Roosevelt Elk

Roosevelt elk are a species of concern because it is believed that past clearcutting and forage seeding programs have resulted in abnormally high populations. Current downward trends in timber harvesting are expected to reduce future amounts of foraging habitat for elk. This may result in decreasing herd sizes and perhaps decreased health. It is also expected to cause elk to concentrate on private agricultural lands.

Historical Background

Roosevelt elk ranged from San Francisco to British Columbia and from the Pacific Ocean to the summit of the Cascades. Many fur trappers and settlers reported them as abundant within the river valleys and bottom lands of western Oregon (Bailey 1936) including the western slopes of the Cascades. In 1848, populations began declining due to market hunting for meat, hides and tallow to support human demands associated with the gold rush and settlement. Legislation was passed in 1872 to restrict hunting and selling of both elk and deer, between February to June, but was not strictly enforced. Beginning around the 1880s, many elk were killed solely for their tusks (upper canine teeth) which brought the seller anywhere from ten to twenty dollars per pair, a lot of money back in those days. The situation got so bad that market and tusk hunting were made illegal in 1899. In 1902, statewide hunting restrictions were implemented and the season was officially shut down in 1905.

In 1910, Forest Service officials reported Roosevelt elk as very scarce along the coastal forests and as "formerly abundant" on the Umpqua National Forest. By the mid-1920s, herd numbers were reported as increasing on the Umpqua National Forest, however, the statewide population was still very small (slightly more than 436 head). In the late 1920s, Rocky Mountain elk were being transplanted within western Oregon to increase herd numbers. Herd populations became high enough to convince the Oregon State Game Commission to reopen the hunting season in 1938.

Today, Oregon Department of Fish and Wildlife estimates the population of Roosevelt elk residing within the Umpqua National Forest to be approximately 5,800 head (Beiderbeck 1994). Because of various game laws designed to protect this animal, and areas set aside by the federal government for the protection of wildlife and their habitat, the Roosevelt elk has made a steady and significant comeback.

Within the watershed, local long-time residents recall that elk used to be scarce in Little River relative to today. Most of the elk sign seemed to occur in the higher elevations near Diamond Lake; these may have been part of a Rocky Mountain elk herd which was located near Crater Lake. During the 1960s and 70s, a large herd of Roosevelt elk were transplanted to this area from the Coast Range. Since this transplanting, elk numbers have steadily increased within the watershed.

Based on habitat conditions alone, between the late 1800s and 1930s larger than present day Roosevelt elk herds could have occurred within this watershed most likely inhabiting the valleys and foothills of the Lower Little River vicinity, the western two-thirds of Middle Little River and the lower and upper reaches of the Cavitt Creek vicinity. These herds may have used summer range located in the eastern third of the Emile Vicinity (Willow Flats), the western third of Black/Clover (Peter Paul Prairie) and the southern half of Upper Little River (Yellow Jacket Glade) vicinities (some of these may have been Rocky Mountain elk). The year round ranges are located on gentle slopes where fire (natural or aboriginal caused) provided good grass-forb forage (especially during winter months). Summer ranges contained more wet openings of smaller size providing good forage and wallows. The highest elk densities were probably along the Lower Little River valley, especially during the winter months, as habitat conditions seemed to be best in this area. Elk in higher elevation areas were seasonally migratory and likely moved west in November toward their winter ranges within the Umpqua Valley and open areas in between.

Faunal remains, of elk and "elk-sized" animals, found at two old Indian campsites located about 6 miles to the southeast and 30 miles to the northwest of the watershed provide evidence that elk were in this area. However, it is hard (if not impossible) to say at what herd size and densities they existed. It is believed that American Indians followed the migratorial patterns of big game from their upland to lowland haunts (Beckham and Minor 1992).

The settlement of the northwestern margins of the watershed (and the Umpqua Valley in general) by Euro-American settlers in the mid 1800's may have forced elk to leave their historic range and move east into the denser timber or perish as occurred in the Willamette Valley (Bailey, 1936). Human pressures in the late 1800s may have kept elk numbers lower than the actual habitat conditions could sustain.

Large predators, such as the gray wolf and cougar, may have some effect on elk populations (Hornocker 1970, Taber et al. 1982). This predator-prey relationship was unbalanced in the early 1900s, when grazing of sheep and cattle increased within the watershed. In the 1930s, over 3,000 head were being grazed in the watershed along Little River up to Hemlock Lake and further east to Limpy Prairie. During this time, the state took an aggressive approach to large predator eradication. One method of eradication was to lead old horses out into the forest, shoot them and then lace the carcasses with strychnine (Schloeman, pers. comm.). In addition, the state paid large bounties for wolf, cougar, bobcat and coyote pelts. An old time trapper by the name of Les Gardener trapped cougar and wolf in the late 1940s and early 1950s in the Little River watershed. His trapping records are still visible on one of the wooden posts at Fairy Shelter. According to this record, from 1947 to 1951 he trapped 8 cougar, 2 gray wolf, 13 bobcat and 7 coyote. Today, the gray wolf are no longer believed to exist within the Umpqua National Forest, however unconfirmed sightings are reported occasionally, even as recently as the winter of 1994. Cougar populations are increasing state wide (Oregon Department of Fish and Wildlife newsletter, *The Wild Times*, summer 1995).

Effects of Timber Harvesting

Within the Little River watershed, intensive timber harvesting through the use of clearcuts began in the early to mid 1940s and rapidly increased in the 1960s. Road construction increased greatly to allow access to timber. Some forage seeding and fertilization of roadsides and clearcuts occurred between 1959 and 1968 within Forest Service administered land. Overall, forage for elk (and deer) has increased from natural levels by 29,110 acres or over 700 percent.

Roosevelt elk are one of the less migratory subspecies of elk. They tend to reside year round within their established home ranges with some seasonal altitudinal movement. The average home range for Roosevelt elk in an unharvested forest is thought to be between 1,250 to 2,400 acres. In managed forests the average range was found to be around 740 acres. This decrease in home range size and increased carrying capacity of the habitat is probably due to the improved spacing of forage and cover resulting from staggered setting clearcuts.

Elk need cover to hide from predators (primarily people) and to regulate their body temperatures, allowing them to keep cool during the summer and warmer in the winter. This energy conservation increases their overall health and productivity. In areas that have had extensive tree cover through time, elk have been shown to avoid good foraging areas that are too far from cover (usually over 600 feet from an edge). Openings of about 20 acres in spruce/fir forests were found to be the maximum opening to be fully utilized by elk in Arizona (Reynolds, 1962). Clearcutting of large tracks of timber without providing a well distributed component of cover will limit elk use of the available forage habitat. This is especially true with increased numbers of open roads which allow human access and increase harassment and decrease escapement.

The current amount of open roads within the watershed limit the ability of elk to hide and fully utilize the existing forage habitat. Road densities greater than two miles of road per square mile can reduce elk use potential by as much as 50 percent (Christensen et al. 1993). Roads also decrease bull elk survival during hunting seasons. Two studies in Idaho indicate that increasing road densities from less than 1 mi/mi^2 to around 4 mi/mi^2 can double bull mortality rates.

Elk prefer to stay at least 0.5 miles from human disturbances such as timber harvesting operations (Lyon and Ward 1982), but will only move as far as needed to stay out of sight. Elk will become accustomed to the presence of humans and their machines in areas where they are protected from hunting (as evident in national parks, game reserves or private lands) and are commonly seen in openings. However, in areas where hunting occurs (including illegal poaching), such as on federally managed lands, they become more wary and will avoid open areas next to roads. There are approximately 961 miles of road within the Little River watershed for an overall road density of 4.7 mi/mi^2.

Current Conditions and Trends

The Little River watershed is located within the northern portion of the State's Dixon Big Game Management Unit. Elk herd counts for this unit peaked at 890 in 1991 and were recorded as 733 total head in 1995. However, aerial counts have not focused on this watershed (Mike Black, personal communication). Bull:cow ratios for the northern portion of the Dixon unit peaked at 14.3:100 in 1993 and were 6.8:100 in 1995. The current calf:cow ratio is 20:100, in 1991 the ratio was at its highest recorded level at 45:100. The Oregon Department of Fish and Wildlife's long term plans for this area (Elk Management Plan, July 1992) are to maintain the bull:cow ratio at 10:100 (the average over the last three years has been 10:100 for this unit).

