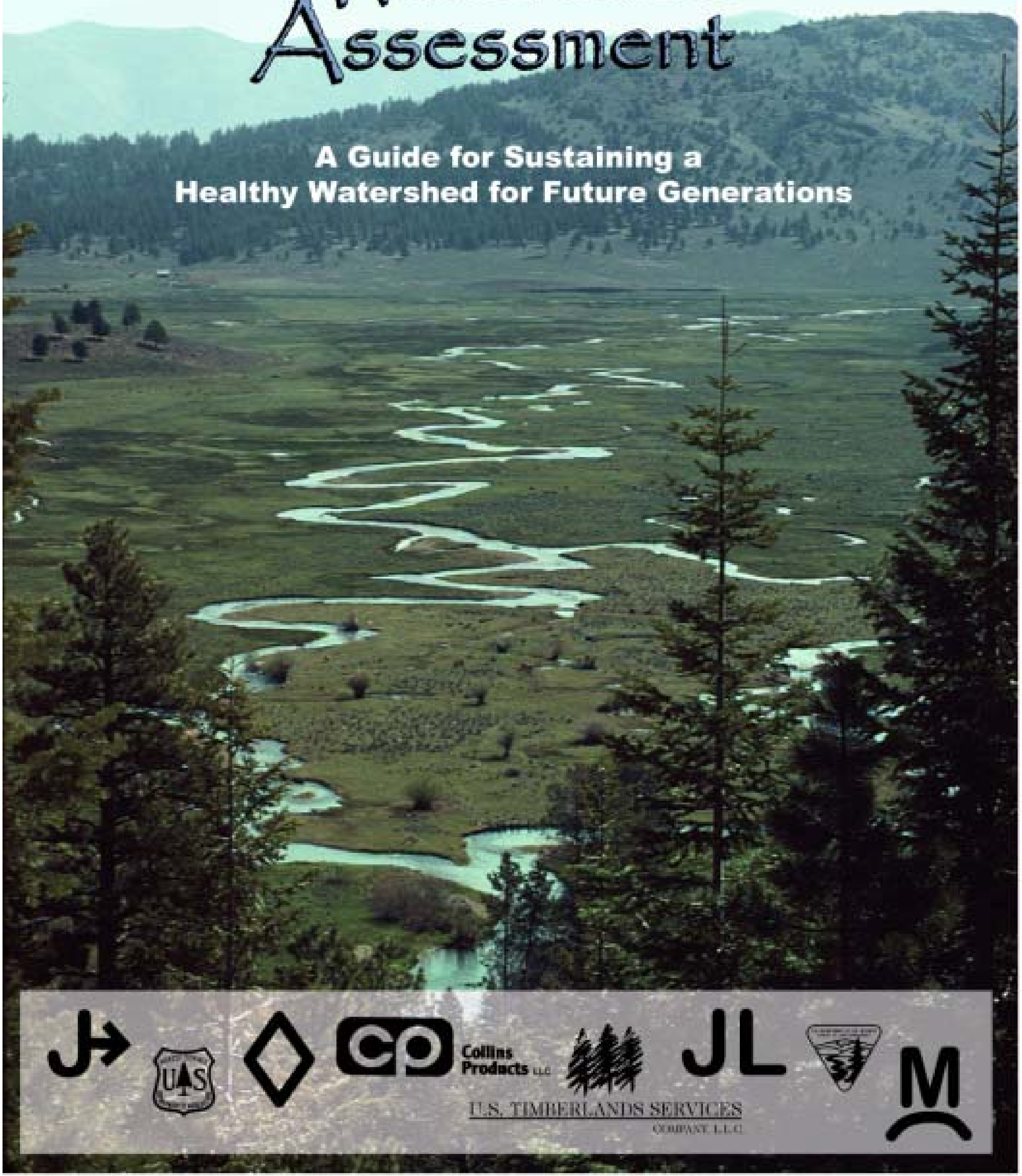
Upper Chewaucan Watershed Assessment

A Guide for Sustaining a Healthy Watershed for Future Generations



Collins Products LLC

U.S. TIMBERLANDS SERVICES COMPANY L.L.C

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Edited by CJ Peets
GIS Illustrations by Michele Reba, USDA Forest Service
Graphics/layout by Stevie Ruda, USDA Forest Service
Stream Type Illustrations from Dave Rosgen

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Scott Peets
Upper Chewaucan Watershed Council Coordinator (March 1995 - August 1999)
North Zone Fishery Biologist
Fremont National Forest

Tom Friedrichsen
Current Upper Chewaucan Watershed Council Coordinator
North Zone Hydrologist
Fremont National Forest

USDA Forest Service, Paisley Ranger District
P.O. Box 67
Paisley, OR 97636
(541) 943-3114

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Table of Contents

CONTENTS **Page**

CHAPTER 1

CHAPTER 2

CHAPTER 3

CHAPTER 4

CHAPTER 5

APPENDICES

Chapter One

Introduction

Working Towards A Healthy Watershed for Future Generations

On March 15, 1995, a group of landowners and managers met at the Paisley Ranger District Office to discuss a fundamental aspect of their livelihoodsó water and the ways in which their watershed captures rain and snow, stores it, then releases it into meadows and streams to produce the things they want mostówater quality, forage, and fish and wildlife habitat. Their goal was to build a foundation which would lead to cooperative management across land boundaries within the 171,562 acre watershed and allow for individual goals, dreams, and aspirationsó all inextricably linked, dependent on the actions of each other. Such was the first Upper Chewaucan Watershed Council meeting; in attendance were Bob Doolittle from the Harvey Ranch, Ed and Martin Murphy of the Murphy Ranch, John OíLeary of the OíLeary Ranch, and Fremont National Forest Service employees. (Refer to Figure 1.1 - Upper Chewaucan Watershed Location and Figure 1.2 - Upper Chewaucan Watershed Land Ownership).

In order to create a better understanding of the watershedís current condition, it became clear that the recent history of the Chewaucan watershed must be understood. Starting in the early 1800ís, European trappers significantly reduced beaver populations in eastern Oregon streams, initiating drastic changes in stream processes. Beaver ponds maintained wide floodplains, dissipated flood energy, and served as sediment collection areas. Once the beaver were trapped and removed, dams washed away, restricting flood energy to a single channel, resulting in streambank erosion and downcutting (Elmore and Bestcha 1987).

Attracted to water, forage, and wood, a steady flow of settlers began to enter the Chewaucan Valley in the 1870ís (Records from Lake County Historical Society). At the same time, large livestock operators moved their cattle, sheep, and horses throughout public domain and lands owned by local ranchers in the Northern Great Basin. Grazing was so intense that many areas were left barren of vegetation causing soil to erode into streams and rivers. Likewise, timber companies clear-cut large tracts of landónot realizing the importance of replanting to prevent soil erosion. Gifford Pinchot, the first Chief of the US Forest Service (USFS) observed these actions on public domain and considered their effects on future generations when he stated ìThink of the wealth which people might have made permanent, simply by using the forests wiselyî (Pinchot 1907).

Keeping future generations in mind, Congress passed a series of laws, including the Organic Act of 1897, which culminated in the National Forest system in 1907. Within National Forests, timber harvest, grazing, and other activities were encouraged but regulated in a manner as to maintain watershed conditions by promoting the safe capture, storage, and release of water (Pinchot 1907).

For the next 90 years, management on both National Forest and private lands in the Upper Chewaucan Watershed has been continually refined to meet this goal. An example is the gradual decrease of livestock permitted to graze Fremont National Forest lands in an effort to match the carrying capacity of the land. In 1909, the livestock permitted to graze Fremont National Forest lands included 110,000 sheep and 26,000 cattle and horses. Although these numbers dropped by 1929 to 78,000 sheep and 10,996 cattle and horses, the Chewaucan-Sycan Allotment was still considered to be in a ìdeplorable conditionî (Bach, 1981). For instance, vegetation along Long Hollow, a tributary of Coffeepot Creek, was drastically reduced and resulted in severe bank erosion and downcutting. Therefore, forest officials and permittees agreed to a further reduction of animal numbers to 31,210 sheep and 12,392 cattle by 1959 (Bach 1981). Then, in the 1960ís, sheep were removed from National Forest Allotments in the watershed because of a drop in market value and demand as well as the division of large allotments into many smaller ones; the additional fencing was not conducive to sheep management. Cattle numbers remain the same to this day at approximately 12,500 with relative reductions occurring in the Upper Chewaucan Watershed.

Current grazing practices throughout much of the Upper Chewaucan Watershed are guided by standards used to ensure maintenance and/or improvement of late-seral plant species such as sedge and willow, which promote bank stability and water quality while also enhancing the forage base for livestock. In an effort to determine better management techniques of the allotment system, the Paisley Ranger District continues to conduct surveys and analyses of the Forest. In addition, private landowners within the council are constructing riparian pasture fences, altering the time of grazing, thinning juniper stands, and implementing controlled burns to enhance upland and riparian conditions.

While livestock numbers decreased in the watershed, timber harvest increased, marking a transition from a livestock to a timber-dependent community. In 1950, the Lakeview Federal Sustained Yield Unit, which included the Upper Chewaucan Watershed, was created to ensure that all timber harvested within the unitó53 million board feet (mbf) per yearó would be reserved for mills in Lake County. A sustained yield unit, area residents claimed, was needed to keep local mills operating, thereby stabilizing local industry, creating employment, and providing opportunity for future planning. That same year, the first large sale in the Upper Chewaucan Watershedóthe 53 mbf Shoestring Creek Saleówas sold to the Fremont Sawmill Company and occurred in the South Creek Subwatershed as a direct result of the sustained yield unit (Bach 1981).

Since the formation of the unit, extensive timber harvestingóincluding old-growth timberóand associated road construction expanded throughout the Upper Chewaucan Watershed. This occurred not only on National Forest lands, but also on large tracts of private lands, including those owned by the Weyerehauser Corporation. The end result was an assumed increase in soil erosion into the streams within the watershed. Then, in 1993, the harvest of old-growth virgin pine came to a sudden halt on National Forest lands when public opinion and Forest Service policy shifted toward the maintenance of old-growth stands and subsequent reduction in road construction. Now, all timber sales on National Forest lands are guided by the Inland Native Fish Strategy and the other guidelines that ensure the maintenance or improvement of stream side areas and old-growth forests.

Starting in 1971, the state of Oregon provided additional management guidelines for forest management by enacting the Forest Practices Actóthe nations firstósetting new forestry standards for private and state lands in the watershed and across the state. The act covers numerous forest operations, including road construction, protecting soils from erosion, protecting waters of the state, encouraging improvement of fish and wildlife habitat through stream buffers. Further, in 1987 the Oregon Watershed Enhancement Board (OWEB)óformerly the Governorís Watershed Enhancement Boardó was created to provide a source of seed money to local community groups and others interested in implementing watershed enhancement projects. In addition, OWEB is instrumental in encouraging the formation of watershed councils throughout the state, such as the Upper Chewaucan Watershed Council in 1995. Finally, in order to help restore Oregonís wild trout and salmon, the Oregon Plan was endorsed and funded by the Oregon Legislature in 1997. The plan encourages cooperative efforts between state, local, federal, tribal, and private organizations and individuals to achieve its goals.

On private forest lands, Collins Products and US Timberlands Services use the Oregon Forest Practices Act to guide timber sales in a matter that promotes riparian health. In addition, Collins Products has proceeded through a certification process where management promotes socioeconomic, timber harvest, and biological sustainability. Further, US Timberlands Services has embarked on an aggressive grazing management program to enhance riparian conditions across its property boundaries. Finally, both companies view the watershed council as an important avenue to manage all aspects of the forest environment in a socially responsible manner.

Even with continual refinements by private and public landowners to adjust management to meet ecological concerns, we are still experiencing the consequences of a watershed altered by European trappers, past grazing, timber harvest, and road construction. Initially, it appeared that the consequences of erosion and downcutting within the watershed would concern only local landowners and managers. Soon after the Councilís formation, however, the consequences expanded to those of national significance. Stream temperatures throughout the upper watershed indicated poor water quality, placing the streams out of compliance with the Federal Clean Water Act. Following suit, the redband trout, a species sensitive to water quality, is now being considered for listing under the Federal Endangered Species Act. In order to make the necessary decisions guiding future management, the Council realized it needed a clearer understanding of the ecological processes of the landscape as well as a more detailed assessment of the watershed. Therefore, the Council applied for and received an OWEB grant to conduct a watershed analysis across private and public lands. As a result, surveys were conducted during the 1998 field season.

The goal of this document is to provide information concerning basic processes and desired conditions of a healthy watershed. Chapter Two will discuss basic watershed processes as they relate to the Upper Chewaucan Watershedóincluding the formation of four key questions concerning better management practices. Chapters Three and Four will answer these questionsóthe former concentrating on the desired conditions, while the latter will compare the desired and current conditions of the watershed with viable recommendations for improvement. Chapter Five summarizes the entire Upper Chewaucan Watershed, bringing together information and analysis from each of the eight subwatersheds with recommendations prioritized at the watershed scale. Finally, this document will enable current council membersóJ-Spear, Harvey, Murphy, and OíLeary ranches, Collins Products, US Timberlands Services, BLM, and Fremont National Forestóto create ìa healthy watershed for future generations.î

Figure 1

Figure 2

Chapter Two

Hydrological Processes of the Upper Chewaucan Watershed

"Like a Big Sponge"

During the first Upper Chewaucan Watershed Council meeting, basic watershed processes were explained using the words of Gifford Pinchot. In 1907, he described the ways in which a watershed functions:

> *"What they (watersheds) do, and this no one of experience disputes, is to nurse and conserve the rain and snow after they have fallen. Water runs down a barren, hard surface with a rush, all at once. It runs down a spongy, soft surface much more slowly, little by little. A very large part of rain and snow of the arid regions falls upon the great mountain ranges. If these were bare of soil and vegetation, the waters would rush down to the valleys below in floods. But the forest cover—the trees, brush, grass, weeds, and vegetable litter—acts like a big sponge. It soaks up the water, checks it from rushing down all at once, and brings about an even flow during the whole season."*

Most current documents and texts that describe watersheds restate Pinchotís observations, some using the same generalities, others providing detailed specifics on capture, storage, and safe release of water (Anderson et al. 1976, Black 1996, Brooks et al. 1997, Dzurik 1990). Quite simply, a watershed is the area that collects and discharges runoff through a given point on a stream (Satterlund and Adams 1992). Furthermore, it has been viewed as a catchment area separated from the next watershed by topographic features like ridgetops (Bedell 1991).

As in other regions, watershed hydrology in the Upper Chewaucan begins with climate. Local weather is influenced to a large degree by the Cascade Mountains. The western peaks of the Upper Chewaucan lie east of the Cascade Mountains, within view of Crater Lake National Park and Mount McLoughlin. This mountain range blocks and lifts the maritime air masses which move eastward from the Pacific Ocean, inducing rain and snow to blanket its slopes. The watershed stands in its shadow, receiving leftover rain and snow, about 15-35 inches each year depending on elevation.

The majority of precipitation falls as snow, with the highest elevations receiving the greatest depths and winter temperatures dropping below 0∞F. Even during the summer, frost and snow may occur at these elevations where aspen leaves display frost crystals in the early morning then feel warm to the touch in the late afternoon. As one Council member said, ìYou may need a slicker any day of the year in the higher elevations.î In contrast, at the lower elevations, summertime highs may exceed 100∞F.

Across the 171,562 acre watershed, from the Gearhart Wilderness to the west and Round Mountain to the east, a portion of the rain or snow is captured (intercepted) by ponderosa pine across the landscape, by juniper and sagebrush along the dry slopes east of the Chewaucan River, and by white fir and lodgepole forests in the upper elevations. Some of this intercepted water evaporates, while the remainder soaks into the soil. The best infiltration occurs when needles and leaves cover the soil, slowing surface runoff and allowing the water to enter the ground.

Most of the soil lying beneath the forest and shrub litter is derived from igneous rocksówhich were ejected from small volcanoes and solidified from a molten state. These volcanoes, such as Gearhart Mountain, in addition to the block faults, such as Coleman Rim and Deadhorse Rim, dominate the geomorphology of the Upper Chewaucan Watershed. The kinds of soils found in the watershed are the result of several factors (parent material, topography, climate, organisms, and time) which have interacted to produce five basic groups. These groups are different in their physical and chemical properties, and therefore, different in their susceptibility to erosion and compaction and their capacity for water infiltration.

The first group of soils are derived of alluvial materialsóthose materials transported and deposited by wateróoccurring along major streams, valleys, and bottomlands. The land along the Chewaucan River and the large meadows in the lower portions of Dairy, Elder, and South Creeks possess these types of soil. Because they occur adjacent to moving water, they are highly susceptible to gully erosion and eventual downcutting.

The second group of soils are derived from basalt, andesite, and tuff parent materials, which are found on lava tablelands, block faults, and shield volcanoes such as Gearhart Mountain. These soils are highly susceptible to compaction from management activities, which reduce infiltration and increase overland flow and erosion. They are the dominant soil and rock types in the Dairy and Elder Creek subwatersheds.

The third group of soils consists of rhyolite, a fine-grained and light-colored volcanic material, associated with dome-shaped volcanoes such as Bald Mountain at the headwaters of Elder Creek, McComb Butte rising above the Chewaucan River, and Drum Hill near Dairy Creek. These soils are susceptible to surface and gully erosion because of their loose, coarse texture and the steep landforms on which they occur.

The fourth group of soils are weathered from pyroclastic and sedimentary rocks. Occurring in the most unstable areas with high erosion and compaction risks, they represent the dominant group in the watershed. Mass movement potential is a concern throughout the watershed as these slump deposits are capable of dumping substantial amounts of sediment into streams. This is apparent along portions of the Chewaucan River.

The fifth group of soils consists of those formed in wind-carried Mazama ash and pumice deposits. Most occur at the mid- to higher elevations on the western parts of the watershed in the Bear Creek, Coffeepot Creek, Elder Creek, and Dairy Creek subwatersheds. These areas have an ash or pumice layer over the buried basalt/andesite or rhyolite derived soils. Erosion risks from management activities are low, but gully erosion and displacement risks are moderate to severe depending on slopes.

Water which escapes interception and use from trees, shrubs, and grasses becomes subsurface flow, eventually making its way through these soils to the narrow strips of land called riparian areas along creeks and rivers or other bodies of water. Riparian areas occupy a small percentage of the watershed, but they are an extremely important component of the landscape, especially in arid eastern Oregon (Elmore and Beschta 1987). Because of their close proximity to water, plant species within riparian zones differ significantly from those of adjacent uplands. Riparian plants such as Geyer willow and Nebraska sedge play a significant role in retaining water received from the uplands. The root systems of these plants stabilize banks, collect sediment, expand the riparian area 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 ponds that expand riparian zones, further ensuring stream flow during summer months (Olson and Hubert 1994).

The subsurface and overland flows make their way to the riparian area, helping to fill stream channels, like Coffeepot or Ben Young Creeks. The drainage network in the watershed consists of about 621 miles of stream channels, all forming an intricate network which eventually culminates in the Chewaucan River. These streams are distributed amongst eight subwatersheds: Bear Creek, 42 miles; Coffeepot Creek, 57 miles; Ben Young Creek, 35 miles; Swamp

Creek, 19 miles; South Creek, 110 miles; Dairy Creek, 113 miles; Elder Creek, 84 miles; and Chewaucan River, 161 miles. Approximately 252 miles of these streams are perennial, thus flowing continuously throughout the year. Intermittent stream channels, ones that flow immediately after a storm event and replenish water tables or seeps, account for 215 miles. Finally, ephemeral channels are similar to intermittent types; however, the stream bed dries up rapidly due to porous soils and a disconnection to saturated water tables (Black 1996). They account for the remaining 154 miles.

Since 1912, flow measurements on the Chewaucan River have been recorded near the base of the watershed. The highest mean flow is 502 cubic feet per second (cfs) and occurs in May, produced by a mixture of rain and snow melt within the watershed. The mean monthly flow for September, the low-flow month, is 31 cfs. Streams originating on the west side of the assessment area (Bear, Elder and Dairy Creeks) generally have higher low- flows than those originating on the eastern and southern side of the assessment area.

The level of stability in riparian areas and stream channels is defined as the balance between sediment deposition along banks (aggradation) and erosion/downcutting (degradation), influencing the integrity of riparian zones in the event of a major disturbance (DeBano et al. 1998). Under present conditions, intense upland erosion resulting from a catastrophic fire would be the most likely disturbance event in the Upper Chewaucan Watershed. A healthy riparian area will buffer against disturbance, capturing sediments that may inundate streams. But even the most productive riparian areas have limitations and cannot withstand severe forms of disturbance. For example, in 1915, Reginald Bradley, the Fremont National Forest Deputy Supervisor, described intense grazing which had downcut a once productive meadow in Lake County, Oregon.

> *"Before this area was grazed the whole of the flat, approximately 200 acres, was a fine meadow with a small stream running on to it and spreading out, naturally irrigating the grass, no pronounced channel being anywhere in evidence. Then came grazing by cattle and horses—principally cattle. Soon it was heavily overstocked and erosion commenced." (Reginald 1915).*

At that first Council meeting, members discussed many of the aforementioned watershed processes as well as a variety of related issues. John OíLeary voiced his concerns over the great quantities of water used by juniper crowding the landscape east of the Chewaucan River, water which could be available for forage production and maintenance of stream flow. Ed Murphy sat next to his son Martin and described the big flood of 1964 which gathered force in the headwaters of Morgan Creek in the Coleman Rim Roadless Area and blasted through their meadow on South Flat. The torrent ripped sedge and grass from the banks and carried away tons of productive top soil, leaving the stream downcut six feet. And, the Forest Service brought up its requirement to manage for viable populations of the redband trout which can be used to indicate whether or not land management activities are ecologically sound.

From the discussion of these issues, we asked ourselves a question: How can the Council better manage the watershed to improve the capture, storage, and slow release of water? To answer this, the council formulated four key questions which reflect the connection between uplands, riparian areas, stream channels, and redband troutóa thought process that will guide the flow of this document.

1. *Is the upland portion of the watershed producing hydrological conditions (water and sediment outputs) which contribute to properly functioning riparian areas?*

2. *Is vegetation in riparian areas contributing to the appropriate channel types and hydrologic regime?*

3. *Are the channels providing adequate fish habitat?*

4. *How are the above watershed conditions influencing redband trout viability?*

Chapter Three

Desired Conditions of the Upper Chewaucan Watershed

Our Map to the Future

To address the four key questions, the Upper Chewaucan Watershed Council invited numerous individuals and representatives from natural resource agencies and institutions to meetings and field trips in order to seek their advice and technical expertise about the most desirable watershed conditions. These include the following: The Oregon Watershed Improvement Coalition, Doc and Connie Hatfield, Izaak Walton League, Oregon State University, Oregon Department of Fish and Wildlife, Oregon Department of Forestry, Oregon Department of Agriculture, Oregon Department of Environmental Quality, USDA Natural Resources Conservation Service, USDA Forest Service, USDI Fish and Wildlife Service, and the National Riparian Team.

One of the most intensive learning experiences for the Council occurred when the National Riparian Team (NRT) visited the Upper Chewaucan Watershed on June 25 and 26, 1997. The NRT, led by Wayne Elmore, is composed of individuals from the Bureau of Land Management and Forest Service who are dedicated to helping landowners of the western United States learn to identify a properly functioning riparian area.

During the first day of their visit, the NRT showed council members slides of healthy riparian areasó creeks with narrow and deep channels, lined with willow and sedge. These plants, they explained, sink their roots deep into the banks, protecting them from high flows. In contrast, an unstable stream was shown. It was wide, shallow, and lined with sagebrush and Kentucky bluegrass, allowing erosion to occur even during summer flows. Ultimately, Mr. Elmore asked the Council, ìWhich stream would you like on your land?î

The next day, Council members and the NRT traveled upstream along the Chewaucan River to a 2,000 acre meadow, where Dairy and Elder Creeks converge to form the Chewaucan River and where South Creek enters a mile downstream. A diverse groupó composed of ranchers, fisheries biologists, range conservationists, and hydrologistsówalked along the meanders of South and Elder Creeks on property owned by the Murphy, Harvey, and J-Spear Ranches. After examining a segment of creek, the group was asked to complete a checklist provided by the NRT to assess stream conditions. Was there an active floodplain? Was the channel narrow and deep? Were the banks lined with a variety of species and age classes of riparian plants, enough to dissipate flood energies? Were gravel bars revegetating? Was the stream stable or downcutting? For each item, we checked yes or no.

From the responses, the group could determine whether or not a stream was in Proper Functioning Condition (PFC)ómeeting the minimum conditions for a riparian area to function properlyóas described by the NRT and defined in ìRiparian Area Management: Process for Assessing Proper Functioning Conditionî (USDI 1995, PFC manual):

> *“Riparian areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high water flows, thereby reducing erosion and improving water quality; filter sediment, capture bedload, and aid floodplain development; improve flood-water retention and groundwater recharge; develop diverse ponding and channel characteristics to provide the habitat*

> *and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity."*

The NRT and PFC manual also discussed Potential Natural Community (PNC)óìthe highest ecological status an area can attain given no political, social, or economical constraintsî (USDI 1995). Realizing that PFC is not the end point in stream evolution, but near the mid-point along the continuum towards PNC, Council members agreed that their desire was for all streams and riparian areas to meet minimum conditions, then strive to get as close to PNC as is attainable under multiple-use management. This concept would involve managing the watershed in a manner which is in harmony with the ecological processes of the area, and thus resulting in enhanced water quality, redband trout habitat, and forage for livestock and wildlife.

PFC and PNC are terms used predominantly in describing the ecological status of riparian areas. In order to prevent confusion and provide consistency when describing other elements within the watershed, the Council chose to use similar terminology which was cooperatively designed by the US Forest Service and the US Fish and Wildlife Service.

This terminology relates to PFC and PNC in the following ways. When a parameter is in its desired condition, it is considered to be functioning appropriately, highly similar to PNC. When a parameter is in a functional condition but has an existing attribute which makes it susceptible to degradation, it is determined to be functioning appropriately but-at-risk. A functioning inappropriately rating is given when a parameter is considerably less than its desired state or does not exhibit conditions of sustainability. The Councilís goal is to manage for conditions that are functioning appropriately.

Desired conditions provide a target for private and public land managers to aim for as they conduct resource management activities across the landscape. Such activities will contribute to healthy uplands, riparian areas, stream channels, and fish habitat.

The Council has developed desired conditions for the following parameters as they relate to the four key questions and will devote the remainder of this chapter to describing them:

ï *Question 1*
  a. desired upland plant communities
  b. desired road density, location, and drainage network

ï *Question 2*
  a. desired riparian vegetation and bank stability
  b. desired Rosgen stream types

ï *Question 3*
  a. desired amount of large woody debris
  b. desired pool numbers
  c. desired percentage of fines in spawning gravel
  d. desired stream temperature
  e. desired fish passageóculverts

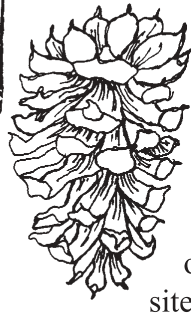
ï *Question 4*
  a. desired redband trout viability.

1 Is the upland portion of the subwatershed producing hydrological conditions (water and sediment outputs) that contribute to properly functioning riparian areas?

a) Upland plant communities and their effect on the amount of water and sediment reaching riparian areas.

Of the upland plant communities, our main focus is conifers as they influence the amount of precipitation available for subsurface flow into riparian areas particularly during the summer monthsóthe period of low flows. In such an arid environment, water becomes scarce during this time so low flows become important for maintaining riparian and aquatic habitat, water for irrigation, wildlife, and livestock. Low precipitation, reduced drainage from soil and bedrock, and sustained high evapotranspiration are factors affecting the amount of available water.

Upland conifers evapotranspirate incoming rain and snowfallóthat is, they evaporate the precipitation which is intercepted on stems and leaves and transpire water which is absorbed through the roots. The precipitation which is not evapotranspirated becomes water yield available to ground water reserves, streams, and lakes. Bassman (1985 and 1988) provided information on the water use of ponderosa pine, mixed conifer, and lodgepole pine which are the major forest types in the Upper Chewaucan Watershed. Data referring to juniper was acquired from Bedell et al. (1993). These are listed below along with water yieldsóthe water left over which is absorbed into the soil and available for grasses, shrubs, and subsurface flow. Refer to Table 3.1.



A tree of major concern in the watershed is juniper. Juniper trees are able to use water in the early spring before other plants begin to grow. Throughout the summer, juniper will continue to draw water when ponderosa pine shut their stomata and discontinue water use. A tree 18 inches in diameter at its base can transpire 30 to 40 gallons per day if adequate soil moisture is available during the summer. Because juniper has the ability to use such large amounts of water, it reduces available water for nearby plants. This lowers shrub and grass density, soil cover, and infiltration rates. It also increases nutrient loss, overland flow, and soil erosion, often resulting in a reduction of site productivity (Bedell et al. 1993).

Table 3.1 - Conifer Species and Associated Water Yield.

Conifer Species	Annual Precipitation	Evapotranspiration Rate	Estimated Water Yield	% of Annual Precip. resulting in water yield
Juniper	11-18" (14.5" ave)	12"	2.5"	17%
Ponderosa pine	18-30" (24" ave.)	16"	8"	31%
Mixed conifer	20-35" (27.5" ave.)	17"	10.5"	36%
Lodgepole pine	25-35" (30" ave.)	17"	13"	33%

For all of the above reasons, an increase in conifer densities results in a loss of water available for stream flow during the dry summer months. To determine the conifer densities under which the Upper Chewaucan Watershed streams evolved, Fremont National Forest silviculturists described a range of presettlement canopy coveragesóor the Historic Range of Variability (HRV) for various forest types. These include the following: ponderosa pine, 11-25%; mixed conifer (ponderosa pine and white fir), 26-55%; lodgepole pine, 41-70%.

In addition, the non-forest plant communities described in the uplands include the following: Bluegrass-Dry Meadow, Hairgrass-Sedge-Moist Meadow, Sedge-Wet Meadow, Big Sagebrush/ Bunchgrass, Juniper/Low Sagebrush, Low Sagebrush/Fescue-Squirreltail, Ponderosa Pine-Quaking Aspen/Bluegrass, and Ponderosa Pine/Mountain Big Sagebrush/Bluegrass (Hopkins 1979). Of particular interest are the three meadow types because they are water storage sites, tucked away in the bottom of almost every small basin throughout the watershed and are the source of many headwater streams. Tree densities in the surrounding catchment area influence the amount of water collected and stored in these meadows.

The integrity of the above vegetation types (HRV forest types) and associated flow regimes are dependent on historic low intensity fires. These low intensity fires promote ecosystem stability because fuel levels are kept at a minimum, reducing the possibility of a catastrophic fire (Agee 1990). For pure ponderosa pine sites in the Upper Chewaucan Watershed, a fire return interval of 11 years was documented (Miller 1997), while mixed conifer sites, characterized by ponderosa pine and white fir, had fire intervals up to 30 years (Agee 1990). These frequent and low intensity ground fires maintained vast stands of open ponderosa pine forests, leaving a fuel gap between the overstory and ground. In the Upper Chewaucan Watershed, it is estimated that these historical fire intervals maintained about 70-80% of the forested stands in a late-seral condition, with roughly 5-15% being in a mid-seral condition, and the remaining 5-15% in early seral condition (Personal Communication with Dwyer 1999).

