitats per fish bearing stream using a Surber sampler with a 500 micron net enclosing an area of 0.3 square meters. Within each riffle, three samples will be collected and combined for a total estimated sampling area of 0.3 square meters. Samples will be obtained from riffles adjacent to redband trout spawning habitat, preserved in 80% ethanol, and shipped to a contracted laboratory for analysis. Sampling will occur in 2003, 2005 and 2008.

Data analysis of samples will require use of a Rapid Bioassessment Protocol that uses a variety of metrics used to describe stream condition and the structure of the aquatic macroinvertebrate community. Calculated metrics will be those most likely to detect change in habitat quality. These metrics will include richness measures, composition measures, tolerance/intolerance measures, and feeding measures.

Riparian vegetation
The response and recovery of riparian vegetation to different levels of burn intensity will be monitored. Photo points and transects will be established on each fish bearing stream. Attempts will be made to locate at least one photo point/transect in each type of burn intensity per stream, if applicable, with two to three sites per stream. The South Central Oregon riparian field guide will be used to identify plants and ecological type.

DETERMINATION OF EFFECTS ON SENSITIVE SPECIES

The proposed project may impact individual redband trout or habitat, but will not likely contribute to a trend towards federal listing or reduced viability for the population or species (MIIH) for all alternatives. 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, 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 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 in 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 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

CONSISTENCY WITH THE FREMONT NATIONAL FOREST PLAN AND OTHER REGULATIONS

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 (RMO's) 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 are 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 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 (large woody debris, water temperature, large pools) are currently below objectives. 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 temperature over the long-term.

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.

/s/ Richard Pyzik — May 9, 2003

Richard Pyzik — Date
North Zone Fisheries Biologist
Fremont National Forest

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