The goal of Oregon's Department of Fish and Wildlife (ODFW) is to protect, maintain and restore elk habitat throughout Oregon (Elk Management Plan, July 1992). To prioritize this work, the focus will be on improving elk habitat effectiveness by maintaining adequate cover, forage and encouraging effective road management programs. To help estimate past and current habitat conditions and predict future trends, a habitat effectiveness model was used to describe habitat conditions for the late 1930s and today (Table 20).

Table 20. Elk habitat effectiveness model results (Wisdom et al. 1986) for reference conditions of the late 1930s compared to conditions for today by vicinity. An index value of 0.3 indicates marginal habitat whereas a value of 1.0 indicates optimal elk habitat.

Vicinity	**Spacing Index**		**Roads Index**		**Cover Index**		**Forage Index**		**Total Index**	
	Late 1930's	*Today*	*Late 1930's*	*Today*	*Late 1930's*	*Today*	*Late 1930's*	*Today*	*Late 1930's*	*Today*
Lower Little River	0.4	0.8	0.7	0.3	0.5	0.4	0.7	0.7	**0.6**	**0.5**
Cavitt Creek	0.6	0.9	0.9	0.3	0.6	0.4	0.8	0.5	**0.7**	**0.5**
Middle Little River	0.6	0.9	1.0	0.3	0.7	0.5	0.8	0.5	**0.8**	**0.5**
Wolf Plateau	0.4	0.9	1.0	0.3	0.8	0.4	0.8	0.5	**0.7**	**0.5**
Emile Creek	0.8	0.9	1.0	0.4	0.6	0.5	0.8	0.5	**0.8**	**0.5**
Black/Clover	0.7	0.8	1.0	0.4	0.6	0.6	0.8	0.5	**0.8**	**0.6**
Upper Little River	0.8	0.8	1.0	0.4	0.9	0.6	0.8	0.5	**0.8**	**0.6**

The results of the habitat effectiveness model show that since the late 1930s overall habitat effectiveness has decreased from highly viable to viable. Timber harvesting has improved the spacing and distribution of forage and cover but has decreased the effectiveness of the remaining cover. Although the amount of forage habitat has increased in all vicinities, the quality of forage has gone down (using the assumptions of the model) causing a decrease in the forage index. Roads have increased by many miles, which reduces overall habitat effectiveness. ODFW would like to improve habitat effectiveness for roads by 15 percent on public lands in the Dixon unit by 1997 (Elk Management Plan, July 1992).

The results of this model indicate that habitat effectiveness for elk was more viable in the 1930s than today despite the increase in forage habitat. This implies that elk numbers should have been higher back then. However, as mentioned before, local residents recall few elk within the watershed.

One possibility for the lower numbers of elk during the middle part of this century could be that elk were in the slow process of making a comeback from the impacts of unregulated harvest and market hunting as previously discussed, and that their numbers were still fewer than the habitat conditions in the late 1930s warranted. An abundance of good habitat and small herd numbers may help explain their rapid increase from an estimated 436 head for Western Oregon back in 1926 to over 5,000 head on just the Umpqua National Forest today (transplanting helped).

There is also the possibility that the model has not adequately assessed habitat conditions. Although this model was tested against twenty-five experts in elk ecology and shown to correlate strongly with expert opinion on habitat effectiveness, when cover:forage ratios exceed 80:20 or fall below 20:80, the model output is less reliable (Holthausen et al. 1994). In most vicinities for the reference periods, cover to forage ratios were at or above the 80:20 level.

Regardless of the reason, elk numbers have increased noticeably within the watershed (mainly Cavitt Creek and Lower Little River vicinities), especially since the early 1980s. Because the Cavitt Creek and Lower Little River vicinities have higher densities of people and agriculture land, animal damage complaints from residents have increased. Most of these residents live within the area of the watershed where private tracts of timber lands occur. Much of this land has been previously clearcut and is within open and closed pole conditions (hiding and thermal cover). Because of short rotations on private lands, it is reasonable to assume that harvest will occur within the next 10 years for many of the private lands within the watershed. With this in mind, elk populations within the western portions of the watershed will probably maintain their numbers and likely increase over the next 10 years. Animal damage complaints on private lands may increase.

Deer

There are two species of deer within the watershed. The Columbian white-tailed which occurs only in the northwestern tip of the Little River watershed and the Columbian black-tailed which occurs throughout the entire watershed. These two species are of concern for much the same reasons as for elk. In addition, the white-tailed is on the Federal endangered species list. However, the following discussion focuses on the black-tailed as it is the most populous of the two within the watershed and the white-tailed is only found mainly on private land in Little River.

Historical Background

The range of the black-tailed deer in Oregon extends from the timbered base of the eastern slopes of the Cascades, westward to the Pacific Ocean.

Deer have always been abundant in the state. However, they too were market hunted in the late 19th century. Numbers rebounded quickly and in 1916, an estimated 2,000 deer were harvested in Douglas county. In 1929, the population on the Umpqua National Forest was estimated to be 4,350. The population decreased to an estimated 2,900 by 1933 (Bailey 1936).

Within the watershed, local residents recall deer as being abundant until two severe winters in the 1930s caused a large reduction in their numbers (Donald Wright, personal communication). One local resident said that deer were less abundant prior to intensive timber harvesting than today. Although less abundant, they were concentrated around natural open areas or recent burned patches and less wary of humans, allowing for a higher hunting success.

Although Bailey (1936) describes the black-tailed deer as "timber-loving deer that hide in the thickest parts of the forest", it has much the same habitat preferences as elk. Overall, deer populations in the watershed are thought to be higher than elk populations.

Effects of Timber Harvesting

Effects of timber harvest are much the same as described for elk. Although black-tailed deer prefer dense forests, they do take advantage of the forage provided by clearcuts. They also seem to utilize these harvested stands for a longer period than elk and deer sign can be seen in several of the open and closed pole stands throughout the watershed.

Current Conditions and Trends

Deer are more abundant than elk in the Little River watershed and populations are thought to be higher today than historically. However, increasing elk populations seem to be causing declines in deer populations in the higher elevations (Terry Farrell, personal communication). Similar occurrences of this phenomenon have been documented in areas where forage is limited such as on winter range used by both animals (Cliff 1939, Cowan 1947). Deer populations are considered stable in the lower elevations (Terry Farrel, personal communication).

Marten

The marten is a species of concern because it is a candidate for the Regional Forester's sensitive species by the U.S. Forest Service, is a BLM assessment species, and also a candidate for listing as threatened or endangered by the state of Oregon. The marten has a wide range, extending from Alaska to New Mexico. Historically, in Oregon it was found mainly above 5,000 feet in elevation in the southern Cascades and at lower elevations within the Coast Range (Bailey 1936).

Historical Background

In 1936, this animal was considered to be generally scarce in Oregon, however, some patchy high densities occurred throughout the state. Trapping records show that 22 marten were trapped in Douglas county in 1914. Recently, a total of 14 were trapped in this county during a six year period, from 1987 to 1993.

In the watershed, one local long time resident recalls seeing a pair of martens in upper Cavitt Creek (1,400 feet in elevation) in the middle part of this century (Jack Schloeman, personal communication). Two other sightings were documented within, or adjacent to, the watershed in 1989. One occurred near Hemlock Lake (4,200 ft. elev.) and the other on top of Panther Ridge (3,700 ft.). A recent monitoring effort being conducted by the Oregon Department of Fish and Wildlife has documented marten occurrence in higher elevations (5,000 ft.) east of the Little River watershed. Over the last three years, monitoring for species in the weasel family (including marten) within the watershed has failed to produce evidence of their occurrence here.

Effects of Timber Harvesting

Marten are described as "creatures of the wilderness", or as preferring dense coniferous forests. They prefer the western hemlock and silver fir communities within the Cascades. Within these communities, they are highly selective for old-growth habitat with high levels of dead and down woody material and low ground cover. The down wood provides them with good hiding and thermal cover, den sites, and also creates cavities under the snow where marten can forage during the winter months (Ruggerio et al. 1994).