When natural fire regimes are excluded and canopy cover increases, forested communities become susceptible to catastrophic fire. The removal of large areas of conifers by wildfire or timber harvesting has the potential to increase the amount of runoff and change the streamflow regime. Research has shown detectable changes in streamflow when 20-30% of a watershed is in a disturbed condition (Troendle and Leaf 1982). Further, when high intensity fires consume vegetation and forest ground cover, erosion increases (McNabb and Swanson 1990). Mass erosion into streams after a wildfire can overwhelm the channel with more sediment than local stream flows are able to transport and deposit onto floodplains, resulting in high levels of sediment in spawning gravels (Swanston 1991).

Desired Upland Vegetation:

Functioning Appropriately - Forested communities are within recommended canopy densities and/or openings (early seral condition) account for proximately 5-15% of the subwatershed; meadow and other upland communities have little or no conifer encroachment. This is the desired condition.

Functioning Appropriately but-at-Risk - Less than 50% of forest communities are outside recommended canopy ranges and/or openings (early seral condition) account for approximately 15-30% of the subwatershed; meadows and other upland communities have experienced conifer encroachment.

Functioning Inappropriately - Over 50% of forested communities are outside recommended canopy ranges and/or openings (early seral condition) account for more than 30% of the subwatershed; the majority of meadow and other upland communities have a high level of conifer encroachment.

b) Road density, location, and drainage network, and their effect on the amount of sediment and water reaching riparian areas.

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). Further, 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 subwatersheds with high (1.7 - 4.7 road mi/mi≤) and extreme (>4.7 road mi/mi≤) road densities (Interior Columbia Basin Ecosystem Management Project (ICBEMP) 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. Also, maintaining a buffer between the road and stream channel provides a filter that minimizes the introduction of fine sediment into the stream channel.

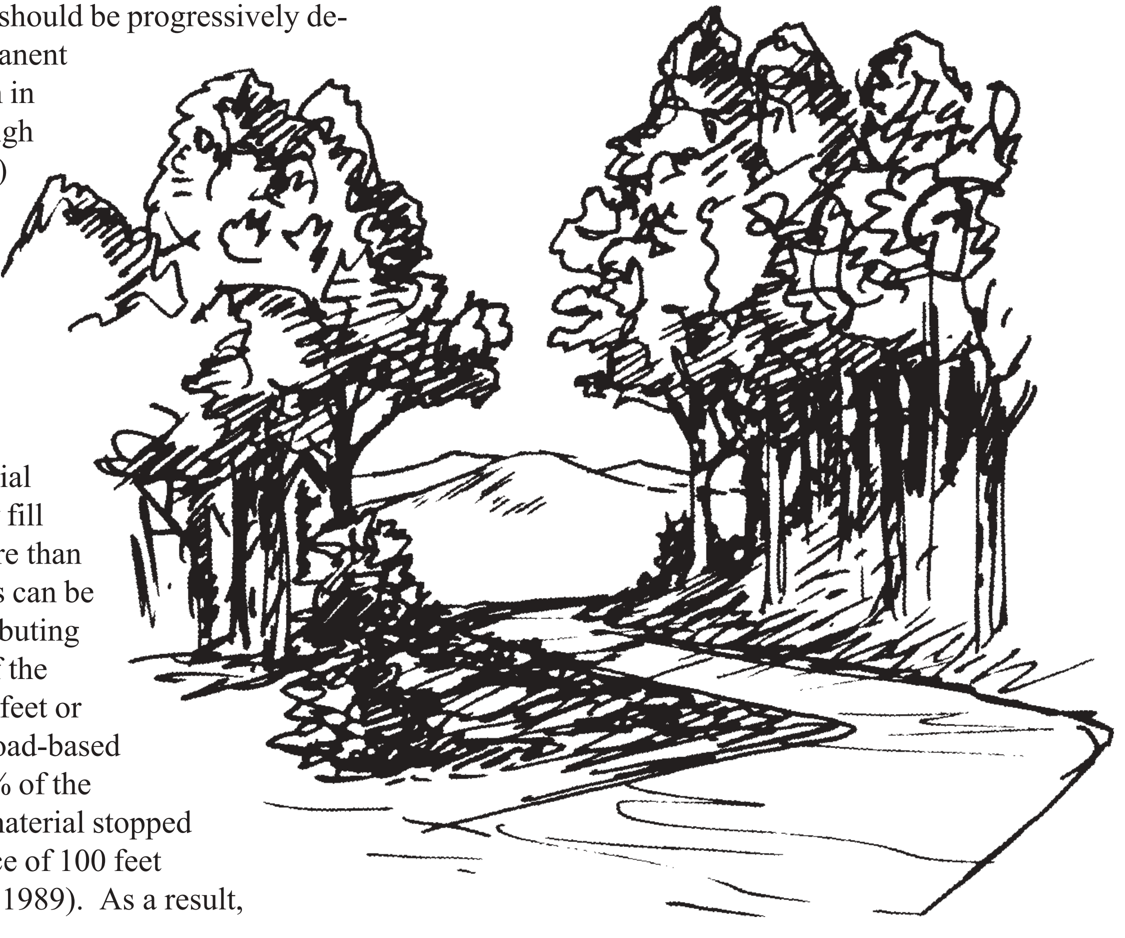
Desired Road Densities:

Functioning Appropriately - Road density less than 1.7 mi/mi≤. This is the desired condition.

Functioning Appropriately but-at-Risk - Road density of 1.7 - 4.7 mi/mi≤

Functioning Inappropriately - Road density greater than 4.7 mi/mi≤.

It is assumed that the number of stream crossings, and roads that are within 300 feet of streams, are in relative proportion to the above road densities.



2 Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

a) Riparian vegetation and associated bank stability.

One of the many functions of riparian plants is to stabilize banks through root mass. Manning et al. (1989) documented that sedge and rush species produced significantly more root mass than dry-land grasses, making these plants conducive to high bank stability. Other vegetation types such as willows, cottonwoods, and conifers provide additional bank stability. The stems of these herbaceous and shrub species provide roughness and resistance to high flows which allows for sediment trapping and bank building (Elmore and Beschta 1987). Under these conditions, water is stored during the wet season and slowly released to the stream during the summer months. In an area where sheets of ice form on the stream surface during the winterósuch as the Upper Chewaucan Watershedóice break-up during spring thaw accelerates bank erosion when riparian vegetation is absent (Platts 1991).

The vegetation types that contribute to the above conditions have been described. Willow, sedge, and rush associations characterize late-seral communities in low gradient meadow stream systems, where approximately 95% of the riparian area provides conditions for late-seral species (Burton et al. 1992). Along steeper gradient mountain streams, where at least 75% of the bank substrate supports late climax species, Mountain Alder will dominate the site while Black Cottonwood, willows, sedges, and grasses are subdominant (Burton et al. 1992, Kovalchik 1987). Early seral species, such as grasses, occupy riparian areas, but under reference conditions these species are subdominant (Kovalchik 1987). The relationship between these plant types and bank stability is reflected in the Native Inland Fish Strategy (USDA 1995) which details standards and guidelines that suggest bank stability should be greater than 80%, while the Interior Columbia Basin Ecosystem Management Project recommends 90% for areas where this is attainable (ICBEMP 1997).

Desired Riparian Vegetation and Bank Stability:

Functioning Appropriately - Riparian communities are highly similar to the late-seral species composition and structure described by Burton et al. (1992) and Kovalchik (1987), and bank stability is >90%. This is the desired condition.

Functioning Appropriately but-at-Risk - Riparian communities are moderately similar to the late-seral species composition and structure described by Burton et al. (1992) and Kovalchik (1987), and bank stability is 80-90%.

Functioning Inappropriately - Riparian communities have low similarity to the late-seral species composition and structure described by Burton et al. (1992) and Kovalchik (1987), and bank stability is <80%.

b) Rosgen Stream Type(s)

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 streamís 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 streamís 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 assessment, we have selected the Rosgen Classification system 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).

First, 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 flood waters are confined to the channel and is not entrenched when flood water can access floodplains.

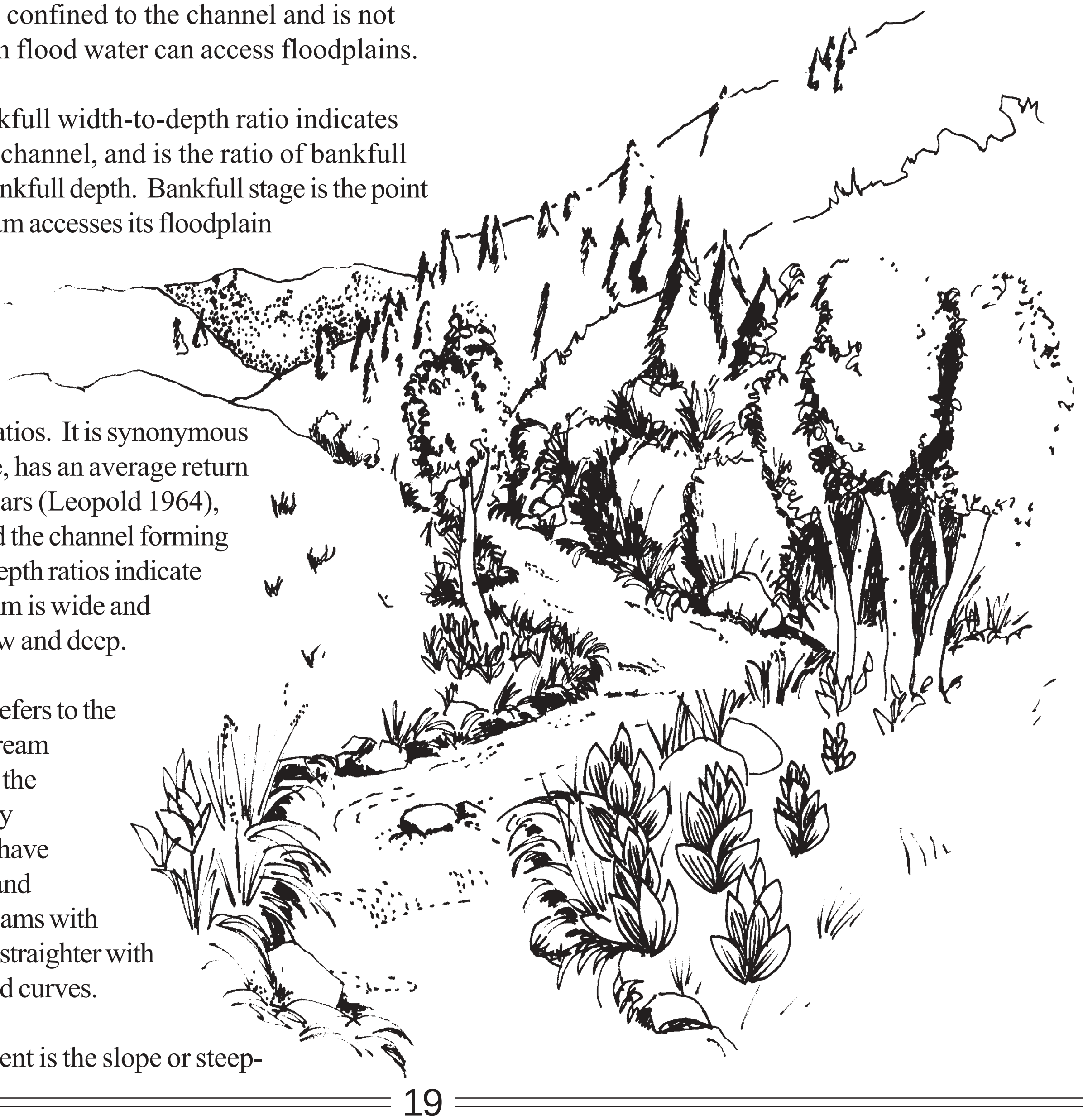
Second, the bankfull width-to-depth ratio indicates the shape of the channel, and is the ratio of bankfull width to mean bankfull depth. Bankfull stage is the point at which the stream accesses its floodplain and is a required measurement in order to determine width-to-depth ratios. It is synonymous to the flood stage, has 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.

Third, sinuosity refers to the extent 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.

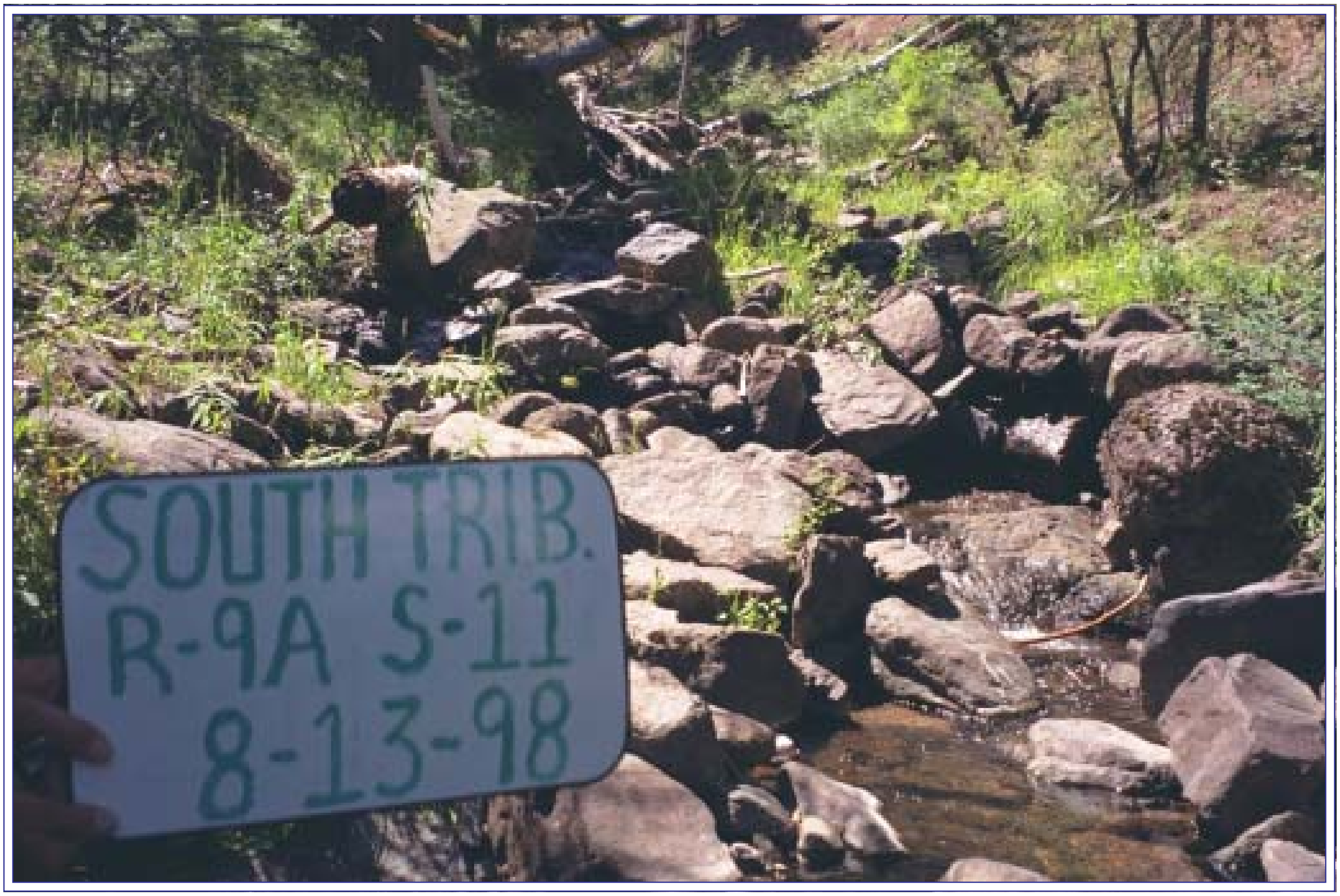
Fourth, the gradient is the slope or steepness of the stream while the dominant channel substrate refers to the size of particle or rock which covers the stream channel. Rosgen (1996) describes enhancement methods for each channel type, methods which work with natural processes of the stream.

Desired Rosgen Stream Types:

Surveys conducted in the Upper Chewaucan Watershed reveal stream types A, B, C, and E. The following stream type descriptions are provided by Rosgen (1996). Numbers which follow the letter designation refer to substrate sizeónumber 3 refers to cobble substrate while 4 refers to gravel substrate.

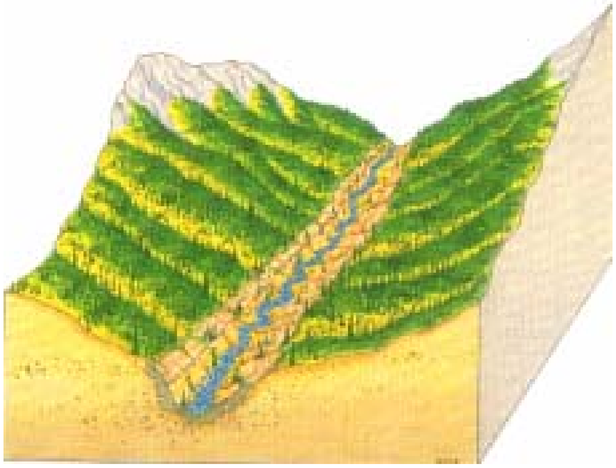


Morphological Description of Rosgen A3 Stream Type



Rosgen A stream types are characterized by steep gradients (between 4 and 10%), with deeply incised channels, and entrenchment ratios <1.4. They have low width/depth ratios (<12) and low sinuosity (<1.2). Local landform and geology dictates channel stability. The A3 channel types, found in the Chewaucan Watershed, are characterized by a high sensitivity to disturbance, very high stream bank erosion potential, and vegetation having a negligible influence in determining channel stability. Overall, these channels exhibit high sediment supply and transport potential. Large woody debris plays a significant role in determining frequency of step pools which provides fish habitat and overall channel stability.

Rosgen A3 Stream Type



Delineative Criteria (A3)

Landform/soils: Steep narrow depositional slopes typical of glacial moraines and debris slides associated with unconsolidated, heterogenous and non-cohesive materials.

Channel Materials: Predominately cobble with a mixture of boulders, gravel and sand.

Slope Range: .04 - .10 (A3a+ > .10)

Entrenchment ratio: < 1.4

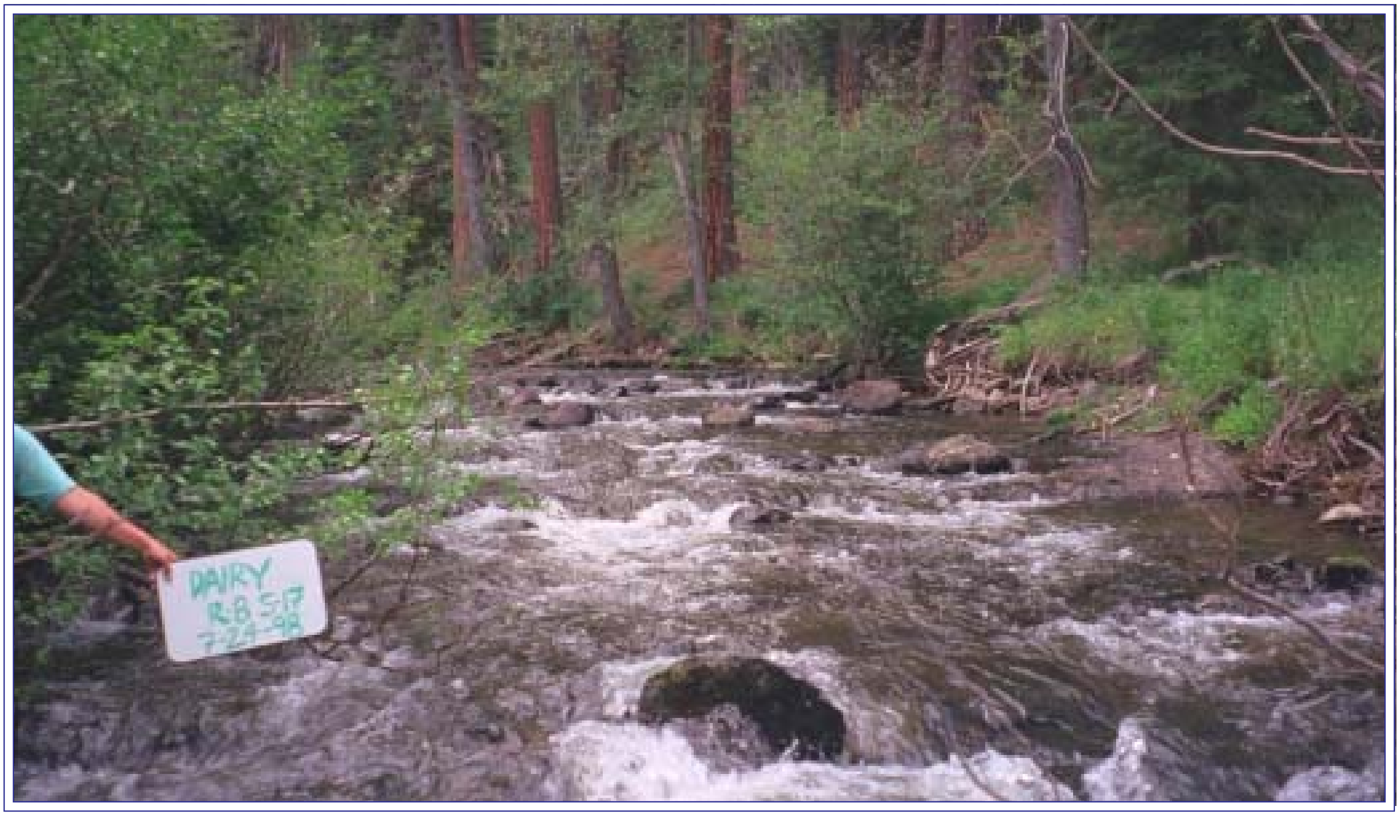
Width/depth Ratio: < 12

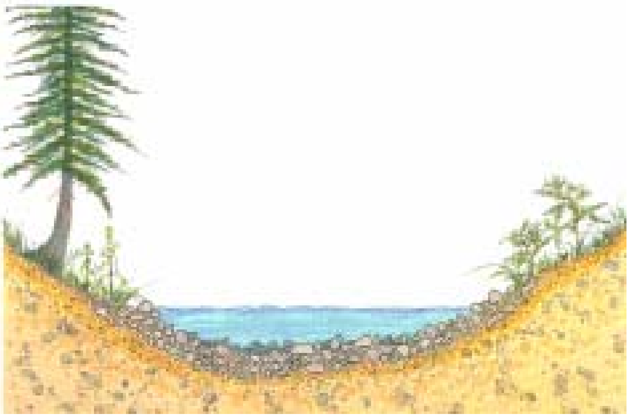
Sinuosity: <1.2

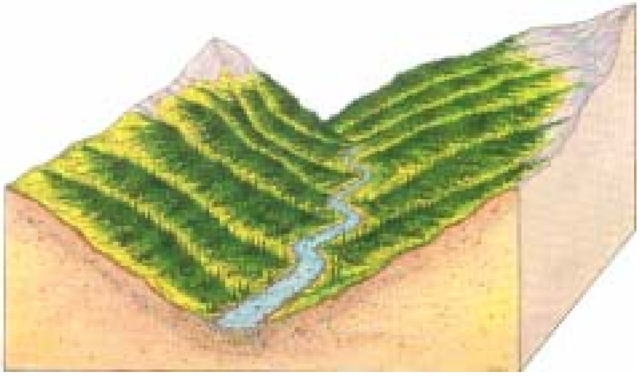
Morphological Description of Rosgen B3 Stream Type

Rosgen B stream types are moderately steep (between 2 and 4%), with rapids and riffles common and scour pools irregularly spaced. These stream types are moderately entrenched (1.4-2.2), with moderate width-to-depth ratios (>12) and sinuosity (>1.2). They are found within ìVî type valleys, usually in forested systems, with substrates ranging from gravel (B3) to cobble (B4). Vegetation has a moderate influence in determining channel stability. These channel types are characterized by low to moderate sensitivity to disturbance and low streambank erosion. Fish habitat is often associated with large woody debris which contributes to scour pool formation and cover.

Rosgen B3 Stream Type







Delineative Criteria (B3)

Landform/soils: Narrow, moderately steep colluvial valley with gentle side slopes. Soils are colluvium and/or alluvium. Often in fault line valleys or on well vegetated alluvial fans.

Channel Materials: Predominately cobble with lesser amounts of boulders, gravel and sand. Streambanks are stable due to coarse material.

Slope Range: .02 - .04 (B3c, < .02)

Entrenchment Ratio: 1.4-2.2

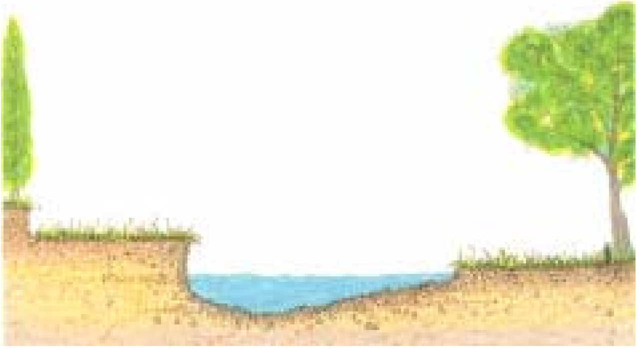
Width/depth Ratio: > 12

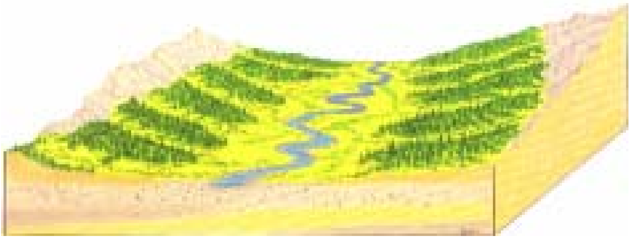
Sinuosity: >1.2

Morphological Description of Rosgen C4 Stream Type

Rosgen C streams types are lower gradient streams which are slightly entrenched (>2.2), have moderate to high (>12) width-to-depth ratios, high sinuosity values (>1.4), and are characterized by riffle/pool sequences. Streams within the watershed are often found in low gradient alluvial valleys with substrates dominated by gravel (C4). Channels have characteristic point bars and broad, well defined floodplains. Vegetation has a very high influence in determining channel stability, and when vegetation is disturbed and removed, these channel types are highly sensitive to both lateral (bank) and vertical (downcutting) erosion. Natural sediment supply is moderate to high except in those areas where stream banks are well vegetated. These streams are highly sensitive to changes in sediment and stream flow.

Rosgen C4 Stream Type





Delineative Criteria (C4)

Landform/soils: Broad, gentle gradient alluvial valleys and river deltas. Soils are alluvium.

Channel Materials: Predominately gravel, with lesser amounts of cobble, sand and silt/clay.

Slope Range: < .02 (C4c- .001)

Entrenchment ratio: > 2.2

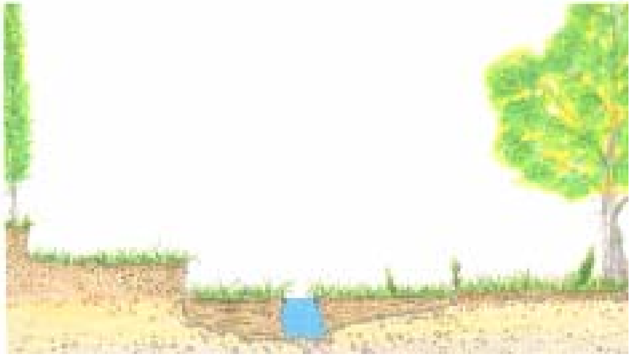
Width/depth Ratio: > 12

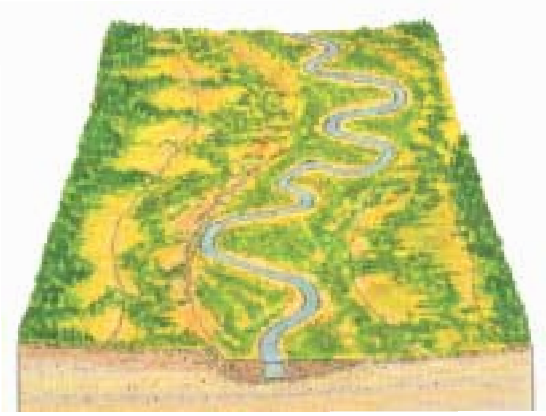
Sinuosity: > 1.4

Morphological Description of Rosgen E Stream Type

Rosgen E stream types are low-gradient streams (<2%, but can reach 4%) which are slightly entrenched (>2.2) with low width-to-depth ratios (<12), and high sinuosity (>1.5), with riffle/pool sequences and well developed floodplains. In the Chewaucan Watershed, channel substrate is dominated by gravel (E4) and to a lesser degree cobble (E3). Valleys are usually wide and gently sloped. Vegetation has a very high influence on channel stability. When it is lacking, these channel types are highly sensitive to disturbance which may result in increased levels of streambank erosion and downcutting. These streams are highly sensitive to changes in sediment and stream flow. The E stream type provides excellent fish habitat through undercut banks, clean spawning gravels, and numerous deep pools.

Rosgen E Stream Type





Delineative Criteria (E4)

Landform/soils: Gentle slopes in broad riverine or lacustrine valleys and river deltas.

Channel Materials: Gravel dominated bed with smaller accumulations of sand and occasional cobble. Streambanks composed of sandy/gravel mixture with dense root mat.

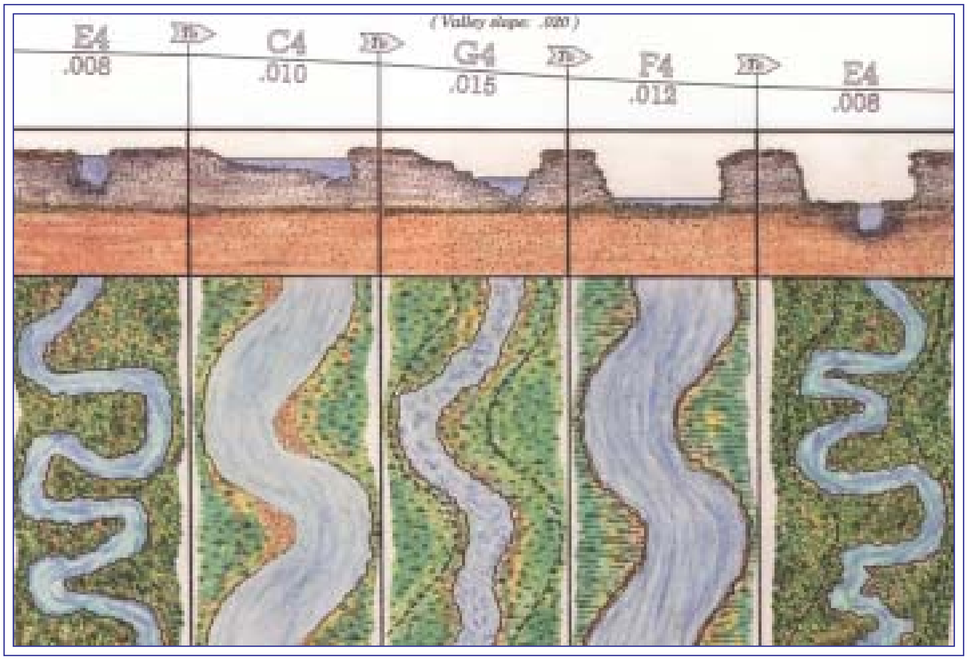
Slope Range: < 0.02

Entrenchment ratio: > 2.2

Width/depth Ratio: < 12

Sinuosity: >1.5

Desired Channel Evolution for a Degraded Low-Gradient System



When vegetation is lacking along an E stream type, lateral (bank) and vertical (downcutting) erosion may lead to progressive stages of channel adjustment, resulting in altered channel dimension, pattern, and profile. As a result of the bank erosion and downcutting, the channel becomes wider and shallower, resulting in a higher width/depth ratio (a conversion from an E to C stream type). During downcutting events, the channel becomes an incised gully, straighter and steeper than the original channelóa G stream type. In doing so, the channel abandons its original floodplain, resulting in a lowered water table. Although downcutting subsides, lateral erosion continues because flood energies are confined within the incised channel. As the banks erode, the width-to-depth ratio continues to increase, creating a wide, shallow, and entrenched stream with no flood-plainóan F stream type. The lateral erosion will continue until a floodplain is developed and wide enough to dissipate flood energies. The development of a floodplain will only occur with good riparian vegetation that is resistant to flows and able to trap sediments and build banks. This will continue until the stream reaches a condition where it is naturally stable and in balance with the landscape setting. Once at this desired state (an E stream type), the stream is able to accommodate the flow and sediment produced by its watershed while maintaining its dimension, pattern and profile (see above figure for desired channel evolution).

Functioning Appropriately - stream channel is highly similar to the Rosgen stream type expected for its setting.

Functioning Appropriately but-at-Risk - stream channel is highly similar to the Rosgen stream type expected for its setting, but its bankfull width-to-depth ratio is larger than expected.

Functioning Inappropriately - stream channel is different from the Rosgen stream type expected for its setting (i.e. we expect an E stream type and it is an F stream type). Data collected from stream surveys in the Upper Chewaucan Watershed indicate that E stream types are expected in low gradient meadow reaches with a drainage area of less than 18 square miles, while C Stream Types are expected where drainage areas exceed approximately 18 square miles.

3 Are the stream channels providing adequate fish habitat?

a) Large Woody Debris (LWD) and its contribution to fish habitat.

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 fishóduring floodsóincrease 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).

Desired amount of LWD:

Large woody debris is evaluated against the 50th and 75th percentile for natural and near natural streams the northern Great Basin (ICBEMP 1997).

Functioning Appropriately - LWD numbers are >75th percentile. This is the desired condition.

Functioning Appropriately but-at-Risk - LWD numbers are >50th and <75th percentile.

Functioning Inappropriately - LWD numbers are <50th percentile.

For this assessment, LWD is defined as being 20 inches in diameter on the small end and greater than 35 feet long in ponderosa pine and mixed conifer sites. In lodgepole pine sites, LWD is defined as 12" in diameter at the small end and greater than 35 feet long. 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.

***Table 3.2** - Natural or Near Natural Frequency of LWD in Northern Great Basin Streams (ICBEMP 1997).*

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

b) Pools and their contribution to fish habitat.

Pools are considered to be 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). When pool numbers, volume, and complexity increases, the streamís capacity to support a diversity of species and life stages/history types increases (Bisson et. al. 1992; Bjornn and Reiser 1991). Further, Decker and Erman (1992) found that rainbow trout numbers were more abundant with an increase in pool habitat. Likewise, an increase in pool numbers and complexity produces conditions for increased fish numbers and biomass (Fausch and Northcote 1992).

Desired Pool Numbers:

The number of pools is evaluated against the 50th and 75th percentile for natural and near natural streams in the northern Great Basin (ICBEMP 1997).

Functioning Appropriately - Pool numbers are >75th percentile. This is the desired condition.

Functioning Appropriately but-at-Risk - Pool numbers are >50th and <75th percentile.

Functioning Inappropriately - Pool numbers are <50th percentile. 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 3.3 *- Natural or Near Natural Frequency of Pools in Northern Great Basin Streams (ICBEMP 1997).*

Slope Class	Pools/Mile 50th	Pools/Mile 75th
All	0.027	0.049
<2%	0.027	0.053
2-4%	0.029	0.044
>4%	0.030	0.051

c) Spawning Gravel Fines and their influence on fish habitat and reproductive success.

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. Based on this information and ICBEMP (1997) recommendations, desired conditions for spawning substrates were determined.

Desired Percentage of fines in Spawning Gravels:

Functioning Appropriately - <20% fines for C and E stream types, and <25% fines for A and B stream types. This is the desired condition.

Functioning Appropriately but-at-Risk - 20-30% fines for C and E stream types, and 25-30% fines for A and B stream types.

Functioning Inappropriately - >30% fines for all stream types.

d) Stream Temperature and its influence on fish habitat.

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 fishís metabolism is directly controlled by its 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 of rainbow trout (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). Finally, temperatures exceeding 29.4∞C (84.9∞F) can be fatal to rainbow trout (Bjornn and Reiser 1991).

Desired Stream Temperatures:

Functioning Appropriately - Seven-day maximum stream temperatures are < 17.8∞C. This is the desired condition.

Functioning Appropriately but-at-Risk - Seven-day maximum stream temperatures are between 17.8∞C and 24.0∞C.

Functioning at Unacceptable Risk - Seven-day maximum stream temperatures are >24.0∞C.

e) Fish PassageóCulverts

Fish need to move up and down streams for a variety of reasons, including spawning migrations and to seek more suitable habitat as a result of competition or unfavorable stream temperature. It has been documented that redband trout travelled 300 feet on Elder Creek, a major tributary of the Chewaucan River, from June until November (Osborn 1967); however, redband may move even greater distances to seek more suitable water temperatures (Bjornn and Reiser 1991) particularly during the summer months and when seeking spawning habitat during April and May (Kunkel 1976).

Road culverts can block fish movements, the most common access inhibitors being excessive water velocities and associated vertical drops (Baker and Votapka 1990). When assessing culverts for trout passage, the following parameters were evaluated: (1) jumping pools, (2) vertical jumps of <1 foot, (3) velocities that do not exceed maximum sustained swimming speed, and (4) culvert length (Furniss et al. 1991). Baker and Votapka (1990) document sustained speeds of rainbow trout being 2.0 - 6.6 feet per second. Further, as the water velocity increases, the length of a culvert that a trout can swim through decreases. For example, a trout can maneuver through a 50-foot culvert with water velocities up to 3 feet per second; however, at water velocities of 4 feet per second, a trout can only swim through a 30-foot culvert.

Desired Fish Passage:

Functioning Appropriately - All culverts are passable. This is the desired condition.

Functioning Appropriately but-at-Risk - When a culvert is a barrier in the middle to upper reaches of a subwatershed.

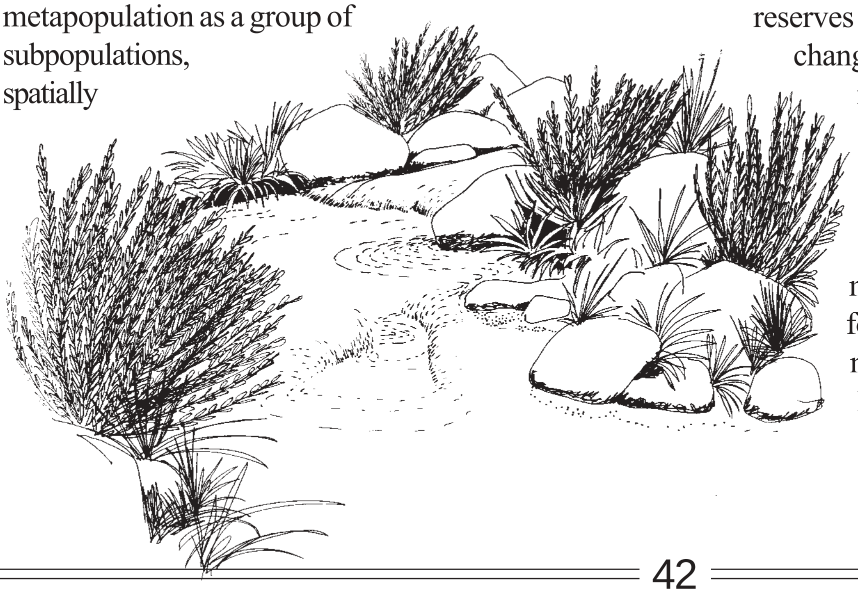
Functioning Inappropriately - When a culvert is a barrier in the lower reaches of a subwatershed.

4 How are the above subwatershed conditions influencing redband trout viability?

Population viability addresses the continued existence of well distributed populations or subpopulations 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 Upper Chewaucan River Watershed, redband trout occupying the upper reaches of the Ben Young Creek subwatershed will possess subtle genetic differences with redband in the upper reaches of the Bear Creek subwatershed. It is important to manage for a diversity of high-quality habitat types to maintain genetic diversity (Meffe 1996).

Meffeís 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 Chewaucan redband 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 subwatershed hosts a separate subpopulation.

A reserve is an area of high-quality habitat which can sustain a viable subpopulation. In this document, reserves in the context of a subwatershed 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 that widely distributed subpopulations will not experience a catastrophe or adverse impact across its entire range. Some subpopulations will escape the impact, eventually recolonize 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).



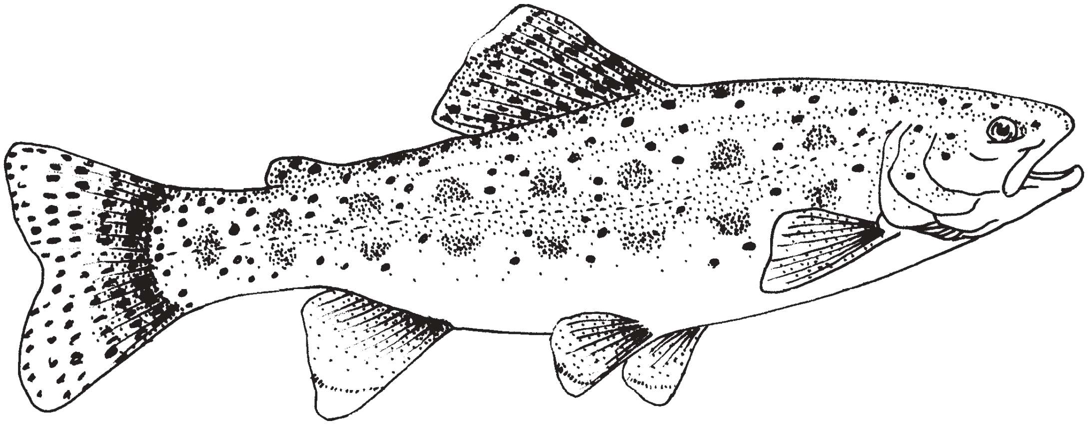
Desired redband trout viability:

Functioning Appropriately - The uplands are producing hydrological conditions (water and sediment outputs) that contribute to properly functioning riparian areas and stream channels, resulting in high-quality habitat and connectivity. Under current management, habitat conditions are able to recover from one short-term disturbance (i.e. flood or small scale wildfire) within one or two generations (3-5 years).

Functioning Appropriately but-at-Risk - The uplands are producing hydrological conditions (water and sediment outputs) that are adversely affectingó or have the potential for adversely affectingóthe functioning of riparian areas and stream channels, contributing to reduced habitat quality and connectivity over a portion of the subwatershed. Under current management, altered habitat conditions will not recover to pre-disturbance conditions within one or two generations (3-5 years).

Functioning Inappropriately - The uplands are producing hydrological conditions (water and sediment outputs) that are adversely affecting the functioning of riparian areas and stream channels, resulting in low quality habitat and connectivity over much of subwatershed. Under current management, habitat conditions are not expected to improve within one to two generations (5-10 years).

Chapter FourCurrent Conditions, Synthesis, and



Chapter Four

Current Conditions, Synthesis, and Recommendations

A Clearer Vision of a Healthy Watershed

During the summer of 1998, a survey crew canvassed eight subwatersheds of the Upper Chewaucan Watershed to obtain data for each watershed element so that an assessment of current conditions could be performed. The main purpose of this chapter is to describe these conditions and compare them to desired conditions of Chapter 3. Initially, a brief description of methodology will be given, then each subwatershed will be detailed using the elements as a guide. For each element, current conditions and ratings will be stated, followed by factors contributing to these conditions. When differences between current and desired conditions exist, management recommendations will be given to move current conditions toward a more ecologically sound state so that the objectives of the Council may be realized.

Current conditions were assessed using the following methods and were conducted in the eight perennial, fish-bearing subwatersheds: Bear Creek, Coffeepot Creek, Ben Young Creek, Swamp Creek, South Creek, Dairy Creek, Elder Creek, and Chewaucan River. Data for question 1 was gathered across an entire subwatershed. Information for questions 2 and 3 was gathered and summarized on a stream reach basis. In general, a reach is a segment of stream of similar gradient, valley type, etc. For example, a segment of stream flowing though a gentle valley would be a separate reach relative to a segment occurring in steeper mountain area. Only the primary stream or streams, bearing the subwatershed name, were surveyed.

1) Is the upland portion of the watershed producing hydrologic conditions that contribute to properly functioning riparian areas?

a. Upland / Forest Vegetation Conditions -

Areas of high canopy densities were located using satellite imagery digitized on the Fremont National Forest Geographical Information System (GIS). Canopy maps were compared with 1988 aerial photographs to verify accuracy.

b. Road Density, Location, and Drainage Network -

Current road locations, densities, and crossings were acquired from the Fremont National Forest GIS 1998 road layer. Using aerial photographs from 1946, 1960, 1969, and 1979, road locations and densities were determined for the following time intervalsóas of 1946, 1947-1960, 1961-1969, 1970-1979, 1980-1988, 1988 to present. Road crossings were identified from GIS and checked for accuracy. Those crossings determined to be inaccurate were deleted.

Rosgen (1991) has developed a Road Impact Index, which is a qualitative indicator of sediment delivery risk associated with road density and the number of stream crossings. It will be used in this assessment and relies on the following formula: Road Impact Index = (acres of road within the subwatershed / acres within the subwatershed) * the number of stream crossings. This index should be used for small subwatersheds.

2) Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

a. Riparian Vegetation and Associated Bank Stability -

During stream surveys conducted in 1998, the four dominant vegetation types within the riparian area were documented. In addition, the associated bank stability was described, as well. Actively eroding banks, above the bankfull height, were counted as unstable.

b. Rosgen Stream Types -

At 2,000' intervals along a surveyed stream, field measurements outlined in Rosgen (1996) were conducted to determine stream type.

3) Are the channels providing adequate fish habitat?

a. Large Woody Debris (LWD) -

Large wood was counted and classified into two categories. For ponderosa pine and mixed conifer sites, LWD was classified as 35' long with the small end being at least 20" in diameter. In lodgepole pine sites (LP), LWD was classified as 35' long with the small end being at least 12" in diameter. In both cases, LWD had to be within the bankfull dimensions of the channel to be counted.

b). Pools -

To be classified as pool, two conditions were required. First, a pool needed to span the entire stream channel. Second, pool length needed to be longer than its width. Using these criteria, pocket pools which occur in the middle of channels were not counted.

c. Spawning Gravel Fines -

Bulk samples of spawning gravel were acquired by inserting a cylinder into the streambed and extracting the gravel from the cylinder. Five samples were taken at each site at pool tail crests or other areas which provided suitable spawning gravels. Next, the samples were taken to the Fremont National Forest Engineering and Soils Lab, dried, and passed through a series of sieves to determine the percent fines (<6.4 mm).

d. Stream Temperature -

Stowaway temperature sensors recorded temperatures at 1/2 hour intervals from July 2 to September 15, 1998. All sensors were tested for accuracy prior to installation.

e. Fish Passage -

The length, diameter, and slope of culverts occurring in a surveyed stream were measured. Then, based on the drainage area above the culvert, the average spring flow was calculated. Using the culvert dimensions and flow information, it was determined whether or not the velocities of water flowing through the culvert exceeded the sustained swimming speed of trout. In addition the presence or absence of jumping pools were documented, and the jump height was measured.

4) How are the above subwatershed conditions influencing redband trout viability?

This section will be a summary of the above elements and their cumulative effects on a subwatershedís ability to serve as a reserve for redband trout.

Bear Creek Subwatershed

1) Is the upland portion of the subwatershed producing hydrologic conditions that contribute to properly functioning riparian areas?

a. Upland / Forest Vegetation Conditions.

Current conditions: Within the 14,332 acre subwatershed, forested lands cover 12,554 acres or approximately 88% of the subwatershed. Conifers have encroached into both dry and moist meadows, which are 905 and 137 acres, respectively. There are an estimated 235 acres of juniper woodlands.

Of the forested acres, 39%, or 4,872 acres, have canopy densities exceeding HRV. Refer to Figure 4.1 - Bear Creek Subwatershed Upland Vegetation. With increased canopy densities, a build up of understory trees heightens the risk of catastrophic fire and also causes conifers to become stressed and susceptible to insects and disease. There may also be a reduction of water available for stream flow during the summer months.

Approximately 9% of the forested lands are in openingsómainly as seedling/sapling standsówhich is below the 15% recommendation for the Upper Chewaucan Watershed and well below the 20-30% figure noted by Troendle (1982), the point where a significant change in flow can be detected.

The majority of property owned by US Timberlands Services was harvested in the 1970ís and is comprised of ponderosa pine plantations having forest canopies within HRV. These forest sites are considered to be hydrologically recovered because the leaf area is sufficient to return transpiration rates to reference or historic conditions and canopy closure is sufficient to prevent excess snow accumulation. (Due to data limitations, canopy closure from ISAT data is used instead of leaf area index to quantify recovery. When canopy closure reaches reference conditions, it is determined to be hydrologically recovered.)

For the above reasons, this element receives a ***functioning appropriately but-at-risk*** rating. The effects of management activities on soil resources has been fairly extensiveóa result of past timber harvest activities throughout most of the subwatershed.

Factors contributing to current conditions: The frequent and low intensity ground fires that maintained vast stands of open ponderosa pine forests have been suppressed since the early 1900ís. This has created conditions that allow conifers to grow in greater densities than occurred historically in both forested and meadow sites. In addition, past silvicultural treatments emphasized either clear-cutting or selective removal of individual large ponderosa pine. Because these treatments were not based on maintaining forested stands within their HRV, they are a contributing factor to current conditions. The Hannon Trail Roadless Area, accounting for 1,584 acres, has been affected by fire suppression and restricted silvicultural treatments, additional factors contributing to dense forest stands in the subwatershed. Other than roads, soil disturbance within the subwatershed is primarily associated with past timber harvesting activities, mainly in the form of skid trails and landings.

Recommendations: To reduce the risk of catastrophic fire and its associated soil erosion and increased flows, forest understories require thinning to restore canopies back to HRV. This will promote conditions for low intensity fires to reoccuróeither naturally or controlledóthroughout the subwatershed and reduce the potential for epidemic insect and disease outbreaks. In the meadows, aspen stands and other non-forested areas, conifers that became established after the advent of fire suppression will be considered for thinning. Where possible, obliterate skid trails and landings throughout the subwatershed to alleviate past soil impactsóbeginning with those areas where understory treatments will occur.

b. Road Density, Location, and Drainage Network.

Current conditions: There are 84 miles of roads within this subwatershed which equates to a road density of 3.8 mi/mi≤; therefore, this element receives a ***functioning appropriately but-at-risk*** rating. Refer to Figure 4.2 - Bear Creek Subwatershed Road Locations. Of these roads, fifteen miles (18%) are within 300 feet of perennial and intermittent streams. Furthermore, roads cross channels at 51 locations, sites where direct sediment introduction occurs. Based on the above numbers, the Road Impact Index was calculated to be 0.65. Along with the 42 miles of stream channels, an estimated 50 of the 84 miles of roads are hydrologically integrated with the stream network, thus increasing the drainage network by 119%óusing Wempleís (1994) study results.

Factors contributing to current conditions: By 1946, 14 miles of roads (0.6 mi/mi≤) were constructed in the subwatershed. From 1947 to 1960, an additional 4 miles were built, raising the road density to 0.8 mi/mi≤. Twenty-four miles of roads were constructed between 1961 and 1969 in conjunction with an increase in the demand for timber, bringing the road density to 1.9 mi/mi≤. From 1970 to 1979, an additional 42 miles of roads were constructed associated with high levels of timber harvest, doubling the road density to 3.8 mi/mi≤. No roads have been constructed since 1980.

Recommendations: To reach the desired road density of 1.7 mi/mi≤ and a functioning appropriately rating, obliterate approximately 46 miles of road. Road obliteration eliminates the road through subsoiling, culvert removal, and recontouring of cut and fill slopes, restoring the land to a more natural state. Emphasis should be placed on those roads within 300' of streams or have numerous stream crossings. The remaining roads should be properly drained to reduce the hydrological connection to stream channels, resulting in less water and sediment flowing down roads and their ditches. This will promote better infiltration of water into forest soils for slow release into stream channels.

2) Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

Bear Creek was divided into eight reaches, approximately 11 miles in length. Reach 4 is approximately 2.5 miles in lengthóprivately owned by US Timberlands Servicesóand was surveyed using the Proper Functioning Condition (PFC) analysis. For reach locations refer to Figure 4.3 - Bear Creek Subwatershed Reach and Monitoring Locations, and for reach summaries refer to Appendix 1 - Bear Creek Reach Summaries. Recommendations can be found in Appendix 2 - Bear Creek Subwatershed Recommendations.

a. Riparian vegetation and associated bank stability.

Current conditions: Along Reaches 1, 2, and 3, the dominant plant typesómountain alder, willow, and black cottonwoodóare highly similar to late-seral species in composition and structure and are providing adequate cover to protect banks and dissipate energy during high flows. However, in Reach 3, sapling-sized white fir are encroaching into the floodplain. Once these trees become larger, they may compete and/or replace late-seral riparian species. The PFC survey conducted in Reach 4 documented late seral vegetationóalder, sedge, rush, conifers.

Along Reaches 5 through 8, the dominant plant typesósedge, rush, willow, lodgepole pineóare also highly similar to late-seral species in composition and structure, resulting in adequate cover for the protection of banks and the dissipation of energy during high flows. Because late-seral species dominate, bank stability exceeds 90% in all reaches. It should be noted, however, that there are localized areas of bank instability in some reaches.

For these reasons, riparian vegetation and associated bank stability along Bear Creek is ***functioning appropriately***.

Factors contributing to current conditions: In the lower four reaches, steep topography has precluded high levels of timber harvest, road construction and grazing, resulting in minimal impacts to riparian areas. Even in the upper four reaches, where these activities have been more intense, few roads exist along Bear Creek, and in most places buffer strips were left to protect riparian areas. There are a few localized areas of bank instability where past livestock grazing has affected stream channels in the lower portion of Reach 5 and the upper portion of Reach 8. Since 1995, however, the grazing system within the Bear Allotmentówhich includes the subwatershedórelies on short duration grazing which has improved riparian plant conditions. Further, the altered fire regimeóor lack of fireó continues to promote high densities of white fir and lodgepole pine in riparian areas, thus competing with willow, aspen, and cottonwood. For example, surveys and associated photographs (Reach 5, Segment 1) indicate pole to sapling size lodgepole pine are competing with willow.

Recommendations: In Reaches 3, 5, 6, 7, and 8, mechanically thin encroaching conifers and/or allow prescribed fire to creep into riparian areas. This will reduce conifer densities and maintain growth of riparian grasses, shrubs, and trees. Starting in 2000, vegetative conditions are expected to continue to improve in all reaches affected by grazing on National Forest lands with new grazing guidelines. These grazing standards will maintain and promote late-seral plant conditions along stream channels and will help resolve localized areas of grazing induced bank instability. Finally, the implementation of INFISH and the Oregon Forest Practices Act will guide timber harvest operations so they will not adversely affect riparian vegetation.

b. Rosgen Stream Type(s).

Current conditions: All reaches are ***functioning appropriately*** in terms of their potential stream type as the shape and size of the stream channel is in balance with its setting. The lower three forested reaches are dominated by B stream types, with moderately steep gradients, gentle sideslopes, and gravel/cobble substrates. In Reaches 5 through 8, E stream types are most common with B stream types less frequent. The E stream types are characterized by low gradients, developed floodplains, and low width-to-depth ratios (narrow and deep). Even though Rosgen stream type measurements were not conducted in Reach 4, the PFC surveys strongly indicate that the channel is in balance with its setting.

Factors contributing to current conditions: In Reaches 1 through 3, the landform and local geology, along with the abundance of mountain alder, provides for bank stability and related moderate width-to-depth ratios. For the E stream types located in the upper reaches, the dominance of sedge promotes high-bank stability, resulting in narrow and deep channels which are resistant to the erosive energy of high flows. Even though the upland vegetation and roads received functioning appropriately but-at-risk ratings, any resulting change to the magnitude and timing of stream flows has not altered channels (stream types) from their natural potential.

Recommendations: Implement recommendations in the upland and riparian vegetation sections above, and add LWD in Reaches 1-3 and 6-8. These actions will maintain or enhance the desired stream types.

3) Are the channels providing adequate fish habitat?

For reach locations refer to Figure 4.3 - Bear Creek Subwatershed Reach and Monitoring Locations. For reach summaries refer to Appendix 1- Bear Creek Reach Summaries. Recommendations can be found in Appendix 2 - Bear Creek Subwatershed Recommendations. The PFC survey conducted in Reach 4 did not assess fish habitat elements.

a. Large Woody Debris (LWD).

Current conditions: Of the three lower reaches, Reaches 1 and 3 are ***functioning inappropriately***, while Reach 2 is ***functioning appropriately but-at-risk***. In Reaches 5-8, only Reach 5 received a ***functioning appropriately*** rating, while the other three were determined to be ***functioning appropriately but-at-risk***.

Factors contributing to current conditions: Even though access is limited in the lower portion of this subwatershed, local areas provide access to riparian zones and may have allowed for selective timber harvest and removal of in-stream wood in Reaches 1-3. Large wood exceeds desired numbers in Reach 5, but not in Reaches 6-8; the uplands along these reaches are dominated by lodgepole pine intermixed with white fir, having diameter sizes 1-3 (seedlings, saplings and poles, small trees), indicating recent encroachment since exclusion of natural fire. Once these trees become larger and near the end of their life cycle, in-stream LWD will increase. The presence of smaller trees along Bear Creek indicates that presettlement (prior to European settlement) conditions occurring under frequent fire intervals, may not have produced the number of LWD currently desired.

Recommendations: In the forested portions along Reaches 1-3 and 6-8, restore large woody debris to the desired 75th percentile. In the short term, mechanically add LWD into the stream channel. For long term and sustainable LWD recruitment in forested reaches, manage for conifers within the riparian and upland zones as prescribed in INFISH and the Oregon Forest Practices Act. Additional large wood in the channel will enhance sediment retention, especially in the event of a catastrophic fire, and help improve water quality and aquatic habitat.

b. Pools.

Current conditions: All surveyed reaches were found to be ***functioning appropriately*** except Reach 8 which received a ***functioning appropriately but-at-risk*** rating.

Factors contributing to current conditions: Pool frequencies reflect near natural numbers in part because stream channels and riparian vegetation are highly similar to desired conditions. It should be noted that the upper reaches, characterized by lower flows, may be unable to produce deep pools in the absence of beaver dams.

Recommendations: The addition of LWD in the forested segments of Reach 8 will help increase the number of pools to the desired condition. Also, even though Reaches 1-3 meet the 75th percentile for pools, the addition of LWD would enhance pool complexity. To effectively create a pool, install wood within the bankfull dimensionsópreferably within the wetted channel. Consult with hydrologist and fishery biologist when implementing these habitat improvement projects.

c. Spawning Gravel Fines.

Current conditions: Thirteen-percent fine sediments were documented in Reach 1, promoting 87% embryo survival and resulting in a ***functioning appropriately*** rating. In Reach 6, the percent fines were 32%, resulting in a ***functioning inappropriately*** rating and an embryo survival rate of only 42%.

Factors contributing to current conditions: The high sediment values recorded in Reach 6 were unexpected because bank instability and road crossings are minimal upstream of where the samples were taken. Naturally high erosion rates associated with soils and geomorphology of this area could be a reason for the high amounts of sediment in spawning substrates.

Recommendations: Obliterate roads, particularly those within 300' of streams or those that have numerous stream crossings. The remaining roads should be properly drained to help reduce the amount of sediment reaching streams. Continue to maintain the existing riparian vegetation and associated bank stability and restore areas of localized bank instability. Place LWD where needed for additional bank stability and sediment storage.

d. Stream Temperature.

Current conditions: Based on stream temperature recordings in Reach 6, it is assumed that Reaches 5 through 8 are ***functioning appropriately***. Conversely, Reaches 1 through 3 are believed to be ***functioning appropriately but-at-risk***, because the 7-day average maximum temperature reached 19.2∞C.

Factors contributing to current conditions: Stream temperatures may be near their potential in part because stream channels and riparian vegetation are near desired conditions. This suggests that the desired temperature of 17.8∞C (State Water Quality Standard) may be lower than is achievable for this subwatershed.

Recommendations: In addition to implementing the recommendations previously described in this chapter, specific desired conditions (i.e. shading levels) and management actions affecting stream temperatures will be addressed in the Upper Chewaucan Water Quality Management Plan to be completed in 2000/2001.

e. Fish Passage (Culvert).

Current conditions: The one culvert surveyed along Bear Creek was identified as a barrier. It is located in Reach 6. Refer to Figure 4.2 - Bear Creek Subwatershed Road Locations. This culvert has a vertical jump (water surface to culvert outlet) of <1 foot, but has velocities that exceed sustained swimming speeds and lacks a pool at its outlet. For these reasons, this culvert is considered a barrier, and because it is in the upper portion of the subwatershed, this element receives a ***functioning appropriately but-at-risk*** rating.

Factors contributing to current conditions: The slope (>5%) of the culvert and the lack of a jumping pool are the reasons this is considered a barrier.

Recommendations: Replace the existing culvert with one that allows for fish passage. Ensure that the correct size of culvert is installed at the proper location and slope working with a hydrologist and engineer. Survey the remainder of stream crossings (approximately 50) in the subwatershed to determine if other barriers exists.

4) How are the above subwatershed conditions influencing redband trout viability?

As previously mentioned, both the upland vegetation and roads are functioning appropriately but-at-risk; yet, these conditions do not appear to be directing riparian vegetation and streams types away from desired conditions. However, if these areas reflected desired numbers, upland conditions could enhance late-seral riparian vegetation, bank stability, and appropriate stream types. For example, restoring canopy densities to HRV may increase the magnitude of low flows, thus providing more water to riparian areas and improve plant growth during the dry summer months. Further, a reduction in road densities would decrease the drainage network, thus lessening the magnitude of high flows and their ability to scour stream banksópromoting late-seral plant development. Therefore, improvements of upland conditions would help return low and high stream flows to a more natural state.

The dominance of late-seral riparian vegetation and appropriate stream types has led to the desired number of pools, except in Reach 8. Because LWD is lacking throughout Bear Creek, structural complexity within these pools is inadequate. In addition to creating more pools, placing LWD in all of the appropriate reaches would provide hiding cover, rearing habitat, and low velocity areas during high flow events. Furthermore, additional wood will capture and store sediments transported during high flows, routing these fines away from spawning substrate, which appears to be a problem in Reach 6. In the event of a catastrophic fire from high canopy densities, large quantities of LWD throughout the forested reaches would buffer downstream areas and tributaries against high sediment inputs and low embryo survival rates.

There are two more considerations. First, redband stress and survival should not be adversely affected by the stream temperature of 19.2∞C in Reach 1. Second, even if good habitat conditions existed throughout the stream, the culvert in Reach 6 prevents upstream movements during all times of the year, essentially dissecting the Bear Creek subpopulation.

In conclusion, several assessment elements have good overall ratings and include the following: riparian vegetation and bank stability, Rosgen stream types, pool numbers, and stream temperatures. However, dense canopies in portions of forested sites, moderate road densities, lack of LWD, and culvert barrier inhibit the Bear Creek Subwatershed from functioning appropriately as a redband trout reserve. As a result, this assessment element is ***functioning appropriately but-at-risk***. Implementing the recommendations listed in this subwatershed section then maintaining those desired conditions will help bring multiple use management in concert with the hydrologic and ecological processes of the landscape.