Martens travel mainly through upland areas and ridge tops. They will only travel along closed canopy corridors and seldom venture more than 75 feet from the forest edge. Because of this, marten are very sensitive to clearcutting and forest fragmentation. Clearcutting also removes habitat needed by some of their main prey species, such as the red-backed vole and the Douglas squirrel.

Populations of marten will decline for several decades after a landscape is heavily clearcut. However, they can return as the forest grows back if healthy populations occur in adjacent areas. In the late 1800s and early 1900s, forest loss to logging and agriculture in the north central United States extirpated marten in that region. By the 1930s, marten were beginning to expand their range back into the area as the forest began to grow back. One study of Eurasian marten suggests that marten populations can be maintained and even increased in forests where only small patches are cut and at least 45 percent of the forest is left intact (Brainerd 1990).

Current Conditions and Trends

Marten populations probably extended into the lower elevations of the Little River watershed during the reference period. Based on home range size, an estimated 20 to 25 marten could have existed in the watershed during the reference period. The areas that had the highest potential for marten would have been the moist/cool, moist/warm, and wet-dry/warm land units of the Western Cascades, because these areas had the most old-growth habitat with large amounts of down wood and low ground cover. The area around Idiot slide has very large amounts of downed wood because of the earth movement occurring there and marten may have occurred in that area.

Today, the amount of marten habitat has declined well below historic levels. Interior forest habitat and closed canopy travel corridors are highly fragmented, especially along ridges, and the extensive road system creates further fragmentation of these corridors, while increasing human presence in the forest. Based on current conditions, an estimated four to six marten may occur within the watershed. However, it is highly likely that the historical population of marten within the watershed has been mostly extirpated, with a few individuals still remaining in the eastern margins of the watershed within the higher elevations.

Band-tailed Pigeon

Historical background

The band-tailed pigeon is a neotropical migrant that utilizes forested habitat along the Pacific Coast from southern British Columbia to northern Baja California. Band-tailed pigeons inhabit all of the national forests on the west side of the Cascade Mountains in Oregon and Washington. They have been observed feeding and roosting throughout the Little River watershed with higher concentrations observed in the Cavitt Creek drainage. Early May migrants have been observed feeding on hemlock seed cones at 4,000 feet elevation near Lookout Mountain. These high elevation conifer stands may provide suitable nesting habitat.

Band-tails, which breed in Oregon and Washington, winter in California with the exception of a few small resident populations. The primary flyway passes through southern Oregon just east of Roseburg, then divides off, with one route continuing along the California coast, and the other moving east and following the Sierra Nevadas.

Band-tailed pigeons were once very abundant throughout their entire range. Market hunting in the decades before and immediately after 1900 drastically depleted the population. The slaughter of band-tails during this period prompted the federal government to close hunting from 1913 to 1932. The Oregon season remained closed from 1932 to 1947, but has been open since.

Band-tailed populations breeding in Oregon have experienced brief periods of increase and more dramatic periods of decline based on population studies from 1950 to 1988. However, even at the highest population peak in the early 1980s, their numbers were well below the long term average. Band-tailed pigeon populations are now at their lowest level since monitoring began in 1950.

Effects of Timber Harvesting

Surprising little is known about the habitat needs of band-tailed pigeons and about the habitats they utilize. Recent telemetry studies have indicated their preferred nesting and roosting habitat consists of conifer stands (Douglas-fir) in the closed pole seral stage. Closed pole stands with mixed hardwoods, especially oak, also provide nesting habitat. During breeding season, males require a tree which rises above the canopy for a "cooing perch". Display flights are initiated from these trees.

Harvest prescriptions favoring retention of large trees scattered across the unit are preferable when near band-tailed habitat. Conifer release prescriptions in closed pole stands may have a negative effect on band-tailed habitat if the canopy is reduced below 70 percent crown closure.

Band-tailed pigeons require minimal water for physiological reasons during early fall. They will congregate in mass near these traditional mineral sites. The disturbance generated through timber harvest activities of traditional congregating spots such as mineral springs, watering sites, and roost areas will affect an element of habitat that is critical to a large number of band-tails. Four out of five known mineral sites within the watershed have been impacted directly through clearcut harvesting.

In Oregon, band-tailed pigeons feed extensively on berries. They are highly mobile and will travel long distances (up to 12 miles) between roost and feeding grounds. The primary food from June to September is red or blue elderberries and cascara berries. Cascara is found below 1,000 feet elevation in the Little River watershed, which limits the species range to below the Cavitt Creek drainage. Observed concentrations of band-tailed pigeons in the lower Cavitt Creek drainage are feeding exclusively on cascara berries. Band-tails have been observed feeding on the fruit of Pacific madrone trees in a mixed closed pole conifer/madrone stand in the Cavitt Creek drainage.

The abundance of shrubs with berries is probably increased by timber harvesting. Foraging habitat has been enhanced by planting elderberry in existing openings and recent harvest areas.

Current Conditions and Trends

The causes of the population decline in band-tailed pigeons is largely conjectural. As a neotropical migrant, the environmental factors affecting the band-tailed pigeon population far exceed the boundaries of the Little River watershed. Forest environments in the Northwest have undergone major changes in the past century and the suitability of current forests for band-tailed pigeons is little known. Management efforts will hopefully become more effective as specific and quantitative information on the habitat needs of the band-tailed pigeon becomes available.

Threatened, Endangered and Sensitive Species

There are 34 species that occur or are likely to occur within the watershed that are listed as threatened, endangered or are otherwise considered to be sensitive to management activities. A summary of all species which are listed by Federal, State, Oregon Natural Heritage Program, and Forest Service are shown in Table 21 at the end of this chapter. The following discussions address some of these species in more detail.

Northern Spotted Owl

This well known medium-sized owl is one of three subspecies which occur over the continent of North America. The northern spotted owl (*Strix occidentalis caurina*) ranges from British Columbia to northern California. There are currently approximately 5,608 pairs or resident singles over the entire range of this bird.

Historical background

Intensive research began on this owl in 1969. Up until that point in time it was considered to be a rare or uncommon species in Oregon (Forsman 1984). Surveys began in this area in the late 1970's. Intensive surveys for timber sale planning began in 1989.

Effects of Timber Harvesting

This bird requires structures commonly found in old growth habitat to nest in, such as large, broken top trees and snags. Historically (during the reference period) optimal nesting habitat covered the majority of the area (see Figure 12 of Appendix E). As discussed earlier in this chapter, through time certain areas within the watershed were less susceptible to fires and had good growing conditions (refer to Figures 14 and 15 in this chapter). In these areas, it is highly likely that old growth conditions were common and sustained for longer periods. This is supported by data collected by Forsman (1984) which shows that owls preferred to nest in areas with these qualities. Most of these areas are delineated in Figure 44 of Chapter 6, with the exception of Red Pond and Shivigny Mountain. It is within these delineated areas that the "best" owl habitat most likely occurred through time.

Timber harvesting has effected the owl in at least two ways. First, the removal of any late seral habitat which contains nesting habitat structure impacts the owl. The amount of late seral within the watershed has decreased by as much as 50 percent over the last 4-5 decades. This decrease in late seral habitat has likely caused crowding of owls into the suitable nesting habitat remaining.

Secondly, the late seral habitat within the gentle and moist areas was the most heavily harvested because of the large tree sizes and easy access. Most of the late seral left is located in areas that may have seldom naturally developed classical old growth characteristics (as discussed previously in this chapter). This implies that as owl nesting habitat was removed through harvest, owls shifted their territories to encompass what was left over, or the late seral in the steeper, drier, warmer areas. Figure 12 of Appendix E shows the reference range and current conditions for the "most" suitable nesting habitat. Table 14 of Appendix E defines what "most" suitable nesting habitat is for the owl. Essentially, Figure 12 depicts owl habitat that is above the "take" limitations defined by the U.S. Fish and Wildlife Service for this species. Note that in this figure, the remaining suitable habitat within the western 2/3 of the watershed is located in areas that lacked suitable habitat during the reference period.