Figure 4.1

Figure 4.2

Figure 4.3

Coffeepot Creek Subwatershed

1) Is the upland portion of the subwatershed producing hydrologic conditions that contribute to properly functioning riparian areas?

a. Upland / Forest Vegetation Conditions.

Current conditions: Within the 14,684 acre subwatershed, forested lands cover 11,429 acres or approximately 78% of the area. Conifers have encroached into dry meadows which account for approximately 1,131 acres. There are an estimated 203 acres of juniper woodlands.

Thirty-eight percent or 4,370 acres of forested areas have canopy densities that exceed the HRV. Refer to Figure 4.4 - Coffeepot Subwatershed Upland Vegetation. With increased canopy densities, a build up of understory trees heightens the risk of catastrophic fire and causes conifers to become stressed and susceptible to insects and disease. There is also a possibility of reduced water availability for stream flow during the summer months.

About 12% of the forested lands are in openingsó mainly seedling/sapling standsóand are below the 15% recommendation for the Upper Chewaucan Watershed and the 20-30% figure noted by Troendle (1982)óthe point where a significant change in flow can be detected.

The majority of property owned by US Timberlands Services was harvested in the 1970ís and is comprised of ponderosa pine plantations having forest canopies within HRV. These forest sites are considered to be hydrologically recovered because the leaf area is sufficient to return transpiration rates to reference or historic conditions and canopy closure is sufficient to prevent excess snow accumulation. Due to data limitations, canopy closure from ISAT data is used instead of leaf area index to quantify recovery. When canopy closure reaches the reference condition range it is determined to be hydrologically recovered. For the above reasons, this element receives a ***functioning appropriately but-at-risk*** rating. The effects of management activities on soil resources has been fairly extensive, a result of past timber harvest activities throughout most of the subwatershed.

Factors contributing to current conditions: The frequent and low intensity ground fires that maintained vast stands of open ponderosa pine forests have been suppressed since the early 1900ís. This has created conditions that allow conifers to grow in greater densities than occurred historically in both forested and meadow sites. In addition, past silvicultural treatments emphasized either clear-cutting or selective removal of individual large ponderosa pine. Because these treatments were not based on maintaining forested stands within their HRV, they are a contributing factor to current conditions. The Hannon Trail Roadless Area, accounting for 249 acres, has been affected by fire suppression and restricted silvicultural treatments, additional factors contributing to dense forest stands in the subwatershed. The seedling/sapling stands are a result of forested areas which were harvested through clear-cutting, shelterwood, and seed-tree silvicultural prescriptions.

Recommendations: To reduce the risk of catastrophic fire and associated soil erosion and increased flows, forest understories require thinning to restore canopies back to HRV. This will promote conditions for low intensity fires to reoccuróeither naturally or controlledóthroughout the subwatershed. This can reduce the potential for epidemic insect and disease outbreaks. In the meadows and aspen stands, conifersóincluding juniperóthat became established after the advent of fire suppression will be considered for thinning. Where possible, skid trails and landings will be obliterated throughout the subwatershed to alleviate past soil impactsóbeginning with those areas where understory treatments will occur.

b. Road Density, Location, and Drainage Network.

Current conditions: There are 66 miles of roads in this subwatershed which equates to a road density of 2.9 mi/mi≤, resulting in a ***functioning appropriately but-at-risk*** rating. Refer to Figure 4.5 - Coffeepot Creek Subwatershed Road Locations. Of these roads, ten miles (15%) are within 300 feet of perennial and intermittent streams. Furthermore, roads cross channels at 58 locationsósites where direct sediment introduction occurs. Based on the above numbers, the Road Impact Index was calculated to be 0.57. Along with the 57 miles of stream channels, an estimated 40 of the 66 miles of roads are hydrologically integrated with the stream network, thus increasing the drainage network by 70%óusing Wempleís (1994) study results.

Factors contributing to current conditions: By 1946, 9 miles of roads (0.6 mi/mi≤) were constructed in the subwatershed. From 1947 to 1960, an additional 7 miles were built, slightly increasing the road density to 0.7 mi/mi≤. Eleven miles of roads were constructed in the upper part of the watershed between 1961 and 1969, bringing the road density to 1.2 mi/mi≤. From 1970 to 1979, an additional 32 miles of roads were constructed throughout the subwatershed associated with high levels of timber harvest, more than doubling the road density to 2.6 mi/mi≤. Since 1980, 7 miles of roads have been constructed, increasing the road density to the current level of 2.9 mi/mi≤.

Recommendations: To reach the desired road density of 1.7 mi/mi≤ and a Functioning Appropriately rating, eliminate approximately 28 miles of road. Emphasis should be placed on those roads within 300' of streams or have numerous stream crossings. The remaining roads should be properly drained to reduce the hydrological connection to stream channels, resulting in less water and sediment flowing down roads and their ditches. This promotes better infiltration of water into forest soils for slow release into stream channels.

2) Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

Coffeepot Creek was divided into 9 reaches, about ten miles in length. Approximately 7 and 3 miles were surveyed on National Forest and private lands (J-Spear), respectively. Reach 8ó just exceeding one mile and owned by US Timberlands Servicesó was surveyed using the PFC analysis. For reach locations refer to Figure 4.6 - Coffeepot Creek Subwatershed Reach and Monitoring Locations, and for reach summaries refer to Appendix 1 - Coffeepot Creek Reach Summaries. Recommendations can be found in Appendix 2 - Coffeepot Creek Subwatershed Recommendations.

a. Riparian vegetation and associated bank stability.

Current conditions: The dominant plant typesó sedge, rush, and willowóalong Reach 1 are highly similar to late-seral species composition, resulting in high bank stability. For these reasons Reach 1 is ***functioning appropriately***. Reach 2 is a low gradient segment dominated by sedge and rush, followed by grass and willow. Because associated bank stability is high, this reach is ***functioning appropriately***. Reach 3, however, contains more grass and lower bank stability (88%), resulting in a ***functioning appropriately but-at-risk*** rating. Reaches 4, 6, and 7 are B stream types and channels are lined with late-seral species, the most dominant being mountain alder with subdominants comprised of sedge, willow, cottonwood, and dogwood. Since, bank stability exceeds 90% in these reaches, they received a ***functioning appropriately*** rating. The PFC analysis conducted in Reach 8 documented late-seral vegetation and high bank stability; consequently, this reach receives a ***functioning appropriately*** rating. Reach 9 was documented as having 99% bank stability with sedge being the dominant plant type, resulting in a ***functioning appropriately*** rating. The two PFC surveys conducted in Reach 8 documented late seral vegetation along both areasómid- to late seral conifers, alder, aspen, willow, sedge, and rush. Based on these surveys, both areas were ***functioning appropriately***.

Factors contributing to current conditions: Reach 1, located on National Forest land, is an E stream type. The meadow is in an allotment pasture that is used during late May and early June, a grazing practice which promotes or maintains late-seral plant species and composition. Reach 2, located on J-Spear Ranch property, is also characterized by an E stream type. Grazing has been excluded on this reach since 1991óa reason for its late-seral species and high bank stability. Reach 3, located on J-Spear Ranch lands, is grazed throughout the season, explaining the lower bank stability and abundance of grass along the stream channel.

Coffeepot Creek flows through a transitional area in Reach 4, changing from an E to a B stream type. The 9% bank instability is due to the relative abundance of grass species along the lower portion of the reach. Upstream, Reaches 5, 6, 7, and 8 flow through steeper gradient mountain areas relatively inaccessible and unaffected by timber harvest, roads, and grazing. When timber harvest was conducted in these areas, buffer strips were left along the stream channel. In both reaches, early-seral conifers were documented and may be more common than historically occurred. Along with the late-seral vegetation, cobble and boulders promote 99% bank stability. Finally, Reach 9 flows through a long meadow interspersed with scattered lodgepole pine woodlands. The grasses, which are relatively abundant, occur primarily in the woodland areas. The Bear Creek Allotment Management Plan covers most grazing along Reach 9 of Coffeepot Creek. As with Bear Creek, grazing is of short duration and was implemented in 1995 to maintain or move riparian plants towards late-seral conditions. When timber harvest was conducted in Reaches 5 and 8, buffer strips were left along the stream channel.

Recommendations: The maintenance of current grazing practices on Reach 1 will continue to promote late-seral vegetation and full expression of willow heights. Likewise, the riparian exclosure along Reach 2 should be maintained until willow become larger; if grazing is allowed, use a practice similar to that used on Reach 1. Grazing management in Reach 3 should be altered to move plant species composition and structure to late-seral conditions. Along Reach 4, bank instability occurs near a pasture fence where cattle often congregate. Localized barriers such as felled trees can protect banks and promote bank stability. This would not decrease the forage base because grass is plentiful away from the stream channel. Starting in 2000, vegetative conditions are expected to continue to improve in all reaches affected by grazing on National Forest lands with new grazing guidelines. These grazing standards will maintain and promote late-seral plant conditions along stream channels and will help resolve localized areas of grazing induced bank instability. Finally, the implementation of INFISH and the Oregon Forest Practices Act will guide timber harvest operations so they will not adversely affect riparian vegetation.

b. Rosgen Stream Type(s).

Current conditions: Reaches 1, 2, 4, 6, 7, and 9 are ***functioning appropriately*** in terms of their potential stream type. For these reaches, the shape and size of the channel is in balance with its setting. The lower two reaches are E stream types which are channels expected in a low-gradient meadow system. Reach 4 is in a steeper area, where a B stream type would be expected. In the forested areasó characterized by moderate gradients along Reaches 6 and 7óB stream types dominate, again reflecting the natural potential. Finally, Reach 9 is an E stream type, expected for the meadow environment. The E stream type is common in Reach 3, but the relatively low bank stability may lead to downcutting resulting in a C or F stream type; therefore Reach 3 is ***functioning appropriately but-at-risk***. Rosgen stream type measurements were not conducted in Reach 5 and 8, but the PFC surveys conducted in Reach 8 strongly indicate that the channel is in balance with its setting.

Factors contributing to current conditions: The late-seral vegetation found in this subwatershed contributes to both B and E stream types, especially the E types. The dominance of sedge and rush along Reaches 1 and 2 promote high bank stability, with narrow and deep channels resistant to erosive energy associated with high flows. Along the B stream types, the local geology and large boulders contribute to channel stability. Again, the abundance of grass associated with season long grazing along Reach 3 contribute to the ***functioning appropriately but-at-risk*** rating in this area. Even though upland vegetation and roads 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. **Recommendations:** Implement recommendations in the upland and riparian sections for the Coffeepot Creek Subwatershed, and add LWD in Reaches 4, 6, and 7. These actions will maintain or enhance the desired stream types.

3) Are the channels providing adequate fish habitat?

For reach locations refer to Figure 4.6 - Coffeepot Creek Subwatershed Reach and Monitoring Locations, and for reach summaries refer to Appendix 1 - Coffeepot Creek Reach Summaries. Recommendations can be found in Appendix 2 - Coffeepot Creek Subwatershed Recommendations. The PFC survey conducted in Reach 8 did not assess fish habitat elements.

a. Large Woody Debris (LWD).

Current conditions: Reaches 1, 2, and 3 are meadow dominated sites, areas where LWD is not expected. Reaches 6 and 7, and parts of 4 and 9 are appropriate sites for LWD. Reach 4 is ***functioning inappropriately***, while Reaches 6, 7, and 9 are ***functioning appropriately but-at-risk***.

Factors contributing to current conditions: In Reach 4, only portions of the channel are lined with conifers, so recruitment trees are not available or expected along the entire reach. As in Bear Creek, past selective harvest may be a reason LWD numbers are low in Reaches 6 and 7. In addition, ponderosa pine densities may be low within the stream corridor, resulting in low LWD recruitment. In 1997, high numbers of ponderosa and lodgepole pine fell into the stream along Reach 9óa result of unusually high winds; however, many segments along this reach are bordered by meadows, areas that are not adding wood to the channel.

Recommendations: In the forested areas along Reaches 4, 6, 7, and 9, add LWD to meet the desired 75th percentile. In the short term, mechanically add LWD into the stream channel. For long term and sustainable LWD recruitment in forested reaches, manage for conifers within the riparian and upland zones as prescribed in INFISH and the Oregon Forest Practices Act. Additional large wood in the channel will enhance sediment retention, especially in the event of a catastrophic fire, and help improve water quality and aquatic habitat.

b. Pools.

Current conditions: All reaches were found to be ***functioning appropriately***.

Factors contributing to current conditions: Pool frequencies are at near-natural numbers in part because stream channels and riparian vegetation in most areas are highly similar to desired conditions. The pool numbers documented in Reach 3 appear to be related to high sinuosity, even though the vegetation and channel are functioning appropriately but-at-risk. It should be noted that the upper reaches (4-9) may be unable to produce deep pools in the absence of LWD and beaver dams.

Recommendations: Even though pool numbers are at the desired state, adding LWD to the pools in Reaches 4, 6, and 7 would create more complex fish habitat. To effectively create a pool, install wood within the bankfull dimensionsópreferably within the wetted channel. Consult with a hydrologist and fishery biologist when implementing these habitat improvement projects.

c. Spawning Gravel Fines.

Current conditions: Fine sediments in spawning substrates were sampled in two reaches within the subwatershed. Reach 1 contains 16% fine sediments, promoting 81% embryo survival. In Reach 4 the percent fines were slightly lower at 14%, promoting 84% embryo survival. As a result, both reaches are ***functioning appropriately***.

Factors contributing to current conditions: Although roads are contributing to sediment levels, E stream typesófound in Reaches 1-3ótransport and capture sediment and is a likely reason for the low sediment values in Reach 1. The low levels of sediment in Reach 4 can be partially explained by the low number of stream crossings above the sampling location.

Recommendations: Obliterate roads, particularly those within 300' of streams or those that have numerous stream crossings. The remaining roads should be properly drained to reduce sediment delivery to streams. Continue to maintain the existing riparian vegetation and restore areas of localized bank instability. Restore LWD where needed for additional bank stability and sediment storage.

d. Stream Temperature.

Current conditions: Reach 1 is ***functioning inappropriately***, resulting from a stream temperature of 24.3∞C. Based on stream temperature recordings from Reaches 4 and 9, the stream in this section is ***functioning appropriately but-at-risk*** because the 7-day average maximum temperature ranged from 20.5∞C to 21.3∞C, respectively. The temperature recording station at Reach 9 was located near the headwater springs. Temperatures were not recorded in Reaches 2, 3, 6, and 7.

Factors contributing to current conditions: The open meadow environment in conjunction with minimal stream flow in Reach 9 may contribute to the high stream temperatures. The influence of cool springs and tributaries along with appropriate channel types help maintain water temperature downstream to Reach 4. Further downstream through the large meadows, extensive beaver dams and lower-than-desired shading levels are likely causes for the rise in temperature in Reach 1.

Recommendations: In addition to implementing the recommendations previously described for the Coffeepot Creek Subwatershed, specific desired conditions (i.e. shading levels) and management actions affecting stream temperatures will be addressed in the Upper Chewaucan Water Quality Management Plan to be completed in 2000/2001. The WQMP will reflect the Councilís desire to manage riparian areas toward PNC.

e. Fish Passage (Culvert).

Current conditions: Of the two culverts surveyed along Coffeepot Creek, one is a barrier. The barrier is located at Reach 9. Refer to Figure 4.5 - Coffeepot Creek Subwatershed Road Locations. This culvert has a vertical jump of >1 foot and has velocities exceeding sustained swimming speeds. For these reasons, it is considered a barrier. Because it is in the upper portion of the subwatershed, this assessment element receives a ***functioning appropriately but-at-risk*** rating.

Factors contributing to current conditions: The slope (4%) of the culvert and a vertical jump >1 foot are the reasons this is considered a barrier.

Recommendations: Replace the existing culvert with one that allows for fish passage. Ensure that the correct size of culvert is installed at the proper location and slope by working with a hydrologist and engineer. Survey the remaining 56 stream crossings in the subwatershed to determine if other barriers exists.

4) How are the above subwatershed conditions influencing redband trout viability?

As in the Bear Creek Subwatershed, both the upland vegetation and roads are functioning appropriately but-at-risk*;* yet, these conditions do not appear to be directing riparian vegetation and streams types away from desired conditions. However, if these areas reflected desired numbers, upland conditions could enhance late-seral riparian vegetation, bank stability, and appropriate stream types. For example, restoring canopy densities to HRV may increase the magnitude of low flows, thus providing more water to riparian areas essential for plant growth and maintenance during the dry summer months. Further, a reduction in road densities would decrease the drainage network, thus lessening the magnitude of high flows and their ability to scour stream banksópromoting late-seral plant development. Therefore, improvements of upland conditions would alleviate the stress placed on riparian vegetation and stream types by unnatural low and high flow events.

The dominance of late-seral riparian vegetation, appropriate stream types, and high sinuosity of Reach 3 has led to the desired number of pools. Along the meadow reaches, especially 1 and 2, pools are narrow and deep with undercut banks which provide cover. Improvement of riparian conditions in Reach 3 would provide similar habitat. However, in the forested reaches, pool complexity is lacking because LWD numbers are low. Additional LWD would create new pools, provide hiding cover, rearing habitat, and low velocity areas during high flow events. Because wood captures and stores sediments transported during high flows, routing these fines away from spawning substrate, it would help to maintain low spawning fines throughout the subwatershed. In the event of a catastrophic fire from high canopy densities, large numbers of wood throughout the forested reaches would buffer downstream areas and tributaries against high sediment inputs and low embryo survival rates.

There are two more considerations. First, temperature stress may be a concern throughout the streamóparticularly in Reach 1. Second, based on measured culverts, redband trout are able to move throughout the lower reaches to escape high temperatures in the summer and for spawning during the spring. Second, in Reach 9, trout attempting to move into this area will encounter a barrieró restricting complete movement through the stream.

In conclusion, several assessment elements have good overall ratings and include the following: riparian vegetation and bank stability, Rosgen stream types, pool numbers, and spawning gravel fines. However, the dense canopies in portions of forested sites, moderate road densities, lack of LWD, high stream temperatures, and culvert barriers are inhibiting the Coffeepot Creek Subwatershed from functioning appropriately as a redband trout reserve. As a result, this assessment element is ***functioning appropriately but-at-risk***. Implementing the recommendations listed in this subwatershed section then maintaining those desired conditions will help bring multiple use management in concert with hydrologic and ecological processes of the landscape.

Figure 4.4

Figure 4.5

Figure 4.6

Ben Young Creek Subwatershed

1) Is the upland portion of the subwatershed producing hydrologic conditions that contribute to properly functioning riparian areas ?

a. Upland / Forest Vegetation Conditions.

Current conditions: Within the 10,426 acre subwatershed, forested lands cover 7,873 acres, approximately 76% of the subwatershed. Conifers have encroached into both dry and moist meadows, which account for 595 acres and 9 acres, respectively. An estimated 1,019 acres of the subwatershed is juniper woodlands. Of the forested acres, 69%, or 5,399 acres, have canopy densities that exceed the HRV. Refer to Figure 4.7 - Ben Young Creek Subwatershed Upland Vegetation. With increased canopy densities, the build up of understory trees heightens the risk of catastrophic fire and may reduce water available for stream flow during the summer months, especially with the existence of juniper woodlands. Under these conditions, conifers also become stressed and susceptible to insects and disease.

About 19% of the forested lands are in openingsó mainly seedling/sapling standsóand are higher than the 15% recommendation for the Upper Chewaucan Watershed but lower than the 20-30% figure noted by Troendle (1982), the point where a significant change in flow can be detected.

For the above reasons, this assessment element receives a ***functioning inappropriately*** rating.

Factors contributing to current conditions: The frequent and low intensity ground fires that maintained vast stands of open ponderosa pine forests have been suppressed since the early 1900ís. This allows conifers to grow in greater densities than occurred historically in both forested and meadow sites. In addition, past silvicultural treatments emphasized either clear-cutting or selective removal of individual large ponderosa pine. Because these treatments were not based on maintaining forested stands within their HRV, they are a contributing factor to current conditions.

Recommendations: To reduce the risk of catastrophic fire and associated soil erosion and increased flows, forest understories require thinning to restore canopies back to HRV. This will promote conditions for low intensity fires to reoccuróeither naturally or controlledóthroughout the subwatershed. This treatment will also reduce the potential for epidemic insect and disease outbreaks. In the meadows, conifersóincluding juniperóthat became established after the advent of fire suppression will be considered for thinning. Where possible, skid trails and landings will be obliterated throughout the subwatershed to alleviate past soil impacts, beginning with those areas where understory treatments will occur.

b. Road Density, Location, and Drainage Network.

Current conditions: There are 55 miles of roads within this subwatershed which equates to a road density of 3.4 mi/mi≤, resulting in a ***functioning appropriately but-at-risk*** rating. Refer to Figure 4.8 - Ben Young Creek Subwatershed Road Locations. Of these roads, ten miles (18%) are within 300 feet of perennial and intermittent streams. Further, roads cross channels at 39 locationsósites where direct sediment introduction occurs. Based on these facts, the Road Impact Index was calculated to be 0.45. Along with the 35 miles of stream channels, an estimated 33 of the 55 miles of roads are hydrologically integrated with the stream network, thus increasing the drainage network by 94%óusing Wempleís (1994) study results.

Factors contributing to current conditions: By 1946, 26 miles of roads (1.6 mi/mi≤) were constructed in the subwatershed. These roads are located primarily along the main stem of Ben Young Creek and on private land in the upper reaches of the subwatershed. From 1947 to 1960, only one mile was added to the transportation system. An additional 22 miles of roads, located in the middle of the subwatershed on land owned by the Forest Service, were constructed between 1961 and 1969. This construction was associated with high levels of timber harvest and nearly doubled the road density to 3.0 mi/mi≤. An additional 6 miles of roads were constructed between 1970 and 1979, increasing the road density to the current level of 3.4 mi/mi≤. No roads have been constructed within the subwatershed since 1979.

Recommendations: To reach the desired road of density of 1.7 mi/mi≤ and a Functioning Appropriately rating, obliterate approximately 28 miles of road. Emphasis should be placed on those roads within 300' of streams or which have numerous stream crossings. The remaining roads should be properly drained to reduce the hydrological connection to stream channels, resulting in less water and sediment flowing down roads and their ditches. This promotes better infiltration of water into forest soils to be slowly released into stream channels.

2) Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

Ben Young Creek was divided into 7 reaches, about 10 miles in length. Approximately 6 and 3 miles were surveyed on National Forest and private lands (Collins Products), respectively. Reaches 1 and 2, totalling about one mile, were not surveyed. For reach locations refer to Figure 4.9 - Ben Young Creek Subwatershed Reach and Monitoring Locations, and for reach summaries refer to Appendix 1 - Ben Young Creek Reach Summaries. Recommendations can be found in Appendix 2 - Ben Young Creek Subwatershed Recommendations.

a. Riparian vegetation and associated bank stability.

Current condition: In Reaches 3 through 7, the dominant plant typesósedge, rush, willow, mountain alder, and lodgepole pineóare highly similar to late-seral species in composition and structure, resulting in adequate cover to protect banks and dissipate energy during high flows. However, there is some evidence of lodgepole pine encroachment into the riparian zone in Reach 6. There are also localized areas of bank instability throughout Reach 4 and the latter half of Reach 5. Overall, late-seral species dominate and bank stability exceeds 95% in all surveyed reaches; consequently, this element is ***functioning appropriately***.

Factors contributing to current conditions: The lack of fire has promoted high densities of mixed conifer and ponderosa pine in riparian areas, creating a minor shift in relative species abundance. For example, surveys and associated photographs (Reach 5, Segment 22) indicate small tree to sapling-sized ponderosa pine are competing with willow in the riparian area.

Recommendations: In Reaches 3, 4, and 5, mechanically thin encroaching conifers and/or allow prescribed fire to creep into riparian areas. These treatments will reduce conifer densities and maintain growth of riparian grasses, shrubs, and trees. In order to promote growth of riparian vegetation, place sedge mats in areas of localized bank instability (Reaches 4 and 5). Starting in 2000, vegetative and bank conditions are expected to improve in all reaches on National Forest lands affected by grazing with the implementation of interim grazing guidelines. These grazing standards will maintain and promote late-seral plant conditions along stream channels and will help resolve localized areas of grazing induced bank instability. Finally, the implementation of INFISH and the Oregon Forest Practices Act will guide timber harvest operations so they will not adversely affect riparian vegetation.

b. Rosgen Stream Type(s):

Current conditions: All reaches are ***functioning appropriately*** with respect to their potential stream type as the shape and size of the stream channel is in balance with its setting. Reaches 3, 4, and 5 are characterized by low gradients, developed floodplains, and low width-to-depth ratios (narrow and deep). Reach 6 is primarily a B stream type with moderately steep gradients, gentle sideslopes, and gravel/cobble substrates. The final reach, Reach 7, is a wet meadow with an undefined channel.

Factors contributing to current conditions: For the E stream types in the middle reaches, the dominance of sedge promotes high bank stability, with narrow and deep channels that are resistant to erosive energy associated with high flows. Developed floodplains further dissipate energy associated with high flow events. Reach 4 is characteristic of an E stream type within an old F stream type and is in the final stage of its natural potential. The landform and local geology along with the dominance of mountain alder and willow, provide for bank stability and associated moderate width-to-depth ratios in Reach 6. Any modification to the magnitude and timing of stream flows has not shifted channels from their natural potential, even though upland vegetation and roads received a functioning appropriately but-at-risk rating.

Recommendations: Implement recommendations in the upland and riparian vegetation sections for the Ben Young Creek Subwatershed, and add LWD to Reach 6.

3) Are the channels providing adequate fish habitat?

For reach locations refer to Figure 4.9 - Ben Young Creek Subwatershed Reach and Monitoring Locations, and for reach summaries refer to Appendix 1 - Ben Young Creek Reach Summaries. Recommendations can be found in Appendix 2 - Ben Young Creek Subwatershed Recommendations. Channel elements were not surveyed in Reaches 1 and 2 (except for temperature in Reach 1).

a. Large Woody Debris (LWD).

Current conditions: Reaches 3, 4, and 7 will not be rated for LWD because they are meadow sites, and therefore, the analysis of LWD is not applicable. Reaches 5 and 6 were determined to be ***functioning inappropriately***.

Factors contributing to current conditions: Past selective timber harvest and removal of in-stream LWD are possible reasons for the low LWD numbers in Reaches 5 and 6. The uplands along these reaches are dominated by ponderosa pine and intermixed with white fir and lodgepole pineóhaving diameter sizes ranging from 1-3 (seedling, saplings and poles, small trees), indicating recent encroachment since exclusion of natural fire. Once these trees become larger and near the end of their life cycle, in-stream LWD will increase. The occurrence of smaller trees along the channel indicates that presettlement conditions, occurring under frequent fire intervals, may not have produced the desired number of LWD.

Recommendations: In the forested portions along Reaches 5 and 6, add LWD to achieve the 75th percentile. In the short term, add LWD into the stream channel. For long term and sustainable LWD recruitment in forested reaches, manage for conifers within the riparian and upland zones as prescribed in INFISH and the Oregon Forest Practices Act. Additional large wood in the channel will enhance sediment retention, especially in the event of a catastrophic fire, and help improve water quality and aquatic habitat.

b. Pools.

Current conditions: All of the surveyed reachesó except Reach 7ówere found to be ***functioning appropriately***. Reach 7 was not rated because the water was spread out across the riparian area, the pool units being indiscrete.

Factors contributing to current conditions: Pool frequencies are at near-natural numbers in part because stream channels and riparian vegetation are near or at their natural potential.

Recommendations: Even though the reaches satisfy the 75th percentile for pools, the addition of LWD will add important structure to the stream while further improving pool habitat. For LWD to create a pool effectively, several of the added pieces must be within the bankfull dimensions, and preferably within the wetted channel. Consult with a hydrologist and fishery biologist when implementing these habitat improvement projects.

c. Spawning Gravel Fines.

Current conditions: Twenty-eight percent fine sediments were documented at the test site located in Reach 3, promoting 53% embryo survival. This element was therefore given a ***functioning appropriately but-at-risk*** rating.

Factors contributing to current conditions: The high sediment values recorded in Reach 3 can be attributed to localized bank instability and the numerous crossings upstream from where the sample was taken. Moreover, natural high erosion rates associated with the soils and geomorphology of this area may be an additional reason for the high sediment in spawning substrates.

Recommendations: Obliterate roads, particularly those within 300' of streams or those that have numerous stream crossings. The remaining roads should be properly drained to help reduce the amount of sediment reaching streams. Continue to maintain the existing riparian vegetation and associated bank stability. Place LWD where needed for additional bank stability and sediment storage.

d. Stream Temperature.

Current conditions: Based on stream temperature recordings in Reaches 1, 3, and 5, (reporting 7-day average maximum temperatures of 23.6∞C, 22.5∞C, and 22.3∞C, respectively) it is assumed that Reaches 1, 3, 4, and 5 are ***functioning appropriately but-at-risk***. However, the 7-day average maximum temperature reached 17.0∞C at Reach 6, which places Reaches 6 and 7 at a ***functioning appropriately*** rating.

Factors contributing to current conditions: Stream temperatures may be near their potential in part because stream channels and riparian vegetation are near their desired conditions. This suggests that the desired temperature of 17.8∞C (State Water Quality Standard) may be lower than is achievable for this subwatershed.

Recommendations: In addition to implementing the recommendations described above in the Ben Young Creek Subwatershed section, specific recommendations (i.e. shading levels) and management actions affecting stream temperatures will be addressed in the Upper Chewaucan Water Quality Management Plan to be completed in 2000/2001.

e. Fish Passage (Culvert).

What are the current conditions?: The three culverts surveyed along Ben Young Creek were all found to be barriers to fish passage. Refer to Figure 4.8 - Ben Young Creek Subwatershed Road Locations. All have acceptable jumping heights and pools at the outlet of the culvert but have velocities that exceed sustainable swimming speeds. For this reason these culverts are barriers to fish passage. Because two of the culverts occur in the lower portion of the subwatershed, this assessment element receives a ***functioning inappropriately*** rating.

Factors contributing to current conditions: The culverts of this subwatershed have steep slopes which results in higher than sustainable velocities for fish. This is the reason these culverts are considered barriers for fish.

Recommendations: Replace existing culverts with ones that allow for fish passage. Ensure that the correct size of culverts are installed at the proper location and slope (work with hydrologist and engineer). Survey the remaining 36 road crossings in the subwatershed to determine if other barriers exist.

4) How are the above subwatershed conditions influencing redband trout viability?

The upland vegetation and roads are functioning inappropriately and functioning appropriately but-at-risk, respectively; yet, these conditions do not appear to be preventing riparian vegetation and streams types from being at desired conditions. If these areas reflected desired numbers, however, upland conditions might enhance late-seral riparian vegetation, bank stability, and appropriate stream types. For example, restoring canopy densities to HRV might increase the magnitude of low flows, thus providing more water to riparian areas, essential for plant growth and maintenance during the dry summer months. Also, a reduction in road densities would decrease the drainage network, thus lessening the magnitude of high flows and their ability to scour stream banks. The result would promote late-seral plant development. Therefore, improvements of upland conditions would alleviate the stress placed on riparian vegetation and stream types by unnatural low and high flow events.