Most owl activity centers or nest sites are located in small, isolated pockets of old-growth conifers located within this late seral habitat (dominantly mature conifer). In a very few instances, owl activity centers are located in stands that are in the later stages of thinning and entering the maturation stage, but contain a few remnant old growth trees or snags.

Current Conditions and Trends

Currently, there are 37 spotted owl pairs and 2 resident singles which occupy 40 spotted owl activity centers located within the watershed. There are 3 pairs outside of but within 0.5 miles of the watershed boundary. Each of these owl pairs (or resident single) is protected by approximately 100 acres of suitable nesting, roosting and foraging habitat around their primary activity centers or nest trees as required (ROD, C-3,10,11). These designated core areas are to be managed as Late Successional Reserves. They cover a total of 4,190 acres within the watershed.

Region-wide, there are indications that the northern spotted owl population is declining across it range (Burnham et al. 1994) and in smaller localized areas (North Fork Siuslaw watershed analysis, 1995). Within this watershed there is some indication that owl populations are declining also. Since 1985, the number of owl pairs located on BLM lands has decreased by approximately 67 percent from a historic 9 pair to 3 pair (confirmed this year) (Nancy Duncan, personal communication). These remaining owls seem to compensate for the lack in habitat by expanding their territories (Duncan, personal communication) and by using alternate core areas. No demographic information is available for owls located on National Forest System public lands and intensive owl surveys on those lands last occurred in 1992.

There is a total of 43,663 acres of nesting, roosting and foraging habitat in the watershed, almost all (>98%) of which is on federally managed public land. Of this, 35,770 acres is above the "take" limit (greater than 40 percent of a 1.2 mile radius circle contains late seral). The remaining 7,893 acres is scattered in small, isolated patches, mostly in the western half of the watershed. There are 14 owl activity centers and owl cores located within this poorer quality habitat. It is also in this area that owl populations seem to be declining.

Approximately 50 percent of the watershed is covered by dispersal habitat. Figure 17 of Appendix E shows the results of a dispersal habitat analysis (50-11-40). Approximately 65 percent of the watershed is greater than four miles from the adjacent Late Successional Reserve (LSR). The status of dispersal habitat between this portion and the LSR is above the 50-11-40 standards. The areas below dispersal standards contain over 95 percent of the owls that have home ranges below the "take" standards.

One third (43,497 acres) of the watershed is currently designated as critical habitat for the northern spotted owl. All of this lies on public lands managed by the U.S. Forest Service. This area was designated by the U.S. Fish and Wildlife Service in 1992 and is part of a region wide system of critical habitat covering 6.9 million acres. Since this designation, the development of the Northwest Forest Plan has occurred and is being implemented (in part through this analysis). This plan was based on work of the Interagency Scientific Committee (ISC) findings and incorporates recommendations from the spotted owl recovery team. The plan established a network of Late Successional Reserves which generally overlap with designated critical habitat (except for this case). The network of Late Successional Reserves covers a total of 7.4 million acres across this region. Riparian reserves, owl cores, wilderness areas an other unmapped reserves add to the overall protection provided to the owl by the Late Successional Reserves. Currently, there has been some discussion about how to address the issue of designated critical habitat in light of the Northwest Forest Plan. However, management actions will still need to be consulted on for projects within current designated critical habitat.

Great Gray Owl

The largest of the North American owls, this animal occurs both in North America and Eurasia. In North America, it occurs from Alaska south to the Sierra Nevada mountains of northern California and east into Ontario, Canada.

Historical Background

Not much is known about this secretive owl within the state of Oregon. Although historical records of this owl exist for the Willamette Valley, it was believed that it primarily occurred in northeastern Oregon and the south-central portion of the Cascade Mountains (Platt and Goggins, 1991). In 1990, a nest was discovered on the west side of the Cascades on the Willamette National Forest. In 1991, two more nests were found as a result of intensive surveys conducted by the Oregon Department of Fish and Wildlife and the Willamette National Forest (Platt and Goggins, 1991).

Since a breeding population has now been documented in a westside forest, an emphasis has been placed on surveying for and protecting this species (ROD, C-21). A survey protocol has been established by the Regional Interagency Executive Committee (RIEC) which requires Federal agencies to begin surveys within the habitat of this owl in 1996. Figure 15 of Appendix E depicts the reference range for suitable nesting habitat for this owl as well as current habitat conditions.

Effects of Timber Harvesting

This owl nests in late seral habitat that is intermingled with open areas that it needs to forage in. Historically, these open areas were natural meadows. The nest usually occurs in abandoned raptor nests (goshawk, red-tailed hawk) in large conifers, snags or broken-top trees. Removal of large conifers through timber harvesting removes nesting structure for the owl. However, timber harvest also creates open areas for foraging. There is some speculation that recent clear cutting has allowed this owl to expand its range into the western slopes of the Cascades by providing a better mix of late seral with openings. Historically, within the watershed, there were large expanses of contiguous, closed canopy late seral forest (refer to Figures 14 and 15 of this chapter). Today, there is much more edge and open areas surrounding late seral habitat. There are indications/speculation that some level of harvesting may benefit this owl however, too much removal of late seral habitat will remove suitable nesting habitats.

Figure 15 of Appendix E shows that the reference range for nesting habitat ranged from 16,553 to 22,498 acres. Today we are still within this range (19,041). However, over 12,000 of this suitable habitat is attributed to clear cutting.

Current Conditions and Trends

Currently, there are no known nests in this watershed. There are two suspected nest groves on the North Umpqua Ranger District. The nearest one is immediately adjacent to the border of this watershed near Panther Ridge. At this site, vocal responses were noted in 1992 and 1994. It is likely that there is a nesting owl pair in this location. The other site is located approximately 6 miles to the east of the watershed. A great gray owl was seen at this location in 1993.

Two other sightings (one visual and one vocal) have been recorded within the North Umpqua Ranger District over the last three years. There is also one documented site south of the watershed in the Jackson Creek watershed (Jackson Creek Watershed Analysis, 1995). One possible vocal detection was documented within the watershed near Wold Creek this year (1995) during great gray owl surveys. These surveys did not meet protocol standards and guidelines. It is highly likely that great gray owls may occur within the eastern margins of this watershed.

Wolverine

The largest member of the weasel family, this animal occurs both in North America and Eurasia. It is considered to be a creature of the "northern wilderness and remote mountain ranges" (Ruggerio et al. 1994).

Historical Background

In 1936, this animal was considered to be rare in the United States (Bailey 1936). It is a wide ranging animal with large home ranges recorded from 73-666 km^2 in North America (Banci et al.

1994). There are several sightings of this animal on record for the state of Oregon. Over 60 percent of these occurred between 1913 and 1980. Twenty-three sightings were documented between 1981 and 1992 (Ruggerio et al. 1994). One observation has been documented within the watershed in 1984.

Although not much is recorded about this animal, it is highly likely that wolverine populations in Oregon were heavily impacted by extensive predator eradication (wolf) programs such as the one mentioned previously in this chapter. This is because wolverines, although omnivorous, are largely scavengers (especially during winter months) which depend on other predators (such as wolves and cougars) to provide carrion (Ruggerio et al. 1994). In fact, all studies of this animal have shown the "paramount" importance of large mammal carrion, and the availability of large mammals to this animals distribution (Ruggerio et al. 1994).

Effects of Timber Harvesting

Little is known about the effects timber harvesting has on this creature. In some places, the wolverine does not show a preference for mid or late seral forest habitat. In general, it seems that wolverines prefer landscapes with high levels of habitat diversity and an abundance of large predators and large mammals (primarily ungulates such as deer and elk). There is some indication that rock outcrops provide a preferred habitat component.

Timber harvesting activities, such as road building, increase human presence within the historic range of this animal. The wolverine seems to avoid areas that are highly fragmented by activities that involve frequent human caused disturbances (timber harvest, mining, settlement, etc.). Predator control practices may also adversely effect this animal.