The dominance of late-seral riparian vegetation and appropriate stream types has led to a high number of pools throughout Ben Young Creek. Along the meadow reaches, especially 3, 4, and 5, many pools are narrow with undercut banks which provide cover. Restoration of localized bank instability would improve pools that lack undercut banks. However, in the forested reachesó5 and 6ópool complexity is lacking because LWD numbers are well below desired numbers. Additional LWD would create new pools, provide hiding cover, rearing habitat, and low velocity areas during high flow events. Furthermore, wood will capture and store sediments transported during high flows, thus, routing these fines away from spawning substrate, maintaining low spawning fines throughout the subwatershed. In the event of a catastrophic fire from high canopy densities, greater quantities of wood throughout the forested reaches would buffer downstream areas and tributaries against high sediment inputs and low embryo survival rates. There are two more considerations. First, temperature stress may be a concern downstream of Reach 6. Second, fish from the Chewaucan River and lower two reaches of Ben Young Creek, which move upstream during the spring spawning season will encounter a culvert barrier in Reach 3, preventing upstream migrations.

In conclusion, several assessment elements have good overall ratings and include the following: riparian vegetation and bank stability, Rosgen stream types, and pool numbers. However, the high canopy coverage in most forested sites, moderate road densities, lack of LWD, moderate stream temperatures, moderate amounts of spawning gravel fines, and culvert barriers inhibit the Ben Young Creek Subwatershed from functioning appropriately as a redband trout reserve. As a result, this assessment element is ***functioning appropriately but-at-risk***. Implementing the recommendations listed in this subwatershed section then maintaining those desired conditions will help bring multiple use management in harmony with the hydrologic and ecological processes of the landscape.

Figure 4.7

Figure 4.8

Figure 4.9

Swamp Creek Subwatershed

1) Is the upland portion of the subwatershed producing hydrologic conditions that contribute to properly functioning riparian areas ?

a. Upland / Forest Vegetation Conditions.

Current conditions: Within the 7,418 acre subwatershed, forested lands cover 6,414 acres or approximately 86% of the subwatershed. Conifers have encroached into both dry and moist meadows, which account for 227 acres and 257 acres, respectively. The juniper woodlands in the subwatershed total 334 acres.

Of the forested acres, 78%, or 4,480 acres, have canopy densities that exceeds HRV. Refer to Figure 4.10 - Swamp Subwatershed Upland Vegetation. With increased canopy densities, the build up of understory increases the risk of catastrophic fire and may reduce water available for stream flow during summer months, particularly in areas with dense juniper stands. Under these conditions, conifers also become stressed and susceptible to insects and disease.

About 23% of the forested lands are in openingsó mainly seedling/sapling standsóand are higher than the 15% recommendation for the Upper Chewaucan Watershed and within the 20-30% figure noted by Troendle (1982), the point where a significant change in flow can be detected.

For the above reasons, this element receives a ***functioning inappropriately*** rating.

Factors contributing to current conditions: The frequent and low intensity ground fires that maintained vast stands of open ponderosa pine forests have been suppressed since the early 1900ís. This has created conditions that allow conifers to grow in greater densities than occurred historically in both forested and meadow sites. In addition, past silvicultural treatments emphasized either clear-cut or selective removal of individual large ponderosa pine. Because these treatments were not based on maintaining forested stands within their HRV, they are a contributing factor to current conditions.

Recommendations: To reduce the risk of catastrophic fire, associated soil erosion, and increased flows, forest understories require thinning to restore canopies back to HRV. This will promote conditions for low intensity fires to reoccuróeither naturally or controlledóthroughout the subwatershed. This can reduce the potential for epidemic insect and disease outbreaks. In meadows, conifersóincluding juniperóthat became established after the advent of fire suppression will be considered for thinning. Where possible, skid trails and landings will be obliterated throughout the subwatershed to reduce past soil impacts, beginning with those areas where understory treatments will occur.

b. Road Density, Location, and Drainage Network.

Current conditions: There are 52 miles of roads within the subwatershed which equates to a road density of 4.5 mi/mi≤, thus, giving this element a f***unctioning appropriately but-at-risk*** rating. Refer to Figure 4.11 - Swamp Creek Subwatershed Road Locations. Of these roads, seven miles (14%) are within 300 feet of perennial and intermittent streams. Furthermore, roads cross channels at 24 locationsó sites where direct sediment introduction occurs. Based on the numbers above, the Road Impact Index was calculated to be 0.37. Along with the 19 miles of stream channels, an estimated 31 of the 52 miles of roads are hydrologically integrated with the stream networkóbased on Wempleís (1994) study resultsóthus increasing the drainage network by 163%.

Factors contributing to current conditions: By 1946, 13 miles of roads (1.1 mi/mi≤) were constructed in the subwatershed. This road construction was focused in the upper reaches of the subwatershed and primarily on private land. Only an additional two miles were added to the transportation system between 1947 to 1960. In the years from 1961 to 1969, 30 miles of roads were constructed on Fremont National Forest property. Almost tripling the road density to 3.9 mi/mi≤, this construction was associated with high levels of timber harvest. Then, from 1970 to 1979, one mile of road was constructed, increasing the road density to 4.0 mi/mi≤. Six miles were added between 1980 and 1988, increasing the road density of Swamp Creek Subwatershed to the current density of 4.5 mi/mi≤. No roads have been constructed since 1988.

Recommendations: To reach the desired road density of 1.7 mi/mi≤ and a Functioning Appropriately rating, obliterate approximately 32 miles of road. Emphasis should be placed on those roads within 300 feet of streams or having numerous stream crossings. The remaining roads should be properly drained to reduce the hydrological connection to stream channels, causing less water and sediment to flow down roads and their ditches. This will promote better infiltration of water into forest soils for slow release into stream channels.

2) Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

Swamp Creek was divided into 8 reaches, approximating 10 miles in length. About 9 and 1 miles were surveyed on National Forest and private lands (Collins Products), respectively. For reach locations refer to Figure 4.12 - Swamp Creek Subwatershed Reach and Monitoring Locations, and for reach summaries refer to Appendix 1 - Swamp Creek Reach Summaries. Recommendations can be found in Appendix 2 - Swamp Creek Subwatershed Recommendations.

a. Riparian vegetation and associated bank stability.

Current conditions: The dominant plant typesó sedge, rush, willow, mountain alder, and lodgepole pineóalong almost all surveyed reaches (Reaches 1 through 8) are highly similar to late-seral species composition and structure, resulting in adequate cover to protect banks and dissipate energy during high flows. However, silver sage is found as the dominant species in Reach 1 and may suggest past and/or continued over use (grazing) of this riparian area. Young lodgepole pineóseedling, sapling/pole, and small tree sizesóare common in Reaches 5, 6, 7, and 8. Once these trees become larger, they may compete with and/or replace late-seral riparian species.

The bank stability of all reaches exceed 90%, and this can be attributed to the dominance of the late-seral species along the riparian zones. Localized areas of bank instability occur in the middle of Reach 1, the end of Reach 3 and 4, and the beginning of Reach 6. Overall, riparian vegetation and the associated bank stability along Swamp Creek is ***functioning appropriately***.

Factors contributing to current conditions: The altered fire regimeóor lack of fireócontinues to promote higher densities of mixed conifer and ponderosa pine in riparian areas, creating a minor shift in relative species abundance. For example, surveys and associated photographs (Reach 5 / Segment 20, Reach 6/Segment 54, and Reach 7/ Segment 2) indicate that pole to small tree size lodgepole pine and white fir are competing with willow in the riparian area. The presence of silver sage as the dominant riparian species coupled with localized bank instability suggests past over use and/or continued over use of this reach.

Recommendations: In all reaches (1, 2, 3-4, 5, 6, 7, and 8) mechanically thin encroaching conifers and/or allow prescribed fire to creep into riparian areas. This will reduce conifer densities and maintain growth of riparian grasses, shrubs, and trees. In order to promote growth of riparian vegetation, place sedge mats or root wads in areas where localized bank instability exists.

Starting in 2000, vegetative and bank conditions are expected to improve in all reaches of National Forest lands affected by grazing with new grazing guidelines. These grazing standards will maintain and promote late-seral plant conditions along stream channels and will help work towards a long-term solution for bank instability. Finally, the implementation of INFISH and the Oregon Forest

Practices Act will guide timber harvest operations so they will not adversely affect riparian vegetation.

b. Rosgen Stream Type(s).

Current conditions: All reaches 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 1, 3-4, 5, 6, 7, and 8 are characterized by low gradients, developed floodplains, and low width-to-depth ratios (narrow and deep). Reach 2 is dominated by a B stream type with moderately steep gradients, gentle sideslopes, and gravel/cobble substrates.

Factors contributing to current conditions: For the E stream types, the dominance of sedge promotes high bank stability with narrow and deep channels that are resistant to erosive energy associated with high flows. Developed floodplains further dissipate energy associated with high flow events. The landform and local geology, along with the dominance of mountain alder and willow, provides for bank stability and associated moderate width-to-depth ratios of Reach 6. Any modification to the magnitude and timing of stream flows has not shifted channels from their natural potential, even though upland vegetation received a functioning inappropriately rating and road density received a functioning appropriately but-at-risk rating.

Recommendations: Implement recommendations in the Swamp Creek Subwatershed upland and riparian vegetation sections above.

3) Are the channels providing adequate fish habitat?

For reach locations refer to Figure 4.12 - Swamp Creek Subwatershed Reach and Monitoring Locations, and for reach summaries refer to Appendix 1 - Swamp Creek Reach Summaries. Recommendations are located in Appendix 2 - Swamp Creek Subwatershed Recommendations.

a. Large Woody Debris (LWD).

Current conditions: Reaches 1, 3, 4, and 5 will not be rated for LWD because they are meadow sites, where LWD is not applicable. Reaches 2, 6, and 7 were determined to be ***functioning inappropriately***.

Factors contributing to current conditions: Past selective timber harvest and removal of in-stream LWD may be potential reasons for the low LWD numbers in Reaches 2, 6, and 7. The uplands along these reaches are dominated by lodgepole pine, ponderosa pine, and white fir that have diameter sizes that range from 1-3 (seedling, saplings and poles, small trees), indicating recent encroachment since exclusion of natural fire. Once these trees become larger and near the end of their life cycle, in-stream LWD will increase.

Recommendations: In the forested portions along Reaches 2, 6, and 7, restore large woody debris to the desired 75th percentile. In the short term, add LWD into the stream channel. For long term and sustainable LWD recruitment in forested reaches, manage for conifers within the riparian and upland zones as prescribed in INFISH and the Oregon Forest Practices Act. Additional large wood in the channel will enhance sediment retention, especially in the event of a catastrophic fire, and help improve water quality and aquatic habitat.

b. Pools.

Current conditions: Reaches 6 and 7 receive ratings of ***functioning appropriately*** while Reaches 1, 5, and 8 are ***functioning appropriately but-at-risk***. Reaches 2, 3, and 4 receive ***functioning inappropriately*** ratings.

Factors contributing to current conditions: Pool counts for Reaches 1 through 4 were taken in early June when high flows had not yet subsided. The high flows made it difficult to discern the start and end of a pool, a likely reason for low pool numbers reported in these reaches. Reach 8, surveyed during lower flows, may be unable to produce deep pools in the absence of beaver dams.

Recommendations: The addition of LWD will add important structure to the stream while further improving pool habitat. For LWD to effectively create a pool, the added pieces must be within the bankfull dimensionsópreferably within the wetted channel. Consult with a hydrologist and fishery biologist when implementing these habitat improvement projects.

c. Spawning Gravel Fines.

Current conditions: Thirteen percent fine sediments were documented at the sample site in Reach 1, promoting 87% embryo survival. Thus, this element received a ***functioning appropriately*** rating. Percent fines in Reach 6 were 27%ó promoting only 52% embryo survivalóresulting in a ***functioning appropriately but-at-risk rating***.

Factors contributing to current conditions: Low sediment readings in Reach 1 may result from the depositional nature of Reaches 3 and 4, marshy sites that filter water prior to its entry into Reaches 1 and 2. The high sediment values documented in Reach 6 could be due to areas of bank instability and the depositional nature of the sample site. Natural high erosion rates associated with the soils and geomorphology of this area could be another reason for the high sediment in spawning substrates as well.

Recommendations: Obliterate roads, emphasizing those within 300' of streams or those that have numerous stream crossings. The remaining roads should be properly drained to help reduce the amount of sediment reaching streams. Continue to maintain the existing riparian vegetation and associated bank stability. Place LWD where needed for additional bank stability and sediment storage.

d. Stream Temperature.

Current conditions: Based on the temperature sensor located at Reach 1, it is assumed that Reach 1, 2, and 3 are ***functioning appropriately but-at-risk***. The temperature gauge at Reach 6 reported a 7-day average maximum temperature of 17.6∞C, placing both Reach 5 and 6 at a ***functioning appropriately*** rating. The 7-day average maximum temperature (19.6∞C) reported for the gauge located at the end of Reach 6 and start of Reach 7 results in a ***functioning appropriately but-at-risk*** rating for Reaches 7 and 8.

Factors contributing to current conditions: Stream temperatures may be near their potential in part because stream channels and riparian vegetation are near their desired condition. This suggests that the desired temperature of 17.8∞C (State Water Quality Standard) may be lower than is achievable for this subwatershed.

Recommendations: In addition to implementing the recommendations described above, specific recommendations (i.e. shading levels) and management actions affecting stream temperatures will be addressed in the Upper Chewaucan Water Quality Management Plan to be completed in 2000/2001.

e. Fish Passage (Culvert).

Current conditions: The three culverts surveyed along Swamp Creek were all found to be barriers to fish passage. Refer to Figure 4.11 - Swamp Creek Subwatershed Road Locations. All have acceptable jumping heights and pools at the outlet of the culvert but, the velocities exceed sustainable swimming speeds. Because culverts are barriers throughout the subwatershed, this element receives a ***functioning inappropriately*** rating.

Factors contributing to current conditions: The culverts in this subwatershed have steep slopes resulting in high velocities. This is the reason these culverts are considered barriers for fish passage.

Recommendations: Replace existing culverts with ones that allows for fish passage. Ensure that the correct size of culverts are installed at the proper location and slope by working with a hydrologist and engineer. Survey the remaining 21 road crossings in the subwatershed to determine if other barriers exist.

4) How are the above subwatershed conditions influencing redband trout viability?

As with the Ben Young Subwatershed, the upland vegetation and roads are functioning inappropriately and functioning appropriately but-at-risk, respectively; yet, these conditions do not appear to be preventing riparian vegetation and streams types from being at desired conditions. If these areas reflected desired numbers, upland conditions could enhance late-seral riparian vegetation, bank stability, and appropriate stream types. For example, restoring canopy densities to HRV may increase the magnitude of low flows, thus providing more water to riparian areas essential for plant growth and maintenance during the dry summer months. Further, a reduction in road densities would decrease the drainage network, thus lessening the magnitude of high flows and their ability to scour stream banks. The result would promote late-seral plant development. Therefore, improvements of upland conditions would alleviate the stress placed on riparian vegetation and stream types by unnatural low and high flow events.

The dominance of late-seral riparian vegetation and appropriate stream types appears to have created high pool numbers in Reaches 1 through 7. Along the meadow reaches, especially 3, 4, and 5, many pools are narrow and deep with undercut banks which provide cover. Restoration of localized bank instability would improve those pools which lack undercut banks. However, in the forested reachesó 2, 6, and 7ópool complexity is lacking because LWD numbers are well below desired numbers. Additional LWD would create new pools, provide hiding cover, rearing habitat, and low velocity areas during high flow events. In addition, wood captures and stores sediments transported during high flows, routing these fines away from spawning substrate. In the event of a catastrophic fire due to high canopy densities, greater quantities of wood throughout the forested reaches will buffer downstream areas and tributaries against high sediment inputs and low embryo survival rates.

There are two more considerations. First, temperature stress may be a concern downstream of Reach 5. Second, fish which move upstream from the Chewaucan River and Reach 1 of Swamp Creek during the spring spawning season will encounter a culvert barrier at the start of Reach 2, preventing upstream migrations.

In conclusion, several assessment elements have good overall ratings and include the following: riparian vegetation and bank stability, Rosgen stream types, and pool numbers. However, the high canopy coverage in most forested sites, moderate road densities, lack of LWD, moderate stream temperatures, moderate levels of spawning gravel fines, and culvert barriers inhibit the Swamp Creek Subwatershed from functioning appropriately as a redband trout reserve. As a result, this assessment element is ***functioning appropriately but-at-risk***. Implementing the recommendations listed in this subwatershed section then maintaining those desired conditions will help bring multiple use management in harmony with the hydrologic and ecological processes of the landscape.

Figure 4.10

Figure 4.11

Figure 4.12

South Creek Subwatershed

1) Is the upland portion of the subwatershed producing hydrologic conditions that contribute to properly functioning riparian areas?

a. Upland / Forest Vegetation Conditions.

Current conditions: Within the 27,648 acre subwatershed, forested lands cover 22,058 acres, approximately 80% of the subwatershed. The encroachment of conifers into both dry and moist meadows and aspen stands account for 1,527 acres, 1,701 acres, and 737 acres, respectively. There are approximately 373 acres of juniper woodlands.

Of the forested lands, 73% or 16,141 acres have canopy densities that exceed HRV. Refer to Figure 4.13 - South Creek Subwatershed Upland Vegetation. With higher canopy densities, the build up of understory trees increase the risk of catastrophic fire and causes conifers to become stressed and susceptible to insects and disease. Because of increased evapotranspiration, there is also less available water for stream flow during summer months.

Conversely, approximately 20% of the forested stands are in openingsómainly seedling/sapling standsóabove the 15% recommendation for the Upper Chewaucan Watershed but within the 20-30% figure noted by Troendle (1982), the point where a significant change in flow can be detected.

Because 73% of the forested acres have canopy densities above HRV and conifer encroachment is generally high in meadow and aspen areas, this element is ***functioning inappropriately***. The effects of management activities on soil resources has been fairly extensive, a result of past timber harvest activities in many portions of the subwatershed.

Factors contributing to current conditions: As in all areas of the Upper Chewaucan Watershed, the frequent and low intensity ground fires that maintained vast stands of open ponderosa pine forests have been suppressed since the early 1900ís. This has created conditions that allow conifers to grow in greater densities than occurred historically in both forested and non-forested areas. In addition, past silvicultural practices emphasized either clear-cutting or selective removal of individual large ponderosa pine. Because these practices were not based on maintaining forested stands within HRV, they are a contributing factor to current conditions. The Coleman Rim Roadless Area, accounting for 5,707 acres, has been affected by fire suppression and restricted silvicultural treatments, additional factors contributing to dense forest stands in the subwatershed. Other than roads, soil disturbance in the subwatershed is primarily due to past timber harvesting activities, mainly in the form of skid trails and landings.

Recommendations: To reduce the risk of catastrophic fire and associated soil erosion and increase flows, forest understories require thinning to restore canopies back to HRV. This will promote conditions for low intensity fires to reoccuróeither naturally or controlledóthroughout the subwatershed. In meadows, aspen stands, and other non-forested areas, conifersóincluding juniperóthat became established after the advent of fire suppression should be considered for thinning. Where possible, obliterate skid trails and landings throughout the subwatershed to alleviate past soil impacts, starting with those areas where understory treatments will occur.

b. Road Density, Location, and Drainage Network.

Current conditions: There are 153 miles of roads in the subwatershed which equates to a road density of 3.5 mi/mi≤, resulting in a ***functioning appropriately but-at-risk rating***. Refer to Figure 4.14 - South Creek Subwatershed Road Locations. Of these roads, 36 miles (24%) are within 300 feet of perennial and intermittent streams. Roads cross channels at 141 locations, sites where direct sediment introduction occurs. Based on the above numbers, the Road Impact Index is 1.70. Along with the 110 miles of stream channels, an estimated 92 of the 153 miles of roads are hydrologically integrated with the stream network, thus increasing the drainage network by 84%óbased on Wempleís (1994) study results.

Factors contributing to current conditions: By 1946, 17 miles of roads (0.4 mi/mi≤) were constructed in the subwatershed. From 1947 to 1960, an additional 70 miles were built, significantly increasing the road density to 2.0 mi/mi≤. This increased road construction began with the advent of the Lakeview Federal Sustained Yield Unit and the ensuing Shoestring Creek Timber Sale of 1950. Next, 45 miles of roads were constructed between 1961 and 1969 in conjunction with continued demand for timber, bringing the road density to 3.1 mi/mi≤. From 1970 to 1979, an additional 21 miles of roads were constructed for timber harvest, increasing the road density to the current level of 3.5 mi/mi≤. No roads have been constructed since 1979.

Recommendations: To reach the desired road density of 1.7 mi/mi≤ and a functioning appropriately rating, obliterate approximately 80 miles of road. Emphasis should be placed on those roads within 300' of streams or have numerous stream crossings. The remaining roads should be properly drained to reduce the hydrological connection to stream channels, resulting in less water and sediment flowing down roads and their ditches. This promotes better infiltration of water into forest soils for slow release into stream channels.

2) Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

About 15 miles of South Creek was divided into 18 reaches. Approximately 10 and 5 miles were surveyed on National Forest and private lands (J-Spear and Murphy), respectively. Reaches 3, 6, and 7ótotalling four milesówere not surveyed. For reach locations refer to Figure 4.15 - South Creek Subwatershed Reach and Monitoring Locations, and for reach summaries refer to Appendix 1 - South Creek Reach Summaries. Recommendations can be found in Appendix 3 - South Creek Subwatershed Recommendations.

a. Riparian vegetation and associated bank stability.

Current conditions: Reaches 1 and 2 are ***functioning appropriately but-at-risk*** because bank stability is 82 and 84%, respectively. The dominance of rushes indicates that plant succession is moving towardsóbut has not reachedóa late-seral community. In Reaches 4 and 5 sedge and rush are dominants but bank stability is 79%, thus both are ***functioning inappropriately***. A contributing factor to these conditions is the lack of willow. The remaining reaches that were surveyed are ***functioning appropriately***, with the exception of Reach 9A which is ***functioning appropriately but-at-risk***.

Factors contributing to current conditions: Land along Reach 1 is owned by the J-Spear Ranch. The pasture is grazed throughout the summer and early fall months, a practice that contributes to the early-seral plant species associated with bank instability. In addition, the bank instability may be associated with the channel increasing its sinuosity and decreasing its gradient (Refer to Chapter 3 discussion) and may prevent the current establishment of vegetation. Similar conditions exist in Reaches 4 and 5, land owned by the Murphy Ranch. Reach 2, a short section of stream, is used to water cattle in the Drum Hill Allotment and may incur short-term but extensive use. Late-season grazing in the above reaches is a contributing factor to the lack of willow. Finally, the high road densities in the subwatershed, especially in the Shoestring and Morgan Creek drainages, may be increasing the magnitude of high flows and their potential to scour stream banks in Reaches 1, 2, and 4.

Reaches 8, 8A, 10A, 11A, 12A, 8B, 9B, 8D, 9D, and 10D all have bank stabilities exceeding 90% with the dominant plant types representative of late-seral species. These reaches are on National Forest lands. Many of these reaches exist in naturally stable environments (Refer to Rosgen Channel Types). Further, cattle grazing is of short duration, allowing for regrowth of vegetation in meadow areas.

Reach 9A, which is ***functioning appropriately but-at-risk,*** is characterized by 88% bank stability with white fir and grass being the dominant species. Bank instability is concentrated in the lower half of the reach, where grass is common along the banks.

Recommendations: Along Reaches 1, 2, 4, and 5, grazing management should be adjusted to promote additional growth of sedge, rush, and willow. Along the meadow sections of the upper reaches, conifers which have become established after fire exclusion should be extensively thinned in and along the meadow areas.

Starting in 2000, vegetative and bank conditions are expected to improve in all National Forest land reaches affected by grazing with the implementation of interim grazing guidelines. These grazing standards will maintain and promote late-seral plant conditions along stream channels and will work towards a long-term solution for bank instability. Finally, the implementation of INFISH and the Oregon Forest Practices Act will guide timber harvest operations so they will not adversely affect riparian vegetation.

b. Rosgen Stream Type(s).

Current conditions: The drainage area (>27 mi≤) and associated tributaries promote Rosgen C stream types in Reaches 1, 2, and 4. The C stream types do occur throughout these reaches, but they are ***functioning appropriately but-at-risk*** because width-to-depth ratios and/or bank instability are too high. Reach 5 is currently a C stream type, but based on the drainage area (<18mi≤) and lack of major tributaries, the reach should produce an E stream type. For this reason, Reach 5 is ***functioning inappropriately***. The remaining reachesóconsisting of B, E, and A stream typesóare ***functioning appropriately***.

Factors contributing to current conditions: As mentioned in Chapter 3, vegetation is essential for maintaining channel integrity of C and E stream types. Consequently, the lack of late-seral vegetation is the major reason that Reaches 1, 2, 4, and 5 are functioning appropriately but-at-risk or functioning inappropriately. Along the A and B stream types, local geology, large substrate (cobbles and boulders), and abundance of alder and conifers are major reasons for the good channel conditions. Finally, the E stream types occur in the lower gradient meadows, high in the subwatershed with low drainage areas, and are maintained by late-seral vegetation which creates narrow and deep channels resistant to erosion. These channels could degrade into a C or F stream type if the late-seral vegetation was removed.

Recommendations: Implement recommendations in the upland and riparian vegetation sections of the South Creek Subwatershed, and add LWD in Reaches 8A, 8B, 9A, 10A, 8D, and 9D. These actions will maintain, enhance, or create the desired stream types.

3) Are the channels providing adequate fish habitat?

For reach locations refer to Figure 4.15 - South Creek Subwatershed Reach and Monitoring Locations. For reach summaries refer to Appendix 1 - South Creek Reach Summaries, and recommendations and can be found in Appendix 2 - South Creek Subwatershed Recommendations.

a. Large Woody Debris (LWD).

Current conditions: Because Reaches 1-5 are large meadow sites, wood is not expected in these areas. In addition, Reaches 8, 11A, 12A, 9B, and 10D are meadow sites where little or no LWD is expected. Within the forested areas, Reach 8B is ***functioning appropriately but-at-risk***, while Reaches 8A, 9A, 10A, 8D, and 9D are ***functioning inappropriately***. Reaches 3, 6, and 7 were not surveyed.

Factors contributing to current conditions: Several factors help explain the low numbers of wood in Reaches 8A, 9A, 10A, and 9D. In these reaches, the stream flows through both meadow and forested areas, but calculations which lead to desired numbers of LWD assume that all areas along the stream are forested. In addition, forest stands may not have progressed to a point where trees are dying and falling into stream channels. Stream surveys indicate, however, that future recruitment is plentiful, especially along Reach 8D.

Recommendations: In forested portions along Reaches 8A, 9A, 10A, 8B, 8D, and 9D, increase large wood to desired levels, to achieve the 75th percentile. In the short term, add LWD into the stream channel. For long term and sustainable LWD recruitment in forested reaches, manage for conifers within the riparian and upland zones as prescribed in INFISH and the Oregon Forest Practices Act. Additional large wood in the channel will enhance sediment retention, especially in the event of a catastrophic fire, and help improve water quality and aquatic habitat.

b. Pools.

Current conditions: Reaches 1, 2, 4, and 5 are ***functioning appropriately but-at-risk***, while the remaining reaches (8, 8A, 9A, 10A, 11A, 12A, 8B, 9B, 8D, 9D, and 10D) are ***functioning appropriately***.

Factors contributing to current conditions: Low pool frequencies recorded in Reaches 1, 2, 4, and 5 reflect the lack of late-seral riparian vegetation. As previously mentioned, C and E stream types require late-seral vegetation to promote and maintain channel integrity with low width-to-depth ratiosó conditions that promote increased pool numbers. Pool frequencies in the remaining reaches are above the desired numbers because stream channels and riparian vegetation are highly similar to desired conditions.

Recommendations: To increase pool numbers in Reaches 1, 2, 3, 4, and 5 to a Functioning Appropriately condition, implement recommendations in the upland and riparian vegetation sections for the South Creek Subwatershed, all of which will promote growth of late-seral species and increase bank stability.

c. Spawning Gravel Fines.

Current conditions: Fine sediments were sampled at two locations. At Reach 2, percent fines were 40%, resulting in a ***functioning inappropriately*** rating. In Reach 8A, twenty-three percent fines were documented, leading to a ***functioning appropriately*** rating.

Factors contributing to current conditions: Reach 2 occurs near the bottom of the subwatershed, downstream of all tributaries. Therefore, the sample location is highly susceptible to cumulative effects from sedimentation associated with roads and bank instability throughout the subwatershed. Conversely, Reach 8A is high in the subwatershed, upstream of most roads and areas of bank instability, a site less susceptible to cumulative effects.

Recommendations: Implement the recommendations in the upland, riparian vegetation, stream types, and LWD sections for the South Creek Subwatershed. Road obliteration will eventually reduce sediment inputs into stream channels. In addition, large wood in the upper reaches will retain sediment from upland sources, such as stream crossings and localized areas of bank instability

d. Stream Temperature.

Current conditions: Stream temperatures in Reach 2 were 26.2∞C (79.2∞F), thus receiving a ***functioning inappropriately*** rating. Reaches 8 and 8D, where South Creek tributaries exit National Forest lands, had stream temperatures of 17.5∞C (63.5∞F) and 16.1∞C (60.9∞F) respectivelyóresulting in ***functioning appropriately*** ratings.

Factors contributing to current conditions: Undesirable stream temperatures in Reach 2 result, in part, from high width-to-depth ratios in Reaches 2, 4, and 5. Wide and shallow channels have more surface area exposed to solar radiation than those with narrow and deep channels. Also, the scarcity of mature willow along these reaches results in low shade values, another factor contributing to high stream temperatures. Reaches 8 and 8D are in close proximity to headwater springs within the Coleman Rim Roadless Area, a reason for the cooler temperatures found at these monitoring sites.

Recommendations: In addition to implementing recommendations described for this subwatershed, more specific recommendations (i.e. shading levels) and management actions affecting stream temperatures will be addressed in the Upper Chewaucan Water Quality Management Plan to be completed in 2000/2001.

e. Fish Passage (Culvert).

Current conditions: Three culverts were surveyed on South Creek and two were determined to be fish passage barriers. Refer to Figure 4.14 - South Creek Subwatershed Road Locations. Because these culvertsóalong Reaches 10A and 11Aóare located in the upper reaches, this habitat element was rated ***functioning appropriately but-at-risk***.

Factors contributing to current conditions: The steep slope of both culverts increases water velocities and prevents fish passage.

Recommendations: Replace the existing culverts to allow for fish passage. Ensure that the correct size of culvert is installed at the proper location and slope by consulting with a hydrologist and engineer. Survey the remaining 138 stream crossings to determine if other barriers exists.

Morgan Creek

A Tributary of South Creek

2) Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

a. Riparian vegetation and associated bank stability.

About 10 miles of Morgan Creek was divided into 5 reaches. Approximately 5 and 5 miles were surveyed on National Forest and private lands (Murphy), respectively. For reach locations refer to Figure 4.15 - South Creek Subwatershed Reach and Monitoring Locations. For reach summaries refer to Appendix 1 - Morgan Creek Reach Summaries. Recommendations can be found in Appendix 2 - South Creek Subwatershed Recommendations.

Current conditions: Reaches 1, 3, and 4 are ***functioning appropriately but-at-risk***, while Reaches 5 and 6 are ***functioning appropriately***.

Factors contributing to current conditions: In Reach 1, the dominant plant type is rushóconsidered to be a colonizer of disturbed sitesóand bank stability is 86%. The creek flows through a large meadow owned by the Murphy Ranch which is used to graze cattle. Based on survey information, it is difficult to determine whether or not current grazing management is moving riparian plants toward a late-seral or early-seral condition.

Even though bank stability is at or above 90% for Reaches 3 and 4, survey photographs and field visits suggest that these reaches are functioning appropriately but-at-risk. The dominant plant type is sedge, but unvegetated point bars are abundant. Lodgepole pine occurs throughout the floodplains, indicating a moderate level of conifer encroachment since fire suppression began in the early 1900ís.

Bank stability is high in Reaches 5 and 6 and sedge is the dominant plant type along stream banks, with conifers being subdominant. The abundance of small white fir in Reach 6 indicate encroachment into the riparian area, a possible result of fire exclusion.

Recommendations: Implement upland recommendations in South Creek Subwatershed. Along Reach 1, grazing management should promote plant succession from rush to sedge. Likewise, grazing management along Reaches 3 and 4 should be conducted in a manner which promotes late-seral vegetation along barren point bars and other disturbed sites. Finally, thin smaller diameter conifers, those resulting from fire exclusion, from the riparian areas, particularly in Reaches 3 and 4.

Starting in 2000, vegetative and bank conditions are expected to improve in all National Forest land reaches affected by grazing with the implementation of interim grazing guidelines. These grazing standards will maintain and promote late-seral plant conditions along stream channels and will work towards a long-term solution for bank instability. Finally, the implementation of INFISH and the Oregon Forest Practices Act will guide timber harvest operations so they will not adversely affect riparian vegetation.

b. Rosgen Stream Type(s).

Current conditions: Reaches 1 and 5 are ***functioning appropriately but-at-risk;*** Reaches 3 and 4 are ***functioning inappropriately***; and Reach 6 is ***functioning appropriately***.

Factors contributing to current conditions: Even though Reach 1 is dominated by E stream types, several C stream types were documented. Because riparian vegetation and associated bank stability is functioning appropriately but-at-risk, the channel is not stable in localized areas and results in width-to-depth ratios that are higher than near-natural conditions.

Based on the local environmentóslope and valley formóMorgan Creek in Reaches 3 and 4 should be an E stream type. Currently, the channels are downcut and entrenched in many locations, conditions which may result from high flows coming out of Reaches 5 and 6. Special attention should be directed to Reach 5 and its tributaries, where roads cross the streams at numerous locations and may augment high flows entering Reaches 3 and 4. The scour potential associated with these augmented flows may be a contributing factor for unvegetated point bars and channel entrenchment.

Data for Reach 5 is lacking, so specific channel conditions were not described. The local geology would result in a B stream type. Like Reaches 3 and 4, Reach 5 appears to be downcut and entrenched and unable to access its floodplain. It also appears that the downcutting was caused, in part, from the increased drainage network located in the northwest corner of the subwatershed, where roads were constructed in the 1970ís to harvest timber.

Local geology promotes stable conditions for Reach 6. Several reach segments are confined by steep hill slopes with the creek being armored with cobble substrate. In addition, the reach occurs on the northern boundary of the Coleman Rim Roadless area, where there is no hydrological connection with roads.
Recommendations: Implement recommendations found in previous sections of the Morgan Creek section of this document. Road obliteration needs to be strongly emphasized in the northwest section of the South Creek Subwatershed to reduce the magnitude of high flows. Add LWD in Reaches 3, 4, 5, and 6 to reduce stream velocities and enhance sediment retention.

3) Are the channels providing adequate fish habitat?

For reach locations refer to Figure 4.15 - South Creek Subwatershed Reach and Monitoring Locations. For reach summaries refer to Appendix 1 - Morgan Creek Reach Summaries. Recommendations can be found in Appendix 2 - South Creek Subwatershed Recommendations.

a. Large Woody Debris (LWD).

Current conditions: Because Reach 1 is a meadow system, this element is not applicable. Reach 4 is ***functioning appropriately but-at-risk***, and Reaches 3, 5, and 6 are ***functioning inappropriately***.

Factors contributing to current conditions: Reaches 3 and 4 do not occur within a continuous forest reach but rather a meadow/forest environment, thus explaining the intermittent nature and low numbers of in-stream wood. Conversely, forested stands occur along Reaches 5 and 6, yet LWD is well below desired numbers. Low wood numbers can be attributed to timber harvest during the 1970ís which removed trees bordering these stream reaches.

Recommendations: Add LWD to Reaches 3, 4, 5, and 6 to raise wood numbers above the 75th percentile. In the short term, add LWD into the stream channel. For long term and sustainable LWD recruitment in forested reaches, manage for conifers within the riparian and upland zones as prescribed in INFISH and the Oregon Forest Practices Act. Additional large wood in the channel will enhance sediment retention, especially in the event of a catastrophic fire, and help improve water quality and aquatic habitat.

b. Pools.

Current conditions: Reach 3, 5, and 6 are ***functioning appropriately***, but Reach 1 and 4 are ***functioning appropriately but-at-risk***.

Factors contributing to current conditions: The first portion of Reach 3 is in good condition and resembles a narrow, deep, and sinuous E stream type. The upper portion of the reach is downcut with a wider channel, but its sinuous nature contributes to pool formation. It should be noted, however, that the lack of LWD and wider channels in the upper portion of this reach result in pools with little complexity. Likewise, Reaches 5 and 6 are lacking LWD, but their steep nature contributes to the formation of many step pools.

Pool numbers in Reach 1 are near desired conditions, but a higher than expected width-to-depth results in lower sinuosity values and associated pools. The downcut nature and lower sinuosity in Reach 4 contribute to low pool numbers. The lack of LWD is limiting pool formation, as well.

Recommendations: Implement recommendations described in the Morgan Creek portion of this assessment. The addition of LWD in all reaches, except Reach 1, will add complexity to existing pools and create new ones.

c. Spawning Gravel Fines.

Current conditions: Substrate fines in spawning gravels were surveyed in Reach 3. Percent fines were 36%, resulting in a ***functioning inappropriately*** rating for this element.

Factors contributing to current conditions: Localized bank instability and road crossings upstream of the sample location are likely sediment contributors. Sediment from road crossings would originate from Reach 5 then move downstream through Reach 4, a downcut channel which prohibits deposition of the sediment onto its floodplain. Instead the sediment probably settles in the channel substrates, creating high gravel fines.

Recommendations: Implement the recommendations in the previous sections of Morgan Creek. Particular attention should be given to a reduction of road crossings in Reach 5 and associated tributaries. In addition, placing large wood along Reaches 3, 4, 5, and 6 will route sediment away from spawning gravels.

d. Stream Temperature.

Current conditions: Three sensors measured water temperature in Morgan Creek, two in Reach 4 and one at Reach 3. Along Reach 4, a sensor was placed above and below a beaver dam to assess the damís influence on temperature. Water temperatures above and below the dam were 19.4∞C (66.9∞F) and 21.5∞C (70.7∞F), respectively. Further downstream, a temperature of 22.9∞C (73.2∞F) was recorded by the sensor at Reach 3. Because all temperatures were between 17.8∞C and 24∞C, this element was rated as ***functioning appropriately but-at-risk***.

Factors contributing to current conditions: The beaver dam in Reach 4 created a large pool that has increased the surface area of the water exposed to solar radiation. This is a probable reason for the 2∞C temperature difference above and below the beaver dam. The increase in temperature downstream in Reach 3 may be a result of poor channel conditions, including a lack of late-seral vegetation and associated shade.

Recommendations: Implement appropriate recommendations listed in this section. Any enhancement efforts which narrow the width-to-depth ratios, promote late-seral vegetation, and associated shade should improve temperature conditions. In addition, specific recommendations (i.e. shading levels) and management actions affecting stream temperatures will be addressed in the Upper Chewaucan Water Quality Management Plan to be completed in 2000/2001.

e. Fish Passage (Culvert).

Current conditions: Four culverts were measured on Morgan Creek; three are considered to be barriers. Refer to Figure 4.14 - South Creek

Subwatershed Road Locations. Because two culverts on Reach 1 are barriers, all upstream reaches are inaccessible. In addition, a culvert barrier occurs along Reach 5. Therefore, this assessment element was rated as ***functioning inappropriately***.

Factors contributing to current conditions: These culverts are considered passage barriers because of their steep slopes.

Recommendations: Replace the existing culverts to allow for fish passage. Ensure that the correct size of culvert is installed at the proper location and slope by consulting a hydrologist and engineer. Survey the remaining 25 road crossings in the Morgan Creek area to determine if other barriers exist.

4) How are the above subwatershed conditions influencing redband trout viability?

Like the Ben Young and Swamp Creek subwatersheds, the upland vegetation and road elements are functioning inappropriately and functioning appropriately but-at-risk, respectively. Unlike these subwatersheds, however, the conditions appear to be directing riparian vegetation and streams types away from desired conditions, especially in the Morgan Creek drainage. If these areas reflected desired numbers, upland conditions could enhance late-seral riparian vegetation, bank stability, and appropriate stream types. For example, restoring canopy densities to HRV may increase the magnitude of low flows, thus providing more water to riparian areas essential for plant growth and maintenance during the dry summer months. Conversely, a reduction in road densities would decrease the drainage network, thus lessening the magnitude of high flows and their ability to scour stream banks. The resulting conditions would promote late-seral plant developmentóespecially in Reaches 1, 2, and 4 of South Creek. Therefore, improvements of upland conditions would alleviate the stress placed on riparian vegetation and stream types by unnaturally low and high flow events.

The low bank stabilities and relatively lower densities of late-seral riparian vegetation in Reaches 1 through 5 of South Creek have resulted in low pool numbers. Along these meadow reaches, pools are fairly deep but their complexity could be increased with the development of undercut banks. Restoration of localized bank instability would promote undercut banks and improve pool habitat. Similar to most subwatersheds throughout the analysis area, pool complexity in forested reaches is lacking because LWD numbers are well below desired figures. Additional LWD will create new pools, provide hiding cover, rearing habitat, and low velocity areas during high flow events. Furthermore, wood captures and stores sediments transported during high flows, routing these fines away from spawning substrate, and thus, helping to maintain low spawning fines throughout the subwatershedó conditions in dire need within the Morgan Creek drainage. In the event of a catastrophic fire, resulting from high canopy densities, greater quantities of wood throughout the forested reaches would buffer downstream areas and tributaries against high sediment inputs and low embryo survival rates.

There are two additional considerations. First, temperature stress may be a concern downstream of Reach 8, especially in the lower meadow reaches where the water temperature exceeded 26∞C. Second, it is possible for fish from the Chewaucan River and the lower reaches of South Creek to gain access the lower and middle reaches of Morgan Creek during the spring spawning season. However, many culverts were not surveyed; therefore, connectivity throughout the subwatershed may be severely limited.

In conclusion, several assessment elements have good overall ratings and include the following: Rosgen stream types and pool numbers. However, the high canopy coverage in most forested sites, relatively high road densities, lack of LWD, high stream temperatures, high spawning gravel fines, and culvert barriers are inhibiting the South Creek Subwatershed from functioning appropriately as a redband trout reserve. As a result, this assessment element is ***functioning inappropriately***. Implementing the recommendations listed in this subwatershed section then maintaining those desired conditions will help bring multiple use management in harmony with the hydrologic and ecological processes of the landscape.

Figure 4.13

Figure 4.14

Figure 4.15

Dairy Creek Subwatershed

1) Is the upland portion of the subwatershed producing hydrological conditions that contribute to properly functioning riparian areas?

a. Upland / Forest Vegetation Conditions and Trend.

Current conditions: Within the 34,003 acre subwatershed, forested lands cover 31,977 acres, approximately 94% of the subwatershed. Conifers have encroached into both the dry and moist meadows and aspen groves, which account for 2,862, 1,025, and 203 acres, respectively. There are also an estimated 260 acres identified as juniper woodlands.

Of the forested acres, 61% (19,496 acres) have been determined to have canopy cover that exceeds the HRV. Refer to Figure 4.16 - Dairy Creek Subwatershed Upland Vegetation. With increased canopy densities, the build up of understory trees heightens the risk of catastrophic fire and causes conifers to become stressed and susceptible to insects and disease. The increased evapotranspiration associated with high forest canopies also increases the possibility of less available water for stream flow during summer months.

Approximately 7% of the subwatershed forest stands are in openingsómainly as seedling/sapling standsó and less than the 15% recommendation for the Upper Chewaucan Watershed and the 20-30% figure noted by Troendle (1982), the point where a significant change in flow can be detected.

For the above reasons, this element receives a ***functioning inappropriately*** rating. Also, the effects of management activities on soil resources has been fairly extensive in areas outside the wilderness boundary, a result of past timber harvest activities.

Factors contributing to current conditions: The frequent and low intensity ground fires that maintained vast stands of open ponderosa pine forests have been suppressed since the early 1900ís. This has created conditions that allow pine and white fir seedlings to grow in greater densities than had occurred historically in both forested and meadow areas. In addition, past silvicultural activities emphasized either clear-cutting or selective removal of individual large ponderosa pine. Because these practices were not based on maintaining forested stands within their HRV for canopy cover, they are a contributing factor to current conditions. Further, the Gearhart Wilderness Area, Coleman Rim Roadless Area, and Deadhorse Rim Roadless Areaó totalling for 8,315 acresóhave been affected by fire suppression and restricted silvicultural treatments, additional factors contributing to dense forest stands in the subwatershed. The seedling/sapling stands are a result of forested areas that were harvested through clear-cutting, shelterwood, and seed-tree silvicultural prescriptions.

Recommendations: To reduce the risk of catastrophic fire and associated soil erosion and increased flows, forest understories require thinning to restore canopies back to HRV. This will promote conditions for low intensity fires to reoccuróeither naturally or controlledóthroughout the subwatershed. This reduces the potential for epidemic insect and disease outbreaks. Furthermore, in the dry meadows and aspen stands, conifersó including juniperóthat became established after the advent of fire suppression should be considered for thinning. This will promote the growth of grasses, forbs, and shrubs. Where possible, skid trails and landings should be eliminated throughout the subwatershed to alleviate past soil impacts, starting with areas where understory treatments will occur.

b. Road Density, Location, and Drainage Network.

Current conditions: There are 136 miles of roads in the subwatershed, leading to a road density of 2.6

mi/mi≤. Consequently, this subwatershed element is ***functioning appropriately but-at-risk***. Refer to Figure 4.17 - Dairy Creek Subwatershed Road Locations. Of these roads, 30 miles (22%) are within 300 feet of perennial and intermittent streams. At 84 locations, roads cross channels, sites where direct sediment introduction occurs. Based on the above numbers, the Road Impact Index was calculated to be 0.73. Along with the 113 miles of stream channels, an estimated 82 of the 136 miles of roads are hydrologically integrated with the stream network, thus increasing the drainage network by 73%óbased on Wempleís (1994) study results.

Factors contributing to current conditions: By 1946, 24 miles of roads (0.5 mi/mi≤) were constructed in the subwatershed. From 1947 to 1960, an additional 61 miles were built in conjunction with an increase in the demand for timber, raising the road density to 1.6 mi/mi≤. Then, 13 miles of roads were constructed between 1961 and 1969, bringing the road density to 1.8 mi/mi≤. From 1970 to 1979, 33 miles of roads were built associated with timber harvesting, increasing the road density to 2.5 mi/mi≤. Since 1980, five miles of roads have been constructed, raising the road density to the current level of 2.6 mi/mi≤.

Recommendations: To reach the desired road density of 1.7 mi/mi≤ and a functioning appropriately rating, obliterate approximately 46 miles of road. Emphasis should be placed on those roads within 300' of streams or have numerous stream crossings. The remaining roads should be properly drained to reduce the hydrological connection to stream channels, resulting in less water and sediment flowing down roads and their ditches. This promotes better infiltration of water into forest soils for slow release into stream channels.

2) Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

Dairy Creek was divided into 16 reaches, approximately 19 miles. Approximately 14 and 4 miles were surveyed on National Forest and private lands (J-Spear and Harvey), respectively. Reaches 9, 11, and 13 were not surveyedóa length of one mile. For reach locations refer to Figure 4.18 - Dairy Creek Subwatershed Reach and Monitoring Locations, and for reach summaries refer to Appendix 1 - Dairy Creek Reach Summaries. Recommendations can be found in Appendix 2 - Dairy Creek Subwatershed Recommendations.

a. Riparian vegetation and associated bank stability.

Current conditions: Reaches 1 through 7 occur in low gradient meadows and meadow forest systems. Within these low gradient areas, Reaches 2, 5, 6, and 7 are ***functioning appropriately*** because late-seral plant types are dominant and provide for high bank stability. However, Reaches 1, 3, and 4 are ***functioning appropriately but-at-risk*** because of low bank stability and associated early-seral plant species. Reaches 10, 12, 14, 15, and 16 occur in steeper gradient and forested areas and are ***functioning appropriately*** due to the dominance of late-seral species and bank stability being greater than 90%.

Factors contributing to current conditions: The land associated with Reach 1 is owned by the J-Spear Ranch and is used for cattle grazing throughout the summer months. Reaches 3 and 4 are owned by the Harvey Ranch and are grazed during late summer and early fall. These practices can remove late-seral vegetationósuch as willowóand promote bank instability.

The remaining low gradient reaches are functioning appropriately for numerous reasons. The majority of Reach 2 is in a fenced exclosure with limited effects from grazing and other management activities. Reaches 5, 6, and 7 are meadow/forest areas with bank stability influenced by alder, willow, and LWD. Grass is abundant in areas of localized bank instability, and livestock grazing is thought to be a reason for this instability. An additional factor affecting bank stability for the above reaches may be the increased drainage network associated with roads, possibly influencing the timing and magnitude of stream flows and their effects on channel scouring. In the higher gradient reaches (10, 12, 14, 15, and 16) bank stability is greater as a result of naturally stable stream types and the dominance of late-seral species (Refer to Rosgen channel type discussion).

Recommendations: Modify grazing strategies in Reaches 1, 3, and 4 to promote the growth of late-seral vegetation, especially sedges and willow. In Reaches 5, 6, and 7, continue management practices that will maintain and/or promote late-seral species. Finally, place root wads in areas of high bank instability as described by Rosgen (1996).

In Reaches 14, 15, and 16, mechanically thin encroaching conifers and/or allow prescribed fire to creep into riparian areas and associated meadows. These treatments will maintain growth of riparian grasses, shrubs, and trees. Starting in 2000, vegetative and bank conditions are expected to improve on all National Forest reaches affected by grazing with new grazing guidelines. These grazing standards will maintain and promote late-seral plant conditions along stream channels and will help work towards a long-term solution for bank instability.

Finally, the implementation of INFISH and the Oregon Forest Practices Act will guide timber harvest operations so they will not adversely affect riparian vegetation.

b. Rosgen Stream Type(s):

Current conditions: Reaches 1 through 7 occur in low-gradient meadows and meadow forest systems with a drainage area >27mi≤; all are classified as the expected C stream type. Reaches 1, 2, 5, and 7 are ***functioning appropriately*** because they have width-to-depth ratios from 13 and 25. In contrast, Reaches 3, 4, and 6 are ***functioning appropriately but-at-risk*** because width-to-depth ratios are greater than 25.

Rosgen B stream types characterize Reaches 8, 10, 12, 14, 15, and 16óall of which are ***functioning appropriately*** in terms of their potential stream type.

Factors contributing to current conditions: An abundance of late-seral riparian vegetation is essential for maintaining low-gradient stream types, such as those found in Reaches 1-7. The dominance of sedge, willow, and alder along Reaches 2, 5, and 7 promote high bank stability with channels that are resistant to erosive energy associated with high flows. However, Reaches 1, 3, 4, and 6, lack willow and are dominated by grasses and rushes, resulting in functioning appropriately but-at-risk ratings for these reaches. Along the B Stream types in Reaches 8, 10, 12, 14, 15, and 16, the local geomorphology and larger substrate sizes contribute to channel stability. Even though upland vegetation and roads received functioning appropriately but-at-risk ratings, any modification to the magnitude and timing of stream flows in these upper reaches has not shifted channels from their natural potential.

Recommendations: Implement recommendations in the upland and riparian vegetation sections listed for the Dairy Creek Subwatershed. Add LWD in Reaches 8, 10, 12, 14, and 16. These actions will maintain and enhance the desired stream types.

3) Are the channels providing adequate fish habitat?

For reach locations refer to Figure 4.18 - Dairy Creek Subwatershed Reach and Monitoring Locations. For reach summaries refer to Appendix 1 - Dairy Creek Reach Summaries, and recommendations can be found in Appendix 2 - Dairy Creek Subwatershed Recommendations.

a. Large Woody Debris (LWD).

Current conditions: Reaches 1-4 pass through meadows with limited LWD potential. Portions of Reaches 5-7 have appropriate sites for LWD, with all reaches exceeding the 75th percentile, resulting in ***functioning appropriately*** ratings. In the B stream types, only Reach 15 is rated as ***functioning appropriately***, while Reaches 8, 10, 12, 14 and 16 are ***functioning appropriately but-at-risk***. The major source of LWD in these reaches is lodgepole pine, except for Reach 8, where large ponderosa pine and white fir exist.

Factors contributing to current conditions: Reaches 5-7 are a mix of meadow and forest/meadow sites, but potential recruitment is ample to meet desired conditions. In addition, only portions of the channel in the upper six reaches are lined with conifersólimiting the potential recruitment. Therefore, there are lower LWD levels in these areas.

Recommendations: In the forested areas along Reaches 8, 10, 12, 14, and 16, add LWD to meet the desired 75th percentile. In the short term, add LWD into the stream channel. For long term and sustainable LWD recruitment in forested reaches, manage for conifers within the riparian and upland zones as prescribed in INFISH and the Oregon Forest Practices Act. Additional large wood in the channel will enhance sediment retention, especially in the event of a catastrophic fire, and help improve water quality and aquatic habitat.

b. Pools.

Current conditions: All reaches were found to be ***functioning appropriately***, even in those locations where riparian vegetation and/or Rosgen channel types were determined to be ***functioning appropriately but-at-risk***. Although the reaches have an adequate number of pools, the complexity of these pools is lackingówith reference to depth, structure, undercut banks, etc.

Factors contributing to current conditions: Pool frequencies reflect near-natural numbers in part because stream channels and riparian vegetation resemble, or are near, their desired conditions.

Recommendations: Implement recommendations in the riparian vegetation section for the Dairy Creek Subwatershed to create undercut banks in Reaches 1, 2, 3, and 4. Even though pool numbers are at the desired level, the addition of LWD in Reaches 8, 10, 12, 14, 15, and 16 would add complexity to existing pools and create new ones to further improve habitat. To effectively create a pool, place wood within the bankfull dimensionsópreferably within the wetted channel. Consult with a hydrologist and fishery biologist when implementing these habitat improvement projects.

c. Spawning Gravel Fines.

Current conditions: Fine sediment in spawning substrates were sampled at three locations in Dairy Creek. Reach 2 had 19% fine sedimentsópromoting 76% embryo survival. Reach 5 had 18% fine sedimentsópromoting 77% embryo survival. Therefore, these reaches are ***functioning appropriately***. At the uppermost sampling station, located in Reach 14 (B stream type), the percent fines were slightly higher at 23%ópromoting 66% embryo survival, but also resulting in a ***functioning appropriately*** rating.

Factors contributing to current conditions: The low sediment levels found in Reaches 2 and 5 are most likely attributed to high bank stability, the abundance of late-seral vegetation, and appropriate stream types. Although roads are contributing to sediment levels, these stream reaches are able to capture and transport the sediment produced by the watershed efficiently. The sediment levels recorded in Reach 14 represent the natural levels expected to be found in the subwatershed, especially for B stream types. This station is located just downstream of the Gearhart Wilderness boundary, where road construction and timber harvest have not occurred.

Recommendations: Obliterate roads, emphasizing those within 300' of streams or those that have numerous stream crossings. The remaining roads should be properly drained to prevent sediment delivery to streams. Continue to maintain, or improve, the existing riparian vegetation and associated bank stability by implementing riparian vegetation recommendations. Add LWD where needed for additional bank stability and sediment storage.

d. Stream Temperature.

Current conditions: Based on stream temperature recordings in Reaches 2, 5, and 6, it is assumed that Reaches 1-8 are ***functioning appropriately but-at-risk***, because the 7-day average maximum temperatures were in the 17.8-24.0∞C range. In contrast, Reaches 10 and above are believed to be ***functioning appropriately***, based on the 7-day average maximum temperature of 16.4∞C in Reach 10.

Factors contributing to current conditions: The relatively low stream temperatures found in Reach 10 are a resultóin partóof upstream riparian vegetation and stream channels being near their desired state. Many of these reaches are within the wilderness boundary, with minimal influence from management activities. The relatively open forest/meadow segments of Reaches 6, 7, and 8, allow temperatures to reach 19.7∞C. Further downstream in Reach 5, the influence of Dead Horse Creek, a cold-water streamócauses cooler water temperatures (18.5∞C). The open meadow environment in the lower four reaches contribute to the relatively high stream temperatures at the monitoring station located in Reach 2. Overall, it is questionable as to whether or not the desired temperature of 17.8∞C (State Water Quality Standard) can be met in the lower reaches.

Recommendations: In addition to implementing the recommendations described in the Dairy Creek Subwatershed, specific desired conditions (i.e. shading levels) and management actions affecting stream temperatures will be addressed in the Upper Chewaucan Water Quality Management to be completed in 2000/2001.

e. Fish Passage (Culvert).

Current conditions: Of the three culverts surveyed along Dairy Creek, one was identified as a barrier in Reach 8 as its resulting stream velocities exceed sustained swimming speeds for trout. Refer to Figure 4.17 - Dairy Creek Subwatershed Road Locations. Since this barrier is located in the mid-to-upper portion of the watershed, this assessment element receives a ***functioning appropriately but-at-risk*** rating.

Factors contributing to current conditions: The slope (nearly 5%) of the culvert in Reach 8 is contributing to high velocities, resulting in a barrier to fish passage.

Recommendations: Replace the existing culvert in Reach 8 with one that allows for fish passage. Ensure that the correct size of culvert is installed at the proper location and slope by working with a hydrologist and engineer. Survey the remaining 81 stream crossings to determine if other barriers exists.

4) How are the above subwatershed conditions influencing redband trout viability?

The upland vegetation and road elements are functioning inappropriately and functioning appropriately but-at-risk, respectively; yet these conditions do not appear to be directing riparian vegetation and streams types away from desired conditions. If these elements reflected desired numbers, upland conditions could enhance late-seral riparian vegetation, bank stability, and appropriate stream types. For example, restoring canopy densities to HRV might increase the magnitude of low flows, thus providing more water to riparian areas for plant growth and maintenance during the dry summer months. Also, a reduction in road densities would decrease the drainage network, thus lessening the magnitude of high flows and their ability to scour stream banks. The result would promote or maintain late-seral plant developmentó especially in the alluvial soils of Reaches 1, 2, 3, and 4. Improvements of upland conditions would alleviate the stress placed on riparian vegetation and stream types by more extreme low and high flow events.

The dominance of late-seral riparian vegetation and appropriate stream types has led to the desired number or pools. Within the meadow sites of Reaches 1, 2, 3, and 4, pools are fairly deep; but improvements of localized bank stabilityóespecially in Reaches 1, 3, and 4ówould promote undercut banks and increase complexity, thus, improving pool habitat. Likewise, pool complexity in several forested reaches is lacking because LWD numbers are below desired numbers. Additional LWD in all forested reaches would create new pools, provide hiding cover, rearing habitat, and low velocity areas during high flow events. Because wood captures and stores sediments transported during high flows, it would route these fines away from spawning substrate and help to maintain low spawning fines throughout the subwatershed. In the event of a catastrophic fire caused by high canopy densities, large quantities of wood throughout the forested reaches would buffer downstream areas and tributaries against high sediment inputs and low embryo survival rates.

Their are two more considerations; temperature stress may be a concern down stream of Reach 2 and a culvert in Reach 8 is a barrier to fish passage, preventing upstream movement into the upper half of Dairy Creek.

In conclusion, several assessment elements have good overall ratings and include the following: riparian vegetation and bank stability, Rosgen stream types, pool numbers, and spawning gravel fines. However, the high canopy densities in portions of the forested sites, moderate road densities, lack of LWD, moderate stream temperatures, and culvert barriers inhibit the Dairy Creek Subwatershed from functioning appropriately as a redband trout reserve. As a result, this assessment element is ***functioning appropriately but-at-risk***. Implementing the recommendations listed in this subwatershed section then maintaining those desired conditions will help bring multiple use management in harmony with the hydrologic and ecological processes of the landscape.

Figure 4.16

Figure 4.17

Figure 4.18

Elder Creek Subwatershed

1) Is the upland portion of the subwatershed producing hydrologic conditions that contribute to properly functioning riparian areas ?

a. Upland / Forest Vegetation Conditions.

Current conditions: Within the 25,605 acre subwatershed, forested lands cover 21,579 acres, approximately 84% of the subwatershed. Conifers have encroached into dry and moist meadows and aspen stands, which account for 1,374 acres, 1,286 acres, and 234 acres, respectively. There are an estimated 195 acres of juniper woodlands.

Of the forested acres, 39%, or 8,448 acres, have canopy densities that exceed the HRV. Refer to Figure 4.19 - Elder Creek Subwatershed Upland Vegetation. With increased canopy densities, the build up of understory trees heightens the risk of catastrophic fire and causes conifers to become stressed and susceptible to insects and disease. The increased evapotranspiration associated with high forest canopies also increases the possibility of less available water for stream flow during summer months.

About 7% of the forested lands are in openingsó mainly seedling/sampling standsóand are well below the 15% recommendation for the Upper Chewaucan Watershed and the 20-30% figure noted by Troendle (1982), the point where a significant change in flow can be detected.

For the above reasons, this assessment element receives a ***functioning appropriately but-at-risk*** rating. Also, the effects of management activities on soil resources has been fairly constant throughout the subwatershed, a result of past timber harvest activities.

Factors contributing to current conditions: The frequent and low intensity ground fires that maintained vast stands of open ponderosa pine forests have been suppressed since the early 1900ís. This has created conditions that allow conifers to grow in greater densities than occurred historically in both forests and meadows. In addition, past silvicultural practices emphasized either clear-cutting or selective removal of individual large ponderosa pine. Because these practices were not based on maintaining forested stands within their HRV, they are a contributing factor to current conditions. Finally, the Hannon Trail Roadless Area and Deadhorse Rim Roadless Areaóaccounting for 4,712 acresóhave been affected by fire suppression and restricted silvicultural treatments, additional factors contributing to dense forest stands in the subwatershed.

Recommendations: To reduce the risk of catastrophic fire and associated soil erosion and increased flows, forest understories should be thinned to restore canopies to HRV. This will promote conditions for low intensity fires to reoccuróeither naturally or controlledóthroughout the subwatershed. In addition, this will reduce the potential for epidemic insect and disease outbreaks. In the dry meadows and aspen stands, conifers that became established after the advent of fire suppression should be considered for thinning. Juniper woodlands will be thinned to promote grasses, forbs, and shrubs. Where possible, obliterate skid trails and landings throughout the subwatershed to alleviate past impacts to soil resources, beginning with those areas where understory treatments will occur.

b. Road Density, Location, and Drainage Network.

Current conditions: There are 101 miles of roads in the subwatershed, which equates to a road density of 2.5 mi/mi≤. Consequently, this element is ***functioning appropriately but-at-risk***. Refer to Figure 4.20 - Elder Creek Subwatershed Road Locations. Of these roads, 14 miles (14%) are within 300 feet of perennial and intermittent streams. Furthermore, roads cross channels at 54, sites where direct sediment introduction occurs. Based on the above numbers, the Road Impact Index was calculated to be 0.46. Along with the 84 miles of stream channels, an estimated 61 of the 101 miles of roads are hydrologically integrated with the stream network, thus increasing the drainage network by 73%óusing Wempleís (1994) study results.