Current Conditions and Trends

This animal probably occurred in the watershed historically. It is possible that it still may occur within the watershed but in light of current conditions it is unlikely that the watershed is more than a dispersal area or outlying part of a larger home range.

Fisher

This medium-sized member of the weasel family is a larger cousin to the marten. Unlike the marten, the fisher occurs only within the North American continent.

Historical Background

Prior to European settlement, the fisher occurred throughout most of the northern forests of North America and south along the Appalachian and Pacific Coast mountain ranges (Ruggerio et al. 1994). As a result of trapping and habitat removal, by 1940, fisher populations had greatly declined throughout the United States and in some areas extirpations occurred.

Only a few trapping records exist for this animal from Douglas County. No sightings have been documented in the watershed. The nearest documented sighting is located about 16 miles to the southeast (see Figure 18 of Appendix E).

Effects of Timber Harvesting

The fisher has much the same habitat preferences as the marten. Figure 13 of Appendix E depicts potential fisher habitat conditions. The main difference in habitat preference between the marten and fisher is that the fisher occurs primarily in mid to lower elevations (<3,200 feet elev.). It seems to avoid areas with heavy snowfall and accumulation. Fisher are thought to be more associated with larger riparian areas. Because of this reason, impacts from timber harvesting are probably more severe for the fisher than for the marten. This is because more harvesting has occurred in the lower elevations than in higher elevations. The same is true for the lower riparian areas which were also settled and converted into agricultural lands and rural housing developments. For further information on timber harvest effects, refer to the effects summarized in the marten discussion.

Current Conditions and Trends

Efforts are ongoing to document the occurrence of fisher in this area (Appendix E). It is likely that this animal has been extirpated from this watershed.

Red Tree Vole

This animal is rated as the most vulnerable of the six species of arboreal rodents (which occur in this area) to local extirpations from loss or fragmentation of habitat (Huff et al. 1992). It is also designated as a "survey and manage" species (ROD, Table C-3).

Historical Background

Due to the difficulty in trapping this animal, not much is known about it. There is one documented occurrence within the DEMO study units at Willow Flats. Other studies have documented the occurrence of this animal within the Umpqua National Forest (Gilbert and Allwine 1991).

Effects of Timber Harvesting

This animals seems to prefer late seral habitat having Douglas-fir in the canopy. Douglas-fir needles are the primary food source of the vole, but other conifer needles are also eaten (Huff et al. 1992). Large conifers with large crowns seem to be the preferred nesting habitat.

It is believed that the voles meet their water intake requirements from moisture condensation on conifer needles. For this reason, suitable habitat occurs primarily in areas with high levels of moisture such as the moister land units and lower riparian areas within the fog belts. Red tree vole avoid dry environments (Huff et al. 1992).

Timber harvesting has effected the vole much in the same way it has effected the spotted owl. The "best" vole habitat was harvested because of where it occurred. Effects on the vole are probably more severe because it's dispersal capabilities are much less than that of the owl.

Figure 14 and Table 14 of Appendix E show and describe the optimal habitat conditions for this animal. There has been less of a shift from moist to dry environments than for the spotted owl, but the decrease in acreage and isolation of remaining habitat is much greater for the vole.

Current Conditions and Trends

Efforts are ongoing to document the occurrence of the red tree vole in this area (Appendix E). This animal is known to utilize younger-aged, mid seral forests but the current data indicates a strong preference for late seral.

Bald Eagle

There have been no historical documentation of bald eagles nesting within the watershed. There have been occasional sightings, mostly in the winter months along the rivers. Local, long time residents do not recall many sightings of this bird. A few individuals may stop and forage during winter months.

Western Pond Turtle

Western pond turtles have been documented within this watershed. The majority of these sightings occur in the lower reaches of Cavitt Creek and Little River. Local residents recall turtles as being abundant within these areas. They were often seen basking on the historically large numbers of large wood within the stream/river channels (Jack Schloeman, personal communication). There have been unconfirmed sightings in ponds in the higher elevations up around Willow Flats.

Amphibians

A herpetological survey is currently being conducted along selected lower, middle, and upper stream reaches to document the occurrence, distribution and habitat preference of riparian amphibians. Results are pending but initial results show that at least one new species has been found to occur within the watershed, the southern seep salamander.

Bullfrogs (a non-native species) occur in many of the ponds and lakes within the watershed. This species was introduced by man and is expanding its range. Stomach contents of seventeen bullfrogs from Red Pond indicate that the frogs do prey on native amphibian species. Bullfrogs have also been documented to prey upon western pond turtle hatchlings (Terry Farrell, personal communication).

Peregrine Falcon

There are over a dozen rock outcrops that have a high to moderate potential for falcon use. Most of these rocks are mapped in GIS, efforts are underway to continue mapping, rating and surveys for falcon use. To date, only one known flacon eyrie exists within the watershed. There have been a few sightings at other locations within the watershed. A management plan is being formulated for the one known site by the Bureau of Land Management (Nancy Duncan, personal communication).

Northern Goshawk

There is currently one documented nest site within the watershed. Several sightings have been noted in previous years. There is approximately 10,000 acres of suitable nesting habitat within the watershed.

Table 21. Listing status and occurrence of sensitive wildlife within the Little River watershed.

CLASS	COMMON NAME	SCIENTIFIC NAME	Listing Status				Occurrence in Wshed	
			FED	STAT	ONHP	USFS	Suspected	Documented
Amphibian	Clouded salamander	*Aneides ferreus*	-	U	3	-		●
Amphibian	Tailed frog	*Ascaphus truei*	-	V	3	-		●
Amphibian	Western toad	*Bufo boreus*	-	V	3	-	●	
Amphibian	Red-legged frog	*Rana aurora*	C2	U	4	S		●
Amphibian	Yellow-legged frog	*Rana boylei*	C2	V	3	-		●
Amphibian	Cascade frog	*Rana cascadae*	C2	V	3	-		●
Amphibian	Southern seep salamander	*Rhyacotriton variegatus*	-	V	3	-		●
Bird	Northern goshawk	*Accipiter gentilis*	C2	C	3	S		●
Bird	Bufflehead	*Bucephala albeola*	-	P	2	-		●
Bird	Barrow's goldeneye	*Bucephala islandica*	-	P	4	-	●	
Bird	Pileated woodpecker	*Dryocopus pileatus*	-	V	4	S		●
Bird	Peregrine falcon	*Falco peregrinus anatum*	E	E	1	S		●
Bird	Common loon	*Gavia immer*	-	-	2	-	●	
Bird	Northern pygmy owl	*Glaucidium gnoma*	-	U	3	-		●
Bird	Bald eagle	*Haliaeetus leucocephalus*	T	T	1	S		●
Bird	Harlequin duck	*Histrionicus histrionicus*	C2	P	2	S	●	
Bird	Acorn woodpecker	*Melanerpes formicivorus*	-	U	3	-		●
Bird	Mountain quail	*Oreortyx picta*	C2	-	4	-	●	
Bird	Black-backed woodpecker	*Picoides arcticus*	-	C	4	-	●	
Bird	Purple martin	*Progne subis*	-	C	3	-	●	
Bird	Western bluebird	*Sialia mexicana*	-	V	4	-	●	
Bird	Great gray owl	*Strix nebulosa*	-	V	4	S	●	
Bird	Northern spotted owl	*Strix occidentalis caurina*	T	T	1	S		●
Mammal	Pacific pallid bat	*Antrozous pallidus pacificus*	-	V	3	-		●
Mammal	Ringtail	*Bassariscus astutus*	-	U	3	-		●
Mammal	California wolverine	*Gulo gulo luteus*	C2	T	2	S		●
Mammal	Marten	*Martes americana*	C2	C	3	-		●
Mammal	Fisher	*Martes pennanti pacifica*	C2	C	2	S	●	
Mammal	Columbian white-tailed deer	*Odocoileus virginianus leucurus*	E	E	1	-		●
Mammal	Townsend's big-eared bat	*Plecotus townsendii townsendii*	C2	C	2	S		●
Reptile	Northwestern pond turtle	*Clemmys marmorata marmorata*	C2	C	2	S		●
Reptile	Sharptail snake	*Contia tenuis*	-	V	4	-		●
Reptile	Common kingsnake	*Lampropeltis getula*	-	V	3	S	●	
Reptile	California mountain	*Lampropeltis zonata*	-	P	3	S	●	

STATUS DEFINITIONS

FEDERAL

Endangered (E) ----- Any species in danger of extinction throughout all or a significant portion of its range.
Threatened (T) ------ Any species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
Proposed (PE/PT) -- Species proposed by the USFWS to be listed as endangered or threatened.
Category 1 (C1) ----- Candidate; Taxa for which the USFWS has sufficient information to support a proposal to list as threatened or endangered.
Category 2 (C2) ----- Candidate; Taxa for which additional information (further research) is needed to be able to propose the species as threatened or endangered.
Category 3 (3A) ----- Taxa for which the USFWS has persuasive evidence of extinction.
Category 3 (3B) ----- Taxa which do not meet the USFWS definition of a species.
Category 3 (3C) ----- Taxa which have proven to be more abundant or widespread than previously believed and/or which have no identifiable threats.

STATE

Endangered (E) ----- Native species determined to be in danger of extinction throughout all or any significant portion of its range or those listed as endangered on the Federal list.
Threatened (T) ------ Native species determined likely to become endangered within the foreseeable future throughout all or any significant portion of its range or those listed as threatened on the Federal list.
Critical © --------- Native species for which listing as threatened or endangered is pending.
Vulnerable (V) ------ Native species for which listing is not believed to be imminent and can be avoided with adequate protective measures.
Peripheral (P) ------- Peripheral or naturally rare species whose populations are on the edge of their range or are historically low in numbers due to naturally limiting factors.
Undetermined (U) -- Species for which status is unclear and requires further scientific study.

OREGON NATURAL HERITAGE PROGRAM

List 1 ----------------- Species that are threatened with extinction throughout their entire range or are presumed extinct. These species are in need of active protective measures to insure their survival.
List 2 ----------------- Species that are threatened with extirpation throughout their entire range or are presumed extirpated from Oregon but are more common or stable elsewhere.
List 3 ----------------- Species for which more information is needed before a status can be determined, but which may be threatened or endangered in Oregon or throughout their range.
List 4 ----------------- Species which are of concern but are not currently threatened or endangered. This includes species which are very rare but currently secure, as well as species which are declining in numbers or habitat but are still too common to be proposed as threatened or endangered. They require continued monitoring.

REGIONAL FORESTER'S LIST

Sensitive (S) --------- Those species identified by the Regional Forester for which population viability is a concern due to significant current or predicted downward trends in population numbers, density or habitat that would reduce the species' existing distribution.

CHAPTER 4

AQUATIC ECOSYSTEM

Uses of the Aquatic Ecosystem

Human

In the Little River watershed, 92 families have domestic water rights and there are 109 irrigation rights issued by the State of Oregon. Numerous other water rights are also used by residents, visitors, and industrial water users of Little River including rights for stock watering, campgrounds, road maintenance, and fire control. Many applications for additional water rights are now pending and others draw water from Little River and tributaries without permits or pending permits.

Both Little River and Cavitt Creek are used for swimming, rafting, fishing, aesthetic uses and general summer recreation. Much of this use occurs in the lower reaches of the watershed where depth and flows sustain it. Numerous constructed lakes and ponds provide water recreation such as fishing, non-motorized boating, swimming, camping etc.

The Federal Clean Water Act provides direction "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." To carry out this law, the state of Oregon has established water quality standards for factors like temperature and pH, and has designated beneficial uses of water and an antidegradation policy to protect water quality conditions needed for beneficial uses. The specific purpose of the antidegradation policy is to "guide decisions that affect water quality such that unnecessary degradation is prevented, and to protect, maintain, and enhance existing surface water quality to protect all existing beneficial uses." To comply with the Clean Water Act, the Forest Service and BLM implement conservation practices to control and reduce pollution from forest management activities and monitor the effectiveness of the conservation practices. This watershed analysis provides information to help the Forest Service and the BLM meet the Clean Water Act by identifying and evaluating factors influencing the health of the watershed and the beneficial uses of water.

Biological

Fish

With a drainage area of 131,853 acres, Little River is one of the largest tributaries to the North Umpqua River. As such, it contains perhaps one of the most diverse communities of aquatic organisms in that drainage. Anadromous fish species known to be present in the watershed include spring chinook salmon, coho salmon, steelhead trout, Pacific lamprey, and searun cutthroat trout. It is also possible that fish from the North Umpqua's small run of fall chinook salmon use the Little River basin, but this has not been verified.

Non-anadromous salmonid species known to inhabit the watershed include resident rainbow trout, resident cutthroat trout, brook trout, and kokanee salmon. Good numbers of relatively large cutthroat trout exist within the basin. It is believed that these fish are "fluvial", meaning they live in larger rivers and tributaries, and then migrate up into smaller streams to spawn.

There is also a relatively diverse group of non-game species inhabiting the watershed, including redside shiner, speckled dace, Umpqua dace, Umpqua squawfish, largescale sucker, riffle sculpin, and probably several other sculpin species.

In addition to these cold or coolwater species, there are also numerous small ponds and water holes that have been stocked with warmwater gamefish species, including largemouth bass, bluegill, black crappie, white crappie, and brown bullhead. These species are not native to the basin and there may be additional non-natives present that have not yet been observed.

At a larger scale, anadromous fish stocks within the North Umpqua River basin are considered to be somewhat unique due to the relative good health of the populations, both in terms of population numbers as well as overall species diversity. While there are some exceptions to this, such as the Umpqua cutthroat trout, which was recently proposed for a Federal Endangered listing due to drastic declines in returning adults, the North Umpqua is one of the few rivers left in the Pacific Northwest that contains "healthy" stocks of spring chinook salmon, as well as winter and summer steelhead trout (Huntington et al. 1994).

Coastal Cutthroat Trout

Cutthroat found within the Little River drainage can be divided into three distinct groups based upon differences in life histories. These groups include resident, fluvial (in-river migratory), and anadromous (or searun). Resident cutthroat trout do not migrate long distances; instead, they remain in upper tributaries near spawning and rearing areas and maintain small home territories (Trotter 1989, as cited by Johnson et al. 1994). They appear to be slower growing than their fluvial and searun counterparts, seldom growing larger than 6 to 8 inches in length and rarely living longer than 2 to 3 years (Wyatt 1959, Nicholas 1978, June 1981, as cited by Johnson et al. 1994).

Fluvial cutthroat trout are those that rear within large river basins, but do not migrate to the sea. Similar to the searun fish, these fluvial cutthroat migrate up into smaller tributaries to spawn. Little is known about these fish, and this life history was only recently identified in the Umpqua River basin. However, only rarely have fluvial cutthroat trout been reported below barriers or in locations occupied by anadromous fish (Johnson et al. 1994).

Anadromous, or searun, cutthroat trout are those that rear within estuaries or make short ocean migrations, and then return to smaller freshwater streams to spawn. Unlike other anadromous salmonids, searun cutthroat trout do not overwinter in the ocean and only rarely make long extended migrations across large bodies of water.

In a report prepared in 1972 by the Oregon State Game Commission (OSGC), it was estimated that 2,000 searun cutthroat trout spawned within the North Umpqua River system. These estimates were based upon average numbers of adult cutthroat crossing Winchester dam. Of these fish, 200 were estimated to use Little River. For comparison, 200 and 300 fish were estimated to use Rock Creek and Steamboat Creek respectively. For an additional contrast, this same report estimated that the South Umpqua River had a spawning population of around 10,000 fish. This estimate is somewhat more suspect however, due to the fact that no accurate dam counts were available for the South Umpqua.

Regardless, the North and South Umpqua fish likely represent an important genetic component of Umpqua basin cutthroat in that they represent portions of the population that migrates farther inland (150-175 miles) than most other cutthroat trout.