Factors contributing to current conditions: By 1946, 40 miles of roads (1.0 mi/mi≤) were constructed in the subwatershed. From 1947 to 1960, and additional 11 miles were built, raising the road density to 1.3 mi/mi≤. Twelve miles of roads were constructed between 1961 and 1969 bringing the road density to 1.6 mi/mi≤. Then, from 1970 to 1979, another 36 miles of roads were built during high levels of timber harvestóincreasing the road density to 2.5 mi/mi≤. Since 1980, approximately two miles of road have been added.

Recommendations: To reach the desired road density of 1.7 mi/mi≤, obliterate approximately 34 miles of road. Emphasis should be placed on those roads within 300' of streams or having numerous stream crossings. The remaining roads should be properly drained to reduce the hydrological connection to stream channels, resulting in less water and sediment flowing down roads and their ditches. This promotes better infiltration of water into forest soils for slow release into stream channels.

2) Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

Elder Creek was divided into 11 reaches, about 19 miles in length. Approximately 10 and 3 miles were surveyed on National Forest and private lands (J-Spear and Harvey), respectively. Reaches 3 and 5, about 1.5 miles, were not surveyed. Reach 6 is approximately 4.5 miles in lengthóowned by US Timberlands Servicesóand was surveyed using the Proper Functioning Condition (PFC) analysis. For reach locations refer to Figure 4.21 - Elder Creek Subwatershed Reach and Monitoring Locations, and for reach summaries refer to Appendix 1 - Elder Creek Reach Summaries. Recommendations can be found in Appendix 2 - Elder Creek Subwatershed Recommendations.

a. Riparian vegetation and associated bank stability.

Current conditions: The bank stability in Reaches 1 and 2 are 87% and 83%, respectively, resulting in a ***functioning appropriately but-at-risk*** rating. In addition, grass and rush are more dominant than expected for these sites, indicating that plant succession is moving towards, but has not reached, a late-seral community. Reach 4 is ***functioning appropriately but-at-risk*** because grass and rush are abundant, although its bank stability is 96%. The remaining six reaches (Reaches 6-11) are ***functioning appropriately*** due to the dominance of late-seral species and bank stability being greater than 95%. The PFC survey conducted in Reach 6 documented late-seral vegetationóalder, sedge, and white fir.

Factors contributing to current conditions: The land area associated with Reach 1 is owned by the J-Spear Ranch, while Reach 2 land is owned by the Harvey Ranch. These areas receive season-long grazing and late-season grazing, respectively, and are the management actions with the greatest influence on bank stability and vegetative conditions, such as low amounts of willows. Another factor affecting bank stability might be the increased drainage network associated with roads, a condition that can increase stream flows and their ability to scour stream channels. Upstream in Reach 4, livestock grazing is again the management action that is most likely having the greatest influence on the local riparian vegetation. Bank stability in Reaches 6, 7, and 8 was highóa result of naturally stable stream types and dominance of late-seral species (Refer to Rosgen channel type discussion). In Reaches 9, 10, and 11, current grazing strategies (deferred/rest rotation) allow for an abundance of late-seral species and minimal bank instability.

Recommendations: Modify grazing strategies in Reaches 1 and 2 to promote the growth of late-seral vegetation, especially sedges and willow. Place root wads, as described by Rosgen (1996), in the areas of bank instability. The desired conditions along Reaches 7 and 8 can be maintained by continuing management practices that promote late-seral species.

In Reaches 2, 4, 9, and the upper part of Reach 8, mechanically thin encroaching conifers and/or allow prescribed fire to creep into riparian areas and associated meadows. These treatments will reduce conifer densities and maintain growth of riparian grasses, shrubs, and trees. Promote growth of riparian vegetation, or place sedge mats or root wads, in areas where local bank instability exist. Starting in 2000, vegetative and bank conditions are expected to improve on all National Forest reaches affected by grazing with the implementation of interim grazing guidelines. These grazing standards will maintain and promote late-seral plant conditions along stream channels and will work towards a long-term solution for bank instability.

Finally, the implementation of INFISH and the Oregon Forest Practices Act will guide timber harvest operations so they will not adversely affect riparian vegetation.

b. Rosgen Stream Type(s).

Current conditions: Reaches 1, 2, 4, and 9 have stream channels which are similar to the stream type (C for Reaches 1, 2, and 4; E for Reach 9) expected for their low-gradient meadow settings. However, their bankfull width-to-depth ratios are greater than expected and thus are determined to be ***functioning appropriately but-at-risk***. Since Reaches 1, 2, and 4 have drainage areas greater than 33 square miles, C stream types are expected. Reach 9, on the other hand, has a drainage area of 7 square miles and is expected to be an E stream type.

In contrast, Reaches 7, 8, 10, and 11 are ***functioning appropriately*** in terms of their potential stream type. For these reaches, the shape and size of the stream is in balance with its geomorphic setting. Reach 7 is dominated by B stream types, with moderately steep gradients, gentle sideslopes, and cobble/gravel substrates. The lower portion of Reach 8 is mainly a low-gradient B stream type, which transitionsówith the changing geomorphologyóto a E/C stream type. Finally, the upper two reaches (10 and 11) are E stream types, those characterized by low-gradients, active floodplains, and low width-to-depth ratios (narrow and deep). Rosgen stream type measurements were not conducted in Reach 6, but the PFC surveys strongly indicate that the channel is in balance with its setting.

Factors contributing to current conditions: An abundance of late-seral riparian vegetation is essential for maintaining low-gradient stream types, as found in Reaches 1, 2, and 4. However, these reaches lack willow and are dominated by grasses and rushes, contributing to the functioning appropriately but-at-risk ratings. Along the B Stream types in Reaches 7 and 8, the local geology and large substrate sizes contribute to the channel stability.

The late-seral vegetation described in the previous section contribute to the stability of E Stream types. The dominance of sedge along Reaches 9, 10, and 11 promote high bank stability, with narrow and deep channels that are resistant to erosive energy associated with high flows. Reach 9, however, is still on the evolutionary path for a degraded low-gradient system (see Chapter 3). Its ample late-seral vegetation will continue to trap sediments and build banks, causing the channel to narrow and deepen, moving towards its naturally stable desired state (E stream type). Finally, even though upland vegetation and roads received functioning appropriately but-at-risk ratings, any modification to the magnitude and timing of stream flows in these upper reaches has not shifted channels from their natural potential.

Recommendations: Implement recommendations in the upland and riparian vegetation sections listed in this subwatershed section, and add LWD in Reaches 7 and 8. These actions will maintain, enhance, or produce the desired stream types.

3) Are the channels providing adequate fish habitat?

For reach locations refer to Figure 4.21 - Elder Creek Subwatershed Reach and Monitoring Locations. For reach summaries refer to Appendix 1 - Elder Creek Reach Summaries, and recommendations can be located in Appendix 2 - Elder Creek Subwatershed Recommendations. The PFC survey conducted in Reach 6 did not assess fish habitat elements.

a. Large Woody Debris (LWD).

Current conditions: Reaches 1, 9, 10, and 11 are in meadows with sparse LWD recruitment potential. Portions of Reaches 2, 4, 7, and 8 are appropriate sites for LWD, with the major source of wood being lodgepole pine. Reaches 2 and 4 are rated as ***functioning appropriately***, while Reaches 7 and 8 are ***functioning appropriately but-at-risk*** and ***functioning inappropriately***, respectively.

Factors contributing to current conditions: Reaches 2 and 4 are a mix of meadow and forest/ meadow sites, but recruitment is ample to meet desired conditions. Also, only portions of the channel (or one side of the channel) in Reaches 7 and 8 are lined with conifers, limiting potential recruitment. Thus, there are lower LWD levels in these areas.

Recommendations: In the forested areas along Reaches 7 and 8, add LWD to achieve the desired 75th percentile. In the short term, add LWD into the stream channel. For long term and sustainable LWD recruitment in forested reaches, manage for conifers within the riparian and upland zones as prescribed in INFISH and the Oregon Forest Practices Act. Additional large wood in the channel will enhance sediment retention, especially in the event of a catastrophic fire, and help improve water quality and aquatic habitat.

b. Pools.

Current conditions: All reaches were found to be ***functioning appropriately***.

Factors contributing to current conditions: Pool frequencies reflect near natural numbers in part because stream channels and riparian vegetation are functioning near or at their desired conditions. It should be noted that in the upper reaches (9-11), deep pools are likely to be uncommon in the absence of beaver dams.

Recommendations: Even though pool numbers are at the desired level, pool complexity and numbers can improve. Implement recommendations in the riparian vegetation section for this subwatershed to create undercut banks in Reaches 1, 2, and 3. More pools can be created with the addition of LWD in Reaches 7 and 8. For LWD to effectively create a pool, the wood must be within the bankfull dimensions, and preferably within the wetted channel. Consult with hydrologist and fishery biologist when implementing these habitat improvement projects.

c. Spawning Gravel Fines.

Current conditions: Fine sediments were sampled at two locations in Elder Creek. Reach 4 has 26% fine sediments (promoting 60% embryo survival), while in Reach 9 the percent fines were lower at 17% (promoting 79% embryo survival). As a result, Reach 4 is ***functioning appropriately but-at-risk*** while Reach 9 is ***functioning appropriately***.

Factors contributing to current conditions: Although roads are contributing to sediment levels, the efficiency with which E stream types (like those found in Reaches 10 and 11) transport and capture sediment is likely the reason for low sediment values at the sampling location in Reach 9. The higher levels of sediment found in Reach 4 can be partially explained by its stream typeóa Rosgen C stream type which often has more unstable banks than E stream types. Also, the high number of stream crossings and roads above this sampling location might be influencing higher sediment levels.

Recommendations: Obliterate roads, emphasizing those within 300' of streams or those that have numerous stream crossings. The remaining roads should be properly drained to reduce sediment delivery to streams. Continue to maintain, or improve, the existing riparian vegetation and associated bank stability by implementing recommendations described in the riparian vegetation section for this subwatershed. Place LWD where needed for additional bank stability and sediment storage. Also, decreasing width-to-depth ratios in the lower reaches will lead to improved sediment routing.

d. Stream Temperature.

Current conditions: Based on stream temperature recordings from Reaches 4, 7, and 9, the stream is ***functioning appropriately but-at-risk*** because the 7-day average maximum temperatures exceeded 17.8∞C. Actual temperature values ranged from 19.1∞C to 21.3∞C, with the highest reading found in Reach 4.

Factors contributing to current conditions: The open meadow surrounding Reaches 9-11, in conjunction with low stream flow, contributes to the relatively high stream temperatures at the temperature-monitoring station located at the lower end of Reach 9. Immediately downstream of this station is the confluence with Witham Creek, a major tributary that provides cooler water to Elder Creek. This is evident by the cooler (approximately 2∞C) temperatures noted in Reach 7. Downstream, the continual warming indicates that the influence of cool springs and tributaries are having less influence. In Reaches 1-4, channels are wider and shallower than desired, resulting in a larger surface area exposed to solar radiation.

Recommendations: In addition to implementing the recommendations described for this subwatershed, specific desired conditions (i.e. shading levels) and management practices affecting stream temperatures will be addressed in the Upper Chewaucan Water Quality Management Plan to be completed in 2000/ 2001.

e. Fish Passage (Culvert).

Current conditions: The culvert identified in Reach 10 is not considered a barrier to fish passage, and thus this assessment item receives a ***functioning appropriately*** rating. It should be noted that a water fall, an apparent barrier, exists in Reach 8. An irrigation weir, located in Reach 1, may be a barrier during high flows.

Factors contributing to current conditions: The culvert in Reach 10 was installed at a slope of less than 1%, has no jump height for fish to negotiate, and has a pool at its outlet.

Recommendations: Survey the remaining 53 stream crossings to determine if other barriers exist.

4) How are the above subwatershed conditions influencing redband trout viability?

As in the Bear Creek and Coffeepot Creek subwatersheds, the upland vegetation and road elements are functioning appropriately but-at-risk; yet, these conditions do not appear to be preventing riparian vegetation and streams types from achieving desired conditions. If these areas reflected desired numbers, upland conditions could enhance late-seral riparian vegetation, bank stability, and appropriate stream types. Restoring canopy densities to HRV might increase the magnitude of low flows, thus providing more water to riparian areas essential for plant growth and maintenance during the dry summer months. Further, a reduction in road densities would decrease the drainage network, thus lessening the magnitude of high flows and their ability to scour stream banks. This would result in conditions that promote late-seral plant developmentóespecially in the alluvial soils of Reaches 1 and 2. Therefore, improvements of upland conditions would help alleviate any stress placed on riparian vegetation and stream types by extreme low and high flows.

The dominance of late-seral riparian vegetation and appropriate stream types has led to the desired number or pools. In the meadow sites of Reaches 1 and 2, pools are fairly deep but lack complexity because the stream has relatively few undercut banks. Improvements of localized bank stability would promote undercut banks and improve pool habitat. Likewise, pool complexity in forested reaches is lacking because LWD numbers are below desired numbers in several reaches. Additional LWD in all forested reaches would create new pools, provide hiding cover, rearing habitat, and low velocity areas during high flow periods. Further, wood captures and stores sediments transported during high flows, routing these fines away from spawning substrate and helping to maintain low spawning fines throughout the subwatershedóespecially in Reach 4. In the event of a catastrophic fire, resulting from high canopy densities, large quantities of wood throughout the forested reaches would buffer downstream areas and tributaries against high sediment inputs and low embryo survival rates.

There are two more considerations. First, temperature stress may be a concern downstream of Reach 4. Second, fish from the Chewaucan River and the lower reaches of Elder Creek may have difficulties moving beyond the weir in the upper portion of Reach 1, limiting connectivity throughout the subwatershed and with other subwatersheds. In conclusion, one assessment element has a good overall ratingópool numbers. However, the remaining elements are moderately out of balanceó forest canopy, road densities, riparian vegetation, Rosgen stream types, LWD, stream temperatures, spawning gravel fineóall of which inhibit the Elder Creek Subwatershed from functioning appropriately as a redband trout reserve. Reach 6, owned by US Timberlands, is relatively long and appears to be functioning appropriately for riparian vegetation and Rosgen stream types.

As a result, this assessment element is ***functioning appropriately but-at-risk***. Implementing the recommendations listed in this subwatershed section then maintaining those desired conditions will help bring multiple use management in harmony with the hydrologic and ecological processes of the landscape.

Figure 4.19

Figure 4.20

Figure 4.21

Chewaucan River Subwatershed

1) Is the upland portion of the subwatershed producing hydrological conditions that contribute to properly functioning riparian areas?

a. Upland / Forest Vegetation Conditions.

Current conditions: Within the 37,446 acre subwatershed, forested lands cover 17,181 acres or approximately 46% of the subwatershed. Conifers have encroached into the dry and moist meadows and aspen stands, accounting for 2,469, 117, and 332 acres, respectively.

In addition, there are an estimated 5,509 acres of juniper woodlands with most occurring in the eastern half of the subwatershed. Of these woodlands, approximately 12% have closed canopies exceeding 50% with densities of around 180 trees per acre. Nearly 99% of the juniper trees in the subwatershed became established after 1860óan expansion that replaced shrub and grass lands and left soil prone to erosion (Miller 1997). In this subwatershed, slopes surrounding Juniper Creek are covered with dense stands of juniper and have little or no ground cover. During intense summer thunderstorms, vast amounts of soil erodes off the hillsides and into the creek where it is then transported to the Chewaucan River. On one occasion, erosion was so great that it blocked the river for several minutes.

Of the forested acres, 52% or 8,863 acres have been determined to have canopy cover that exceeds HRV. Refer to Figure 4.22 - Chewaucan River Subwatershed Upland Vegetation. With increased canopy densities, the build up of understory increases the risk of catastrophic fire and causes conifers to become stressed and susceptible to insects and disease. The increased evapotranspiration associated with high forest canopies and juniper woodlands also increases the possibility of less available water for stream flow during summer months.

Conversely, about 4% of the subwatershed consists of forest openingsómainly seedling/sapling sitesó well below the 15% recommendation for the Upper Chewaucan Watershed and the 20-30% figure noted by Troendle (1982), the point where a significant change in flow can be detected.

In conclusion, this element is ***functioning inappropriately***óprimarily from the expansive juniper encroachment. Also, the effects of management activities on soil resources has been fairly extensive throughout the subwatershed, a result of past timber harvest activities and juniper expansion.

Factors contributing to current conditions: The frequent and low intensity ground fires that maintained vast stands of open ponderosa pine forests and grassy hillsides have been suppressed since the early 1900ís, creating conditions that allow conifer seedlings to grow in greater densities than occurred historically. Juniper woodlands have also increased due to changes in the fire regime along with potential climate change, especially along the eastern portion of the subwatershed. Prior to 1903, the mean fire interval for the basin was around 11 years, maintaining plant communities dominated by grasses, forbs, and to a lesser extent, shrubs (Miller 1997).

In addition, past silvicultural treatments emphasized either clear-cutting or selective removal of individual large ponderosa pine. Because these treatments were not based on maintaining forested stands within their HRV for canopy cover, they are a contributing factor to current conditions. The seedling/sapling stands are a result of forested areas that were harvested through clear-cutting, shelterwood, and seed-tree silvicultural prescriptions.

Recommendations: To reduce the risk of catastrophic fire and associated soil erosion, sedimentation, and increased flows, forest understories should be thinned to restore canopies to HRV. This will promote conditions for low intensity fires to reoccuróeither naturally or controlledó throughout the subwatershed. Further, this reduces the potential for epidemic insect and disease outbreaks. In the dry meadows and aspen stands, conifers (especially juniper in the eastern portion of the subwatershed) that became established after the advent of fire suppression should be considered for thinning. Aspen stands will continue to decline across the subwatershed with the absence of fire. Thus, the use of prescribed fire, as well as thinning of juniper trees, is recommended to restore these sites (Miller 1997).

Juniper woodlands require thinning to promote the growth of grasses, forbs, and shrubs. On steep and south-facing slopes with little ground cover, trees should be selectively cut and left on the ground to prevent further erosion and provide a better environment for the growth of ground vegetation. If juniper encroachment is not curtailed, these trees will eventually dominate a much larger portion of the subwatershed, leading to even more adverse effects on water quality.

Where possible, skid trails and landings should be eliminated throughout the subwatershed to alleviate past soil impacts, beginning with those areas where understory treatments will occur.

b. Road Density, Location, and Drainage Network.

Current conditions: There are 115 miles of roads in the subwatershed, a road density of 2.0 mi/mi≤, resulting in a ***functioning appropriately but-at-risk*** rating. Refer to Figure 4.23 - Chewaucan River Subwatershed Road Locations. Of these roads, 29 miles (25%) are within 300 feet of perennial and intermittent streams. In addition, roads cross channels at 132 locations, sites where direct sediment introduction occurs. Based on the above numbers, the Road Impact Index was calculated to be 0.88. Along with the 161 miles of stream channels, an estimated 69 of the 115 miles of roads are hydrologically integrated with the stream network, thus increasing the drainage network by 43%óusing Wempleís (1994) study results.

Factors contributing to current conditions: By 1946, 58 miles of roads (1.0 mi/mi≤) were constructed in the subwatershed to provide access to private lands and timber resources of the Upper Chewaucan Watershed. From 1947 to 1960, an additional 22 miles were built in conjunction with timber harvesting, raising the road density to 1.4 mi/mi≤. Twenty-eight miles of roads were constructed between 1961 and 1969, bringing the road density to 1.8 mi/mi≤. These roads are primarily on Forest Service lands in the western portion of the subwatershed. From 1970 to 1979, an additional seven miles of roads were constructed for continued timber harvesting, increasing the road density to the current level of 2.5 mi/mi≤. No roads have been constructed since 1979.

Recommendations: To reach the desired road density of 1.7 mi/mi≤ and a functioning appropriately rating, obliterate approximately 16 miles of road. Emphasis should be placed on those roads within 300' of streams or have numerous stream crossings. The remaining roads should be properly drained to reduce the hydrological connection to stream channels, resulting in less water and sediment flowing down roads and their ditches. This promotes better infiltration of water into forest soils to be slowly released into stream channels.

2) Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

The Chewaucan River was divided into 24 reaches, about 30 miles in length. Approximately 15 and 3 miles were surveyed on National Forest and BLM lands, respectively. About 10 miles were surveyed on private lands (J-Spear and Murphy). Reaches 5 and 14 were not surveyed, approximately two miles. For reach locations refer to Figure 4.24 - Chewaucan River Subwatershed Reach and Monitoring Locations, and for reach summaries refer to Appendix 1 - Chewaucan River Reach Summaries. Recommendations can be found in Appendix 2 - Chewaucan River Subwatershed Recommendations.

a. Riparian vegetation and associated bank stability.

Current conditions: The bank stability in Reaches 1-4 is greater than 95%, resulting in ***functioning appropriately*** ratings. Reach 8 is the only low-gradient meadow reach that is ***functioning appropriately***. Reach 8 is near desired vegetative conditions with its abundance of willow in the first three classes. Even though bank stability is greater than 90%, Reaches 5A, 6, 11, 13, 15, 16, 17, and 18, are ***functioning appropriately but-at-risk*** because they lack sufficient willow in all age classes. Reaches 7, 10, and 20 are ***functioning appropriately but-at-risk*** because they have low bank stability and plant communities which lack willow along the stream channel.

Reaches 9 and 12 are ***functioning inappropriately***, due to low abundance values for bank stability and late-seral species. Reach 19 is also ***functioning inappropriately***óalthough its bank stability exceeds 80%óbecause it has primarily grass and rush, but no mature willow.

Factors contributing to current conditions: Naturally stable stream types (Refer to Rosgen channel type discussion) and the dominance of late-seral species in Reaches 1-4, promote high bank stability.

Past livestock practices have led to reduced stability and early-seral vegetative conditions, such as the lack of willow throughout the low-gradient meadow systems (Reaches 5A-21). The majority of these reaches are grazed during July, August, and September. The juniper revetments installed in many of these reaches (5A and all of the Forest Service reaches) have aided in stabilizing streambanks and providing an environment for the establishment of late-seral species.

An additional factor leading to localized bank instability might be the increased drainage network associated with roads throughout the subwatershed and entire watershed. Increased peak flows can scour already unstable banks.

Reach 8 characterizes a stretch to river which is near desired conditions. Sedge is common along the banks and willow are abundant along point bars and areas of past gravel deposition. Cattle grazing occurs during the early season when grass is abundant, resulting in little use of willow.

Recommendations: Reach 8 could be used as an example to guide vegetative conditions in the low-gradient C stream types. Evaluate and modify grazing strategies in Reaches 5A-21 to promote the growth of late-seral vegetation, especially sedges and willow. On a limited basis, place sedge mats and possibly root wads as described by Rosgen (1996) in areas of high bank instability along fully devloped meander bends (geometry). Starting in 2000, vegetative and bank conditions are expected to improve on all National Forest reaches affected by grazing with the implementation of interim grazing guidelines. These grazing standards will maintain and promote late-seral plant conditions along stream channels and will work towards a long-term solution for bank instability.

Finally, the implementation of INFISH and the Oregon Forest Practices Act will guide timber harvest operations so they will not adversely affect riparian vegetation.

b. Rosgen Stream Type(s).

Current conditions: Reaches 1-4 are ***functioning appropriately*** in terms of their potential stream type and have channels that are in balance with their geomorphic setting. These reaches are dominated by B stream types, with low-to-moderate gradients, gentle sideslopes, and cobble/gravel substrates. Reaches 5A-21 are all C stream types and are similar to those expected for low-gradient meadow systems with large drainage areas. These reaches are ***functioning appropriately but-at-risk***, however, because their bankfull width-to-depth ratios are higher than desired conditions. Reach 8 is the only exceptionówith width-to-depth ratios meeting desired conditionsóthus it receives a ***functioning appropriately*** rating.

Factors contributing to current conditions: Along the B stream types in Reaches 1-4, the local geomorphology and larger substrate sizes contribute to high channel stability.

In the lower gradient C stream types (Reaches 5A-21), an abundance of late seral riparian vegetation maintains channel integrity. The dominance of sedge, rush and willow in Reach 8 promote high bank stability, with channels that are resistant to erosive energy from high flows. However, many of the other reaches lack an abundance of these late-seral species, and are dominated by grasses and rushes, contributing to the functioning appropriately but-at-risk ratings for these areas.

The juniper revetments installed along the meanders of low-gradient meadow reaches have stabilized streambanks. (They were placed in channels that were relatively straighter than occurred historically.) However, the revetments have locked the channel into its current position, preventing lateral movement that would result in higher sinuosity--a condition that leads to lower stream gradient and associated stream channel energy. For example, the flood of 1997, the largest on record, did not increase channel sinuosity where revetments were in place. In areas where revetments were absent, the flood energies increased sinuosity.

Associated with the juniper revetments, large boulders were placed in the middle of the channel to create pool habitat. These structures did create pools, at several locations. In many places, however, the boulders widened the stream channel through the formation of mid-channel bars, a reason for high width-to-depth ratios along National Forest C4 stream types.

Finally, less than desirable ratings for upland vegetation and roads for this and other subwatersheds have likely modified the magnitude and timing of stream flows in the Chewaucan River and might be inhibiting the ability of stream channels to revegetate and form stable banks.

Recommendations: Implement recommendations in the upland and riparian vegetation sections listed for this subwatershed. Remove boulders from reaches described as Rosgen C4 stream types. If structures along eroding meanders are used, do so only when the meander geometry (lateral erosion) is fully developed or when there is a risk of losing sinuosity. These actions will maintain, enhance, or produce the desired stream types.

3) Are the channels providing adequate fish habitat?

For reach locations refer to Figure 4.24 - Chewaucan River Subwatershed Reach and Monitoring Locations, and for reach summaries refer to Appendix 1 - Chewaucan River Reach Summaries. Recommendations can be found in Appendix 2 - Chewaucan River Subwatershed Recommendations.

a. Large Woody Debris (LWD).

Current conditions: Of all the reaches surveyed, only Reaches 1- 4 are appropriate sites for LWD. Reach 3 is ***functioning appropriately***. Reaches 2B, 3A, and 4 are ***functioning appropriately but-at-risk***, and Reaches 1 and 2 are ***functioning inappropriately***.

Factors contributing to current conditions: Although Reaches 1-4 are appropriate sites for LWD, recruitment is limited to scattered large ponderosa pine and black cottonwood trees. The Chewaucan River has enough energy during high flows to move even the largest debris, making it difficult to retain wood in these reaches. The other reaches are characterized by meadows with limited LWD recruitment potential.

Recommendations: In the areas where woody recruitment does exist, add LWD to achieve the desired 75th percentile. In the short term, add LWD into the stream channel. For long term and sustainable LWD recruitment in forested reaches, manage for conifers within the riparian and upland zones as prescribed in INFISH and the Oregon Forest Practices Act. Additional large wood in the channel will enhance sediment retention, especially in the event of a catastrophic fire, and help improve water quality and aquatic habitat.

b. Pools.

Current conditions: In all of the reaches characterized by B stream types, pool numbers are ***functioning appropriately***, even though large wood is lacking in all but one reach. Reaches 18 and 20, C stream types are rated as ***functioning appropriately*** *but-at-risk*. The remainder of C stream reaches were determined to be ***functioning appropriately,*** even in those locations where riparian vegetation and/or Rosgen channel types were determined to be ***functioning appropriately but-at-risk*** or ***functioning inappropriately***. Although all reaches have adequate numbers of pools, complexity of these pools is lacking (depth, structure, undercut banks, etc.).

Factors contributing to current conditions: In the B stream types, boulders and channel constrictions are the important structural elements resulting in the desired number of pools. In the C stream types, pools are typically found along the outside meanders and undercut banks.

Recommendations: Even though pool numbers are at the desired level, additional pools would further improve habitat by placing LWD or rock structures in Reaches 1-4. For these structures to effectively create a pool, they must be within the bankfull dimensionsópreferably within the wetted channel. Implementation of the riparian vegetation recommendations listed for this subwatershed will create undercut banks in the meadow reaches, increasing habitat complexity.

c. Spawning Gravel Fines.

Current conditions: Fine sediment in spawning substrates was sampled at four locations in the Chewaucan River. Reach 3, a B stream type, has 28% fine sedimentsópromoting 53% embryo survival. Reach 4, another B stream type, has 23% fine sedimentsópromoting 66% embryo survival, respectively. Thus, Reach 3 is ***functioning appropriately but-at-risk,*** while Reach 4 is ***functioning appropriately***.

Reach 8, a C stream type, has 19% fine sedimentó promoting 76% embryo survival and resulting in a ***functioning appropriately*** rating. At the uppermost sampling station, located in Reach 19 (also a C stream type), the percent fines were much higher at 44%ópromoting 17% embryo survival and is ***functioning inappropriately***.

Factors contributing to current conditions: The relatively low sediment levels found in the lower three sampling locations (Reaches 3, 4, and 8) are most likely attributed to the high bank stability, the abundance of late-seral vegetation, and appropriate stream types. Although roads and upstream bank instability are contributing to sediment levels, these stream reaches are able to efficiently transport the sediment produced by the watershed. The high values reported in Reach 19 are probably associated with bank instabilityóboth within the reach and in upstream reaches. It is highly possible that the high number of stream crossings and roads above this sampling location throughout the entire watershed influence sediment levels in Reach 19.

Recommendations: Obliterate roads, emphasizing those within 300' of streams and/or those that have numerous stream crossings. The remaining roads should be properly drained to prevent sediment delivery to streams. Treat juniper woodlands, as described in the uplands section for this subwatershed, to reduce soil erosion into the Chewaucan River. Maintain, or improve, the existing riparian vegetation and associated bank stability by implementing recommendations in the riparian vegetation section for this subwatershed. Restore LWD where needed for additional bank stability and sediment storage.

d. Stream Temperature.

Current conditions: Based on stream temperature recordings in Reaches 3, 4, and 6 it is assumed that Reaches 1-13 are ***functioning inappropriately*** because the 7-day average maximum temperatures exceed 24.0∞C. Reaches 15-21 are believed to be ***functioning appropriately but-at-risk,*** based on the 7-day average maximum temperature of 22.6∞C in Reach 19.

Factors contributing to current conditions: The relatively high stream temperatures throughout the Chewaucan River are attributed to its relatively warm tributaries and the open nature of the meadow environments in the upper reaches of the river. Because both Dairy and Elder Creeksóheadwater streams that join to create the Chewaucan Riveró exceed the State Water Quality Standard of 17.8∞C, the Chewaucan River exceeds this standard at its formation.

As discussed in previous subwatershed evaluations, many of the low-gradient reaches in the entire Upper Chewaucan Watershed have been affected by at least one factor influencing stream temperaturesówide stream channels, loss of riparian and upland shade, lower stream flows caused by increased evapotranspiration,. With continued improvement in riparian and stream channel conditions, additional shading and narrowing of stream channels should result in lower stream temperatures. Even though it is assumed that stream temperatures were historically lower than they are today, it is highly questionable as to whether or not current state standards can be achieved in all streams.

Recommendations: In addition to implementing the recommendations described in the above sections, specific desired conditions (i.e. shading levels) and management practices affecting stream temperatures will be addressed in the Upper Chewaucan Water Quality Management Plan to be completed in 2000.

e. Fish Passage (Culvert).

Current conditions: No culverts or any type of barrier exists on the Upper Chewaucan River; thus this element is ***functioning appropriately***.

Factors contributing to current conditions: Due to the riverís large size and flows, culverts were not installed at river crossings. Only bridges and low-water fords are used to cross the Chewaucan River.

Recommendations: Survey all 132 stream crossings in the subwatershed to determine whether or not barriers exist.

4) How are the above subwatershed conditions influencing redband trout viability?