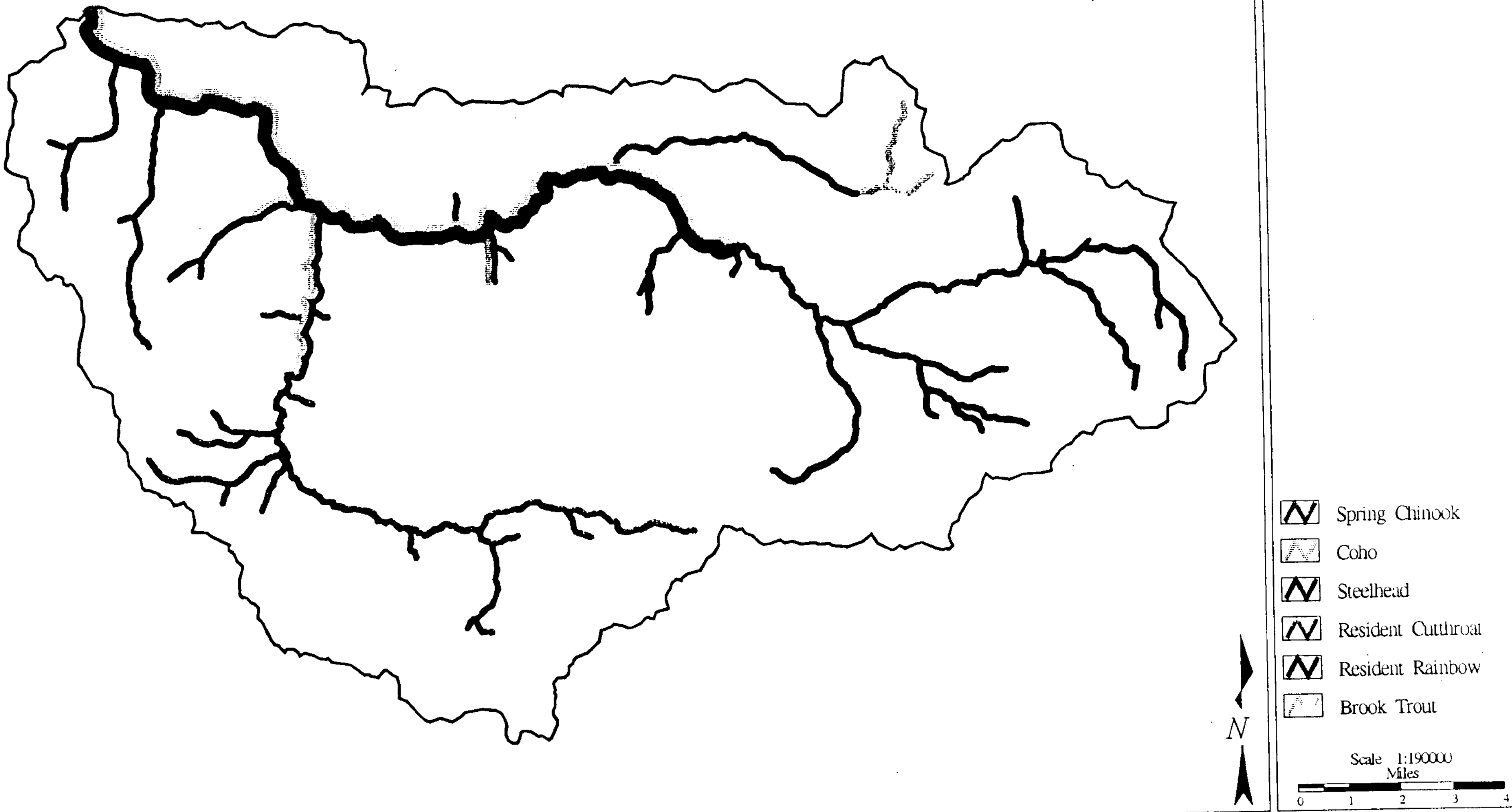
Anecdotal observations from long time residents in Little River indicate that there is a relatively large population of migratory sized (12"-16") cutthroat found there. These fish are likely to be fluvial cutthroat due to the low numbers of searun cutthroat crossing Winchester dam in recent years. They are reported to be more plentiful in Little River than in any of the other large tributaries of the North Umpqua River. Assuming searun cutthroat trout tend to utilize similar habitat as fluvial cutthroat, that may be an indication that the Little River system is of special importance to the declining searun fish.

The present stronghold for resident cutthroat trout within the Little River basin is in Cavitt Creek, specifically the upper tributaries which are almost completely dominated by resident cutthroat. In mainstem Little River, populations of resident cutthroat trout have been found in tributaries as far upstream as White Creek (Figure 28). The fish habitat above this point is dominated by rainbow trout. The lack of cutthroat trout above this point is probably due to a natural falls barrier, located a short distance above White Creek on the mainstem of Little River. This falls is in the vicinity of Poore Creek, and is known as the Poore Creek falls. This waterfall was most likely a complete barrier to cutthroat trout, coho salmon, and possibly spring/fall chinook salmon. Steelhead were able to pass over the falls when flow conditions allowed. A concrete passageway was installed in 1989 which allows passage to virtually any of the migratory fish that inhabit the basin. To date, limited investigations above this ladder have found no resident or migratory cutthroat, but there is nothing to prevent their passage to upstream waters in future years.

The same report prepared by the OSGC in 1972 for the entire Umpqua River basin stated that the highest populations of searun cutthroat trout seen in the Umpqua basin seem to occur in streams where coho populations are highest. In the North Umpqua system, Cavitt Creek is reported as being one of the largest producers of coho salmon (see coho section).

Figure 28

Fish Distribution



Cutthroat trout apparently are less tolerant of high water temperatures and experience a lower lethal limit than steelhead (Golden 1975, Bell 1986, as cited by Johnson et al. 1994). The information reported in the stream temperature section of this document indicates that much of Little River and Cavitt Creek have water temperatures that are well above those preferred by most salmonids. In addition, the relatively long duration of these high temperatures is an indication that temperature related stress and mortality may be occurring.

In studies where cutthroat and rainbow trout or steelhead occupied the same watersheds, the cutthroat trout have been found primarily in the headwater tributaries, while the steelhead and rainbow trout occupied the larger river reaches (Hartman and Gill 1968, Edie 1975, Hanson 1977, Jones 1978, Nicholas 1978a, and Johnson et al. 1986, as cited in Johnson et al. 1994). It is believed that cutthroat trout have evolved to exploit habitats least preferred by these other species, partly because of their subordinate behavior to other salmonids. In Little River, this trait is evident in the distribution of resident cutthroat, but the migratory cutthroat appear to occupy the same habitat as other salmonids throughout the basin.

Coho Salmon

Coho salmon have been considered the most important commercially caught salmonid in Oregon. Until recently, they were usually the most common salmonid in most coastal streams (Nickelson et al. 1992). Wild coho salmon populations in the Umpqua basin make up 25-30 percent of the total number of wild coho on the Oregon Coast (Loomis, personal communication, as cited in Jackson Creek Watershed Analysis). Umpqua coho contribute primarily to Oregon ocean fisheries with a minor contribution to northern California and southern Washington ocean fisheries (ODFW unpublished data).

Coho salmon in the Umpqua basin were assessed as being at a moderate risk of extinction due to habitat degradation and hatchery influences (Nehlsen et al. 1991). Umpqua basin coho salmon have been proposed for a threatened or endangered listing under the Endangered Species Act.

The 1972 OSGC report estimated the total numbers of spawning adult coho in the Umpqua system to be around 25,000 fish. Drainages that supported large numbers of spawning coho included Smith River, mainstem Umpqua River, Elk Creek, and the South Umpqua River. The North Umpqua's contribution was relatively small and estimated to be around 1000 spawning fish. Of these fish, 550 were estimated to utilize Little River for spawning purposes. This estimate is an indication that the Little River system is an important producer of coho salmon in the North Umpqua River system. Conversations with state biologists have indicated that Little River, specifically Cavitt Creek, is considered to be one of the primary producers of coho salmon in the North Umpqua River basin (Loomis 1993).

As with virtually all of the other fish species within Little River, there is very little quantitative information available concerning coho salmon populations. Cavitt Creek is more characteristic of typical coho habitat, in general, in that it has lower gradients (averaging around 1-2 percent), several reaches with wide alluvial (gravel) flats, terraces and side channels, and very few obstacles that would be considered as barriers. One of the lower tributaries of Cavitt Creek, Evarts Creek, has been found to support coho salmon for a short distance near its mouth. Other tributaries located in the middle of the Cavitt subbasin, such as Copperhead Creek, Buck Peak Creek, and White Rock Creek, may also provide habitat for coho during years when high escapements allow adult coho to access and seed these areas. To date, no coho have been observed in these streams within the last several years, but historical records suggest that coho once inhabited these upper habitat areas.

Index reach coho spawning surveys, organized by the Oregon Department of Fish and Wildlife, have been conducted in Little River and Cavitt Creek for one spawning season, the winter of 1994-95. According to this information, 7 redds (fish nests in gravel), or 14 fish were accounted for on the 7 miles of survey reaches surveyed regularly throughout the spawning season. Anecdotal reports indicate sightings of spawning coho in other areas located in the lower basin, however no estimates of fish numbers can be made from these sightings. Turbid water in Little River and Cavitt drainages made visual surveys of spawning fish and/or redds nearly impossible for a large majority of the time. It is likely that a substantial portion of the spawning fish and/or redds were not seen during surveys.

Spring Chinook Salmon

Umpqua basin spring chinook salmon occur as two stocks, one in the North Umpqua River and one in the South Umpqua River. The North Umpqua population is considered healthy and stable with a 47 year average wild fish run size of 5,513 fish (Loomis and Anglin 1992). The South Umpqua stock is considered "depressed" by the Oregon Department of Fish and Wildlife with estimated escapements varying widely and ranging from 92-716 fish in the last 10 years (ODFW unpublished data as cited by La Marr 1995).

The North Umpqua River spring chinook population is one of only 5 spring chinook stocks identified as being relatively healthy in the Pacific Northwest, and one of only 2 spring chinook stocks considered to be healthy within the state of Oregon (Huntington et al. 1994). As such, these fish represent an extremely valuable and rare resource within the state and region. It is likely that the North Umpqua population will remain stable barring any unforeseen catastrophic event that may occur within their ocean range or fresh water habitat. Factors that may account for the apparent stability and health of this stock include: 1) the relatively cold, clear, and abundant high quality water in the North Umpqua, 2) presence of stable and diverse rearing and oversummering habitat in the mainstem North Umpqua, and 3) no sport fishery for these fish is allowed in uppermost 32 miles of the North Umpqua, where these fish over-summer and spawn. It is also possible that these fish are less susceptible to the commercial and sport ocean fisheries by nature of their relatively early maturation out of the ocean and back to fresh water. In general, a large portion of these fish mature at three years of age (roughly one year in freshwater and 2 years in the ocean) and tend to enter freshwater in early spring, before the ocean troll fisheries begin

(Nicholas and Hankin 1988).

Little River is not known to support large numbers of oversummering adult chinook due to the warm water temperatures found in the lower reaches throughout the summer months. However, these fish have been documented using the lower 6-10 miles of the mainstem for spawning in the fall. No estimates on total numbers using Little River are available at this time, but based on trends observed in other large tributaries, as well as the tendency for these fish to be "mainstem spawners", it is not likely that the numbers of fish utilizing lower Little River would represent a large percentage of the run. A report prepared in 1972 by the Oregon State Game Commission estimated that none of the roughly 12,000 spring chinook spawning in the North Umpqua system at that time spawned in Little River. This estimate was highly speculative and not based on field observations.

Although very little field verified information is available concerning spring chinook salmon within the Little River basin, we do know that these fish utilize the system to some extent. Twelve spawning spring chinook were observed by fisheries biologists in early October of 1994. These fish were sighted within 3 miles of surveyed stream, all located downstream from the confluence of Cavitt Creek. While these surveys are by no means comprehensive enough to make any estimates of total escapement, they do provide proof of spring chinook presence in the Little River basin, where none had been documented before.

Literature on juvenile chinook salmon indicates that they exhibit two general fresh water rearing patterns: stream type rearing and ocean type rearing. Stream-type chinook do not migrate to sea during their first year of life, but delay migration to salt water for one or two years (Healey 1983, as cited by Groot and Margolis). The stream types often move out of the tributary streams and into the river main stem, where they occupy deep pools or crevices between boulders and rubble during the winter. Ocean-type chinook migrate to the sea during their first year of life, normally within three months after emergence from the spawning gravels.

One season (1995) of outmigrant trapping in Little River documented the downstream movement of numerous chinook fry (newly hatched juveniles), and young-of-the year smolts. This trapping effort suggests that Little River's chinook exhibit the ocean type rearing strategy but further study would be necessary to confirm this. Chinook juveniles found in the lower mainstem areas of Little River would have to migrate downstream to the cooler waters of the North Umpqua by late June or early July in order to avoid the lethal water temperatures that develop in the basin shortly after this time. It is likely that any juveniles remaining in the upper watershed would be forced to delay migration until the fall, when water temperatures cool.

Steelhead

The North Umpqua winter steelhead population is one of 35 winter steelhead stocks identified as healthy in the Pacific Northwest, and one of only 7 winter steelhead stocks considered to be healthy within the state of Oregon (Huntington et al. 1994). The same OSGC report mentioned earlier estimated that 9,500 winter steelhead utilized the North Umpqua River system. Of these fish, approximately 1,000 were estimated to use Little River for spawning purposes. For comparison, this same report estimated that Rock Creek and Steamboat Creek were utilized by 1,100 and 500 spawning fish respectively. For contrast, the report estimated that 10,000 fish spawned in the South Umpqua basin.

The North Umpqua population of summer steelhead is one of 6 summer steelhead stocks identified as healthy in the Pacific Northwest, all of which occur in Oregon. The other five stocks are found in various forks and the mainstem of the John Day River in Eastern Oregon (Huntington et al. 1994). The fact that only two river systems within the northwest are considered to support relatively healthy populations of summer steelhead is an indication that the North Umpqua population of summer steelhead is an extremely rare and valuable resource. The OSGC report estimated that roughly 12,000 summer steelhead utilized the North Umpqua River system for spawning. Of these fish, 225 were estimated to utilize the Little River basin. For comparison, 225 and 2,060 fish were estimated to use Rock Creek and Steamboat Creek respectively. This report also estimated that no summer steelhead utilized the South Umpqua River system, most likely a result of the extreme low flows and high water temperatures that system experiences during the summer months. More recent information indicates that the above estimates for steelhead use in Steamboat Creek were low, but that the relatively low estimates given for Little River are likely to be representative of actual fish use in that system.

While no large groups of adult steelhead have been observed oversummering in the Little River basin (as they do in Steamboat Creek and the upper North Umpqua), stream surveys and anecdotal records have verified the presence of an occasional adult steelhead in Little River during the summer months. The lack of summer steelhead may be partially caused by the presence of high water temperatures during the summer months, which would make the system less likely to serve as high quality over-summering habitat for these fish. It is possible that small groups of adult summer steelhead are able to over-summer below the confluences of colder water tributaries in Little River, but to date this has not been observed. It is likely, however, that Little River does provide important spawning habitat for the summer steelhead population. As water temperatures cool in the late summer and early fall, it is feasible that late-migrating summer steelhead would enter Little River, the first large tributary encountered on the upstream migration of the North Umpqua River.

As with all the other fish species within Little River, there is very little information available concerning steelhead populations in the basin. We do know, however, that steelhead are the most abundant of the anadromous species found within the drainage. Adult steelhead have been observed spawning as far upstream as the Cedar Creek area of mainstem Little River, and as far upstream as Cultus Creek in the upper Cavitt Creek drainage (Figure 28). In total, steelhead utilize approximately 45 miles of habitat within the basin.

Dambacher (1991) documented what he called a partial rearing life history of steelhead in Steamboat Creek, a large (roughly 140,000 acres) tributary of the upper North Umpqua River.

This life history is one in which steelhead parr (juveniles that have not yet transformed into smolts) emigrate from their natal streams in their second or third spring, seeking out the larger habitat areas of the main stem North Umpqua River. La Marr and