The upland vegetation and road elements are functioning inappropriately and functioning appropriately but-at-risk, respectively, resulting less than desired conditions for the uplands. The dense juniper woodlands occupying the east portion of the watershed are contributing vast amounts of sediment into the river. In addition, road densities throughout the Upper Chewaucan Watershed route sediment into the river. If these elements were at the desired level, upland conditions could enhance late-seral riparian vegetation, bank stability, and appropriate stream types. For example, by restoring canopy density throughout the analysis area to HRV, the magnitude of low flows might increase, thus providing more water to riparian areas which is essential for plant growth and maintenance during the dry summer months. Also, reduced road densities across the analysis area would decrease the drainage network and lessen the magnitude of high flows and their ability to scour stream banks. The resulting conditions would promote late-seral plant developmentóespecially for the low-gradient C stream types. Therefore, improvements of upland conditions would alleviate any stress placed on riparian vegetation and stream types by unnaturally low and high flows.

Even though pool numbers are near or at desired numbers, low bank stability and densities of late-seral riparian vegetation, contribute to a lack of pool complexity in Reaches 5A through 21. Along these meadow reaches, pools can be improved with the creation of more undercut banks with increased bank stability. Similar to most subwatersheds throughout the analysis area, pool complexity in forested reaches is lacking because LWD numbers are below desired figures. Additional LWD would create new pools, provide hiding cover, rearing habitat, and low velocity areas during high flows. Because wood captures and stores sediment transported during high flows, it would route these fines away from spawning substrate and help to maintain low spawning fines throughout the subwatershed.

In the event of a catastrophic fire caused by high canopy densities, narrower stream channels with well-developed floodplains in the upper reaches and greater quantities of wood throughout the forested reaches would buffer against high sediment inputs and low embryo survival rates.

Furthermore, temperature stress is a concern along the river, especially downstream of Reach 13, where water temperatures are Functioning Inappropriately . Because the river is Functioning Appropriately but-at-Risk at its origin, stream temperature must be resolved across the entire watershed. Establishment of late-seral plant communities and resulting narrow width-to-depth ratios will help maintain cooler temperatures. Finally, a strong point for the Upper Chewaucan River relates to is accessibility for fish throughout all reaches. The river can be used as a corridor to all of the subwatersheds assessed in this document.

In conclusion, two assessment elements have good overall ratings and include the following: pool numbers and fish passage. However, the remaining elements need improvementóhigh canopy coverage in forested sites, dense juniper woodlands, moderate road densities, lack of LWD, high stream temperatures, and moderate to high spawning gravel fines. These limiting factors inhibit the Chewaucan River Subwatershed from functioning appropriately as a redband trout reserve. In addition, the reliance of this subwatershed on existing conditions from other subwatersheds place the Chewaucan River in a tenuous position. As a result, this assessment element is ***functioning inappropriately***. Implementing the recommendations listed in this subwatershed section then maintaining those desired conditions will help bring multiple use management in harmony with hydrologic and ecological processes of the landscape.

Figure 4.22

Figure 4.23

Figure 4.24

Chapter Five

Summary

Chapter One brought to our attention that the members of the Upper Chewaucan Watershed Council are experiencing consequences of an altered landscape, the result of past management which was conducted outside the carrying capacity of the land. To work within the carrying capacity of the watershed, the Council strives to understand and help the watershed work ìLike a Big Sponge,î as described in Chapter Two, where the ground captures, stores, and slowly releases water throughout the summer months. Chapter Three describes the desired hydrological and ecological conditions of the watershedóupland vegetation, road densities/drainage network, riparian areas, stream types, channel conditionsóas they relate to water quality and fish habitat. The main purpose of Chapter 4 was to compare current and desired conditions and to provide recommendations where differences occur. To accomplish this, information was gathered from the uplands, riparian areas, and stream channels in each of the eight perennial fish-bearing subwatersheds. To conclude the assessment, the remainder of this chapter will briefly summarize conditions of the entire Upper Chewaucan watershed, bringing together information from each of the eight subwatersheds.

1) Is the upland portion of the watershed producing hydrological conditions (water and sediment outputs) that contribute to properly functioning riparian areas?

a. Upland/Forest Vegetation Conditions.

Current Conditions: Within the 171,562 acre watershed, forested land covers 131,065 acres, approximately 76% of the watershed. Of the forested acres, 55% or 72,069 acres have canopy densities exceeding the Historical Range of Variability (HRV). As mentioned in Chapter 3, when over 50% of forested communities are outside recommended canopy ranges, the forest stands are functioning inappropriately. Five of the eight individual subwatersheds are functional inappropriately and include the followingóSouth Creek (75%), Ben Young Creek (69%), Dairy Creek (61%), Swamp Creek (60%), and the Chewaucan River (52%). The remaining three subwatershedsó Bear Creek, Coffeepot Creek, and Elder Creekóare functioning appropriately but-at-risk with nearly 40% of forest canopies exceeding HRV. Refer to Figure 5.1 - Upper Chewaucan Watershed Upland Vegetation, and refer to Appendix 3 - Watershed Summaries: Upland Vegetation and Road Density.

Conifers have expanded into nearly every meadow and most riparian areas throughout the watershed, promoting competition with riparian vegetationó willows, aspen, cottonwood, alderónecessary to maintain proper stream types and bank stability. In addition, dense and vast juniper stands have become established throughout the landscape as a result of fire exclusion, especially in the Chewaucan River and Ben Young Creek subwatersheds. As stated in Chapter 4, 99% of the juniper stands became established after 1860, the time of European settlement. The woodlands have and are replacing numerous vegetation types, leaving the soils prone to erosion and reducing late summer stream flows. The increased conifer densities are likely contributing to lower base flows, but the extent is unknown.

For the above reasons, the upland vegetation in the watershed is ***functioning inappropriately***.

Factors Contributing to Current Conditions: As mentioned in the subwatershed sections of Chapter 4, fire suppression is the main reason for the watershed rating. The frequent and low intensity ground fires that maintained open stands of ponderosa pine have been suppressed since the early 1900ís, allowing conifers to grow in higher densities than occurred historically in both forested and meadow sites. To a lesser degree, past silvicultural treatments, which emphasized clear-cutting, usually moved forest stands away from HRV. Wilderness and/or roadless areas (approximately 20,547 acres) within several of the subwatersheds, especially South Creek and Dairy Creek, have been affected by fire suppression and restricted silvicultural treatments, promoting dense forest stands throughout most of these acres.

Recommendations: The dense forest stands common throughout the watershed require thinning to meet desired canopy levels. Trees that became established after the advent of fire suppression are the primary target for forest thinning, thus reducing canopy cover and providing the essential growing space for the remaining old growth ponderosa pine and other conifer species. This will reduce the risk of catastrophic fire and associated soil erosion into the watershed streams. Conifers that have encroached into riparian areas should also be thinned.

Initial thinning efforts should be focused in the subwatersheds of greatest need, such as South Creek, Ben Young Creek, Dairy Creek, and Swamp Creek. Juniper thinning projects should be directed toward the Chewaucan River and Ben Young Creek subwatersheds.

b. Road Density, Location, and Drainage Network.

Current conditions: There are 762 miles of roads within the 171,562 acre watershed, resulting in a road density of 2.84 mi/mi≤; consequently the watershed is ***functioning appropriately but-at-risk***. Along with the 621 miles of stream channels within the watershed, an estimated 457 of the 762 miles of roads are hydrologically integrated with the stream network, thus increasing the drainage network by 74%óbased on Wempleís (1994) study results. Four of the subwatersheds have increased drainage networks that exceed this valueóSwamp Creek (163%), Bear Creek (119%), Ben Young (94%), and South Creek (84%). The remaining four subwatersheds are below this valueóDairy (73%), Elder (73%), Coffeepot (70%), Chewaucan (43%). Refer to Figure 5.2 - Upper Chewaucan Watershed Road Locations, and refer to Appendix 3 - Watershed Summaries: Upland Vegetation and Road Density.

It is believed the effects of the increased drainage network throughout the eight subwatersheds, from roads and to a lesser extent detrimental soil compaction, have increased the number of days the Chewaucan River exceeds bankfull flows. Table 5.1 displays the comparison of data summarized from the gauging station on the Chewaucan River during the periods of 1926-1945 and 1946-1989. This table displays that the number of days the river exceeds bankfull stage is significantly higher during the latter period of time.

Table 5.1 - Bankfull flows for Average Precipitation Years on the Chewaucan River.

		DAYS PER YEAR		
Year	Precipitation (Average)	Range of 80% to 120% Bankfull (Average)	Exceeding 120% Bankfull (Average)	Exceeding Bankfull (Average)
1926-1945	14.91	22	1	8
1946-1989	14.89	18	12	20

Besides altering peak flows, roads also increase the sediment delivery into streams. Of the 762 miles of roads, 151 (20%) are within 300 feet of perennial and intermittent streams. Furthermore, roads cross channels at 583 locationsósites where direct sediment introduction occurs. Based on the weighted average for the eight subwatersheds, the Road Impact Index was calculated to be 0.83. Road Impact Index numbers were greater than the average in two of the eight subwatershedsóSouth Creek (1.70) and Chewaucan River (0.88). The remaining five subwatersheds are below the averageóDairy (0.73), Bear (0.65), Coffeepot (0.57), Elder (0.46), Ben Young (0.45), Swamp (0.37). As stated in Chapter Four, the Road Impact Index is an indicator of sediment delivery risk associated with road density and the number of stream crossings.

Factors contributing to current conditions: By 1946, 201 miles of roads (0.7mi/mi≤) were constructed in the watershed. From 1947 to 1960, and additional 178 miles were built, raising the road density to 1.4 mi/mi≤. One-hundred and eighty-four miles of roads were constructed between 1961 and 1969 bringing the road density to 2.1 mi/mi≤. Then, from 1970 to 1979, another 178 miles of roads were builtóincreasing the road density to 2.8 mi/mi≤. From 1980 to 1988, 20 miles of road were constructed, resulting in the current road density of 2.84 mi/mi≤. Most roads were built in association with high levels of timber harvest, especially after the Lakeview Federal Sustained Yield Unit was implemented in 1950.

Recommendations: To reach the desired road density of 1.7 mi/mi≤ and a functioning appropriately rating, obliterate approximately 310 miles of road. Emphasis should be placed on those roads within 300' of streams or having numerous stream crossings. The remaining roads should be properly drained to reduce the hydrological connection to stream channels, resulting in less water and sediment flowing down roads and their ditches. This promotes better infiltration of water into forest soils for slow release into stream channels.

2) Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

Approximately 125 miles of stream were surveyed within the eight subwatersheds and were distributed in the following manner: Bear Creek (11 miles); Coffeepot Creek (11 miles); Ben Young Creek (10 miles); Swamp Creek (10 miles); South Creek (15 miles), Morgan Creek (10 miles); Dairy Creek (18 miles); Elder Creek (13 miles); Chewaucan River (27 miles). Proper Functioning Condition surveys were conducted on stream reaches owned by US Timberlands Services and included Bear Creek, Coffeepot Creek, and Elder Creek.

For reach locations refer to Figure 5.3 - Upper Chewaucan Watershed Reach and Monitoring Locations. Refer to Appendix 3: Watershed Summaries - Riparian Vegetation, Bank Stability, and Rosgen Stream Type.

a. Riparian vegetation and associated bank stability.

Current conditions: Sixty-five percent of the 89 reaches surveyed have an abundance of late-seral riparian vegetation, thus are ***functioning appropriately***, while 29% of the reaches are ***functioning appropriately but-at-risk***. The remaining 6% are ***functioning inappropriately***. The majority of those reaches functioning appropriately are B and E stream types, most having an abundance of late seral vegetation and high bank stability, exceeding 90%. These reaches occur throughout the eight subwatersheds.

Those areas that were not rated as functioning appropriately are predominantly C stream types and are located along the large meadow reaches of South Creek, Dairy Creek, Elder Creek, and the Chewaucan River. In general, these meadow reaches have bank stability less than 90% and/or have a lack of sedge, rush, and willow. Because gravel point bars are common in C stream types, greater densities of willow are expected relative to other stream types.

Factors contributing to current conditions: The B stream types are usually located in forested reaches and within canyons, areas which are inherently stable. For this reason, forest management activities (such as timber harvest and grazing) have been conducted away from these stream reaches, leaving them relatively unaffected. However, the lack of fire continues to promote higher densities of mixed conifer and ponderosa pine in riparian areas along B stream types, creating a minor shift in relative plant species abundance. In addition, the E stream types found throughout the watershed are characterized and maintained by late-seral vegetation, resulting from grazing management which is conducive to late-seral plant composition.

The majority of stream reaches that are not functioning appropriately are the C stream types and are located in large meadow reaches along South Creek, Dairy Creek, Elder Creek, and Chewaucan River. Because these are areas of high forage production, late season grazing practices have altered riparian vegetation. For example, the riparian areas have the potential to produce greater densities of large willow than currently exists; however, cattle graze willow during the late summer because the desirable grasses have lost their palatability and protein contents.

Recommendations: In all reaches where conifer encroachment is common, mechanically thin encroaching conifers and/or allow prescribed fire to creep into riparian areas. This will reduce conifer densities and maintain growth of riparian grasses, shrubs, and trees. Implement grazing management that promotes growth of willow along the C stream types and reduction of width-to-depth ratios.

Starting in 2000, vegetative and bank conditions are expected to improve on all National Forest reaches affected by grazing with the implementation of interim grazing guidelines. These grazing standards will maintain and promote late-seral plant conditions along stream channels and will work towards a long-term solution for bank instability. Finally, the implementation of INFISH and the Oregon Forest Practices Act will guide timber harvest operations so they will not adversely affect riparian vegetation.

b. Rosgen Stream Type(s):

Current conditions: Two-hundred and eighty-four sites along 89 stream reaches were measured to determine Rosgen stream types. Of the 89 reaches, 57 (64%) were ***functioning appropriately*** in terms of their potential stream typeóas the shape and size of the stream channel is in balance with its setting. Thirty-one percent of the reaches are ***functioning appropriately but-at-risk***, while 5% are ***functioning inappropriately***. Five of the eight subwatersheds met or exceeded the watershed average of 69% and include the following: Bear Creek (100%), Ben Young Creek (100%), South Creek (80%), Dairy Creek (77%), and Coffeepot Creek (71%). The remaining four creeks had averages below 69% and include the following: Elder (63%), Morgan (60%) within the South Creek Subwatershed, and Chewaucan (41%).

The three dominant stream types are B (38%), C (32%), and E (26%). The remaining 4% is comprised of A, F, and G stream types. Most stream reaches that are functioning appropriately (64%) are the B and E stream types found throughout the watershed, while those which are functioning appropriately but-at-risk (31%) are C stream types that have width-to-depth ratios greater than expected. Most of the C stream types which are functioning appropriately but-at-risk are primarily located in the South Creek, Dairy Creek, Elder Creek, and Chewaucan River subwatersheds. The remaining stream reaches that are functioning inappropriately (5%) are reaches currently characterized as C stream types that should be E types.

Early land management activities have influenced the current water table elevations and floodplain widths for the C and E stream types throughout the watershed. Beaver trapping and historical livestock grazing have led to downcut stream channels in low gradient meadows, converting C and E stream types with wide floodplains into F stream types with little to no floodplain. This resulted in lowered water tables with less water storage and lower base flows. As a result of improved livestock grazing strategies continually promoted on the watershed, E stream types have reclaimed many meadow sites, resulting in the reestablishment of floodplains dominated with late-seral riparian plants. However, the floodplains and areas of water storage are less extensive than they were prior to downcutting. This has likely reduced base flows within the watershed. Furthermore, beaver dams are not present in their historical numbers, further reducing the lateral extent of bank saturation and groundwater storage essential for maintenance of base flows during summer months.

Factors contributing to current conditions: The B stream types are inherently stable because of geology and other landscape characteristics, such as large woody debris from forested areas and large streambed substrates. As expected, all of these stream types were in balance with the landscape. The majority of stream reaches that are not functioning appropriately are the C stream types and are located in large meadow reaches along South Creek, Dairy Creek, Elder Creek, and Chewaucan River. Because these are areas of high forage production, the meadows have been strongly influenced by grazing practices which reduce densities of riparian vegetation important for bank stability and low width-to-depth ratios. In addition, the large boulders which were placed in the middle of the Chewaucan River (National Forest C4 stream segments) in the early 1980ís, have contributed to wider stream channels through the formation of mid-channel bars.

Recommendations: Implement recommendations described in this chapter. Emphasis should be placed on implementing grazing practices that promote the growth of sedge, rush, and willowóplants required for high bank stability and low width-to-depth ratios in low gradient systems.

3) Are the channels providing adequate fish habitat?

For reach locations refer to Figure 5.3 - Upper Chewaucan Watershed Reach and Monitoring Locations. Refer to Appendix 3: Watershed Summaries - Habitat Elements.

a. Large Woody Debris (LWD):

Current conditions: Of the 89 reaches surveyed, 45 are within forested areas where LWD is expected. Of these forested reaches, 18% are ***functioning appropriately***, while 33% are ***functioning appropriately but-at-risk***. The remaining 49% are ***functioning inappropriately***. The majority of the forested reaches are B stream typesówith a few C and E typesóand occur in every subwatershed.

Factors contributing to current conditions: Past selective timber harvest and removal of in-stream LWD may be potential reasons for the low LWD numbers throughout the watershed. In addition, presettlement conditions occurring under frequent fire intervals cultured open, park like stands of ponderosa pine, potentially leaving future recruitment of LWD at lower levels than is described in the desired conditions listed in Chapter Three.

Recommendations: In the short-term, add LWD in reaches throughout the watershed, raising the numbers into the ***functioning appropriately*** category. Emphasis streams include Bear Creek, Dairy Creek, and Elder Creek. The long-term solution for LWD recruitment can be achieved by leaving buffers along forest reaches. Buffer widths are prescribed in the Oregon State Forest Practices Act for state and private lands and INFISH for National Forest lands.

b. Pools:

Current conditions: Of the 88 reaches surveyed where pools are expected, 83% are ***functioning appropriately*** for pool numbers, while 15% are ***functioning appropriately but-at-risk***. The remaining 2% are ***functioning inappropriately***. All reaches within Coffeepot Creek, Ben Young Creek, Dairy Creek, and Elder Creek are ***functioning appropriately***. The percent of surveyed reaches for the remaining streams that meet desired pool numbers include the following: Chewaucan River (91%), Bear Creek (86%), South Creek (73%), Morgan Creek (60%), Swamp Creek (29%).

Factors contributing to current conditions: Pool numbers reflect near natural numbers, for the most part, because stream channels and riparian vegetation are highly similar to desired conditions throughout the watershed. In other words, streams are lined with late-seral vegetation that contribute to appropriate stream types and width-to-depth ratios, factors which contribute to desired pool numbers.

Those reaches which are not functioning appropriately have pool numbers that are near the desired level. Most of these stream reaches are associated with riparian vegetation and stream types that are not at desired levels, where width-to-depth ratios are high. For example, most of the reaches on South and Morgan Creeks where pool numbers are low are associated with low bank stability and high width-to-depth ratios. As previously mentioned, the low pool numbers in Swamp Creek result from stream surveys being conducted during a period of relatively high stream flow, when a clear distinction between pools could not be determined. As seen in Appendix 1 - Swamp Creek Reach Summaries, seven of the eight reaches were functioning appropriately for riparian vegetation, while all reaches were functioning appropriately for stream types, supporting the assumption that a survey conducted during low stream flow would document higher pool numbers.

Recommendations: In the C stream types that occur in the large meadows along the lower reaches of South Creek, pool numbers can be increased with increased bank stability and decreased width-to-depth ratios. To accomplish this, grazing management which promotes the growth of late-seral vegetation will need to be maintained or promoted. Even though pool numbers are at desired numbers in the meadow reaches of the Chewaucan River, Dairy Creek, and Elder Creek, pool complexity and depth can increase with smaller width-to-depth ratios and increased bank stability, creating an abundance of undercut banks for fish cover. These same management concepts should apply to all c and E stream types throughout the watershed. Also, managing for beaver and their dams would increase deep pool habitat and cool water refugia.

In the B stream types, the addition of LWD will help create additional pool habitat. Large wood will also make pools more complex, increasing cover, depth, rearing habitat, cool water refugia, and winter habitat. For LWD to effectively create a pool, the added pieces must be within the bankfull dimensionsópreferably within the wetted channel. Consult with a hydrologist and fishery biologist when implementing these habitat improvement projects.

c. Spawning Gravel Fines:

Current conditions: Of the 19 reaches surveyed for spawning gravel fines, 58% are ***functioning appropriately***, while 21% are ***functioning appropriately but-at-risk***. The remaining 21% are ***functioning inappropriately***. Two of the eight streams surveyedóDairy Creek and Coffeepot Creekóare ***functioning appropriately*** at all monitoring sites.

Factors contributing to current conditions: In general, the low to moderate sediment values found are likely attributed to high bank stability, abundance of late-seral vegetation, and appropriate stream types. Even though roads may be contributing sediment into streams, the appropriate stream types can efficiently transport the sediment through the channel and capture it on the adjacent floodplain. This process would apply primarily to those areas where riparian vegetation and stream types are found to be functioning appropriately.

The high sediment values documented at some of the subwatershed streams are due to cumulative effects from sedimentation associated with the increased drainage network and bank instability. For example, the only site monitored on South Creek was functioning inappropriately and occurred below all tributaries (at Reach 2) at the lower end of the subwatershed. This subwatershed has the highest Road Impact Index, and the monitoring site is located downstream of areas with high bank instability. Conversely, Reach 8A is functioning appropriately and is high in the subwatershed, upstream of most roads and areas of bank instability.

Further, beaver are no longer a significant influence in watershed streams with few dams present to trap sediments. It is assumed that higher numbers of beaver dams would help reduce sediment levels in watershed spawning gravels.

Recommendations: Obliterate roads, emphasizing those within 300' of streams or those that have numerous stream crossings. The remaining roads should be properly drained to help reduce the amount of sediment reaching streams. Based on the Road Impact Index numbers listed in this chapter, the South Creek and Chewaucan River subwatersheds should receive priority when considering road obliteration projects. Implement recommendations in riparian vegetation section and Rosgen stream type sections. Place LWD where needed for additional bank stability and sediment storage. Manage for increased beaver colonies throughout the watershed to enhance sediment storage.

d. Stream Temperature:

Current conditions: Of the 89 reaches, 66 were rated for stream temperature. Of those reaches, 22% are ***functioning appropriately***, while 51% are ***functioning appropriately but-at-risk***. The remaining 26% are ***functioning inappropriately***. In general, Bear Creek has the lowest water temperatures throughout its length compared to other surveyed streams. The Chewaucan River and Coffeepot Creek, however, have relatively high water temperatures throughout their length.

Factors contributing to current conditions: For Bear Creek and other watershed reaches that are functioning appropriately, water temperatures may be near or at their potential because stream channels and riparian vegetation are near their desired condition. Most of the stream reaches that are not functioning appropriately occur in the lower meadow reaches of subwatershed streams. For instance, the lower reaches of South Creek which are functioning inappropriately have high width-to-depth ratios (wide and shallow channels), increasing the water surface area exposed to solar radiation. In addition, large willows are lacking along many of these meadow reaches, particularly along the large meadow areas of the Chewaucan River, South Creek, Dairy Creek, and Elder Creek. Because the Chewaucan River is a larger stream, willow will not have as much influence on shading as they do in smaller streams. Late season grazing is probably a major contributor to the lack of willow in these meadow environments. The relatively high stream temperatures throughout the Chewaucan River are attributed to its relatively warm tributaries and the open nature of the meadow environments in the upper reaches of the river. Because both Dairy and Elder Creeksóheadwater streams that join to create the Chewaucan Riveró exceed the State Water Quality Standard of 17.8∞C, the Chewaucan River exceeds this standard at its formation.

As discussed in previous subwatershed evaluations, many of the low-gradient reaches in the entire watershed have been affected by at least one factor influencing stream temperaturesówide stream channels, loss of riparian and upland shade, lower stream flows caused by increased evapotranspiration in the uplands, etc. With continued improvement in riparian and stream channel conditions, shading and a narrowing of stream channels should result in lower water temperatures. Even though it is assumed that stream temperatures were historically lower than they are today, it is highly questionable as to whether or not current state standards can be achieved in all streams.

Recommendations: The area which requires the most attention occurs in the large meadow where Dairy Creek and Elder Creek join to form the Chewaucan River and where South Creek enters a mile downstream. In addition, the meadow reaches of the Chewaucan River require management that will work towards a reduction in the width-to-depth ratiosóthis includes removing the large boulders in the C4 stream segments on National Forest lands.

Implement recommendations found in the riparian vegetation and Rosgen stream type sections of this chapter. These recommendations will promote late-seral vegetation that results in narrow stream channels and decreased surface areas exposed to solar radiation. In addition to implementing the recommendations described above, specific recommendations (i.e. shading levels) and management actions affecting stream temperatures will be addressed in the Upper Chewaucan Water Quality Management Plan to be completed in 2000/2001.

e. Fish Passage (Culvert).

Current conditions: Only two of the eight subwatershedsóElder Creek and Chewaucan Riveróare ***functioning appropriately***. (Note the culvert on Elder Creek on US Timberlands was not surveyed. If this culvert were a barrier, the subwatershed would be ***functioning appropriately but-at-risk*** or ***functioning inappropriately***). Four of the subwatersheds are ***functioning appropriately but-at-risk***óBear Creek, Coffeepot Creek, South Creek, and Dairy Creek. Ben Young Creek and Swamp Creek subwatersheds are ***functioning inappropriately***. It should be noted that additional culvert surveys might place more subwatersheds into the functioning inappropriately category.

Factors contributing to current conditions: In most cases, culverts are considered barriers because their slopes result in excessive water velocities (water velocities exceed maximum sustained swimming speeds).

Recommendations: Replace existing culverts with ones that allows for fish passage. Ensure that the correct size of culverts are installed at the proper location and slope by working with a hydrologist and engineer. Survey the remaining 567 road crossings in the subwatershed to determine if other barriers exist. Not all road crossings occur on fish-bearing streams.

4) How are the above subwatershed conditions influencing redband trout viability?

For this assessment, redband trout viability is used as an indicator for watershed health, being linked to upland, riparian, and channel conditions. If conditions are conducive to long term trout viability, then the watershed attributes that the Council is striving for should occur across the landscape. Those attributes include good water quality, high forage production, and good fish and wildlife habitat.

Under current conditions described in this document, six of the eight subwatersheds are functioning appropriately but-at-risk for the long term viability of redband trout populationsóBear Creek, Coffeepot Creek, Ben Young Creek, Swamp Creek, Dairy Creek, and Elder Creek. The remaining two subwatersheds, however, are functioning inappropriatelyóSouth Creek and Chewaucan River. Overall, the watershed receives a ***functioning appropriately but-at-risk*** rating for redband trout viability. Recognizing the connection between uplands, riparian areas, stream channels, and redband trout, the following reasons support this rating.

First, dense forest stands are a major reason why subwatersheds are functioning appropriately but-at-risk or functioning inappropriately. A large part of the watershedís forest canopies are dense, resulting from nearly 100 years of fire exclusion. Prior to 1903, the natural fire return interval was around 11 years, maintaining relatively open forest stands with little understory fuels to carry a fire from the ground to the canopy layers. In addition, once intensive timber harvest began in the 1950ís, old growth timber within these dense stands were usually removed through clearcutting because their wood production had slowed down. Clearcutting converted these slow growing stands into fast growing wood producing sites. This left the landscape in a matrix of dense and early-seral stands, leaving the dense canopies at high risk of catastrophic fire which could result in added sediment and altered flow regimes in watershed streams. If stands remain in their current condition, the question is not ìWill these dense forests burn?î but ìWhen will they burn?î

In addition, fire exclusion has allowed conifers to expand into meadows and other riparian areas, promoting competition with riparian plants (sedge, rush, willows, aspen, cottonwood, and alder) necessary to maintain bank stability and proper stream types. In addition, dense and vast juniper stands have become established throughout the landscape as a result of fire exclusion, especially in the Chewaucan River and Ben Young Creek subwatersheds. The woodlands have and are replacing numerous vegetation types, leaving the soils prone to erosion and contributing to reduced summer stream flows.

Next, the high road densities are a major reason why the watershed is functioning appropriately but-at-risk for redband trout viability. Starting with the creation of the Lakeview Federal Sustained Yield Unit in 1950, road construction intensified throughout the watershed to haul timber. Many of these roads paralleled and crossed stream channels. The resulting road network has increased flow intensity and the amount of sediment reaching stream channelsóflows that can prevent natural healing of unstable banks and sediment that can fill spawning gravels and pools.

Riparian conditions, both vegetation/bank stability and Rosgen stream types, support the functioning appropriately but-at-risk rating for redband trout viability throughout the watershed. Survey results documented that about 2/3 of the riparian vegetation and associated bank stability is functioning appropriately, suggesting that most current management practices promote late-seral vegetation required for bank stability. Further, the predominance of late-seral riparian vegetation in the watershed appears strongly correlated to the abundance (2/3) of Rosgen stream types that are functioning appropriately. As previously mentioned in this chapter, Rosgen B stream types are most abundant across the watershed and are anchored by alder, willow, sedge, and conifers. The abundance of E stream types throughout the watershed is directly tied to sedge, rush, and to a lesser degree, willow.

However, the increased drainage network and associated crossings in various subwatersheds appear to be affecting the ability of riparian areas to function appropriately. For instance, the road densities and crossings in the upper reaches of Morgan Creek appear to be leading to high intensity flows which scour and maintain a degraded channel on National Forest lands. Late season or season long cattle grazing along watershed streams, especially meadow areas dominated by Rosgen C and E stream types, have pushed riparian vegetation and associated bank stability along some stream reaches away from the functioning appropriately category. The increased flow intensities coming from the uplands may compound this meadow issue by scouring already weakened stream banks.

The predominance of late-seral riparian vegetation and appropriate stream types has led to high pool numbers throughout the watershed streams. Within the E and healthy C stream types, pools are complexórelatively deep with undercut banks. However, in the C stream types that lack willow and have high width-to-depth ratios, pools are lacking depth and undercut banks that provide fish cover. In the B stream types throughout the watershed, the lack of LWD limits pool complexity. Further, low wood numbers decrease the ability of watershed streams to capture and store sediment, especially in the event of a catastrophic fire, placing spawning habitat at risk of sedimentation.

An additional reason for placing redband trout viability in the functioning appropriately but-at-risk category is high stream temperatures in the mid to lower portion of the watershed. The Chewaucan River has relatively high temperatures throughout its length, along with other meadow streams in the mid to lower elevations, creating potential temperature stress for both juvenile and adult fish. High temperatures are resulting, in part, from higher than expected width-to-depth ratios (shade to a lesser degree), in the larger C stream channels.

Finally, culvert barriers exist throughout the watershed, inhibiting free movement of redband within and amongst subwatersheds, movement necessary for spawning, access to cool water refugia, and immigration from degraded to good habitat.

In conclusion, several assessment elements have good overall ratings and include the following: riparian vegetation/bank stability, Rosgen stream types, and pool numbers. However, the remaining elements need significant improvement to reach desired levelsóhigh canopy coverage in forested sites, dense juniper woodlands, moderate road densities, lack of LWD, moderate to high stream temperatures, moderate to high spawning gravel fines, and culvert barriers. The less than desired conditions of these elements inhibit the Upper Chewaucan River Watershed from functioning appropriately as a redband trout reserve. As a result, this assessment element is ***functioning appropriately but-at-risk***.

The Council intends to proceed from here by implementing the recommendations listed throughout this document, ones that focus on bringing each assessment element to desired levels, all of which will bring redband trout viability towards the functioning appropriate category. In doing so, the Council will move closer to achieving its goalócreating and working towards a healthy watershed for future generations.

figure 5.1

figure 5.2

figure 5.3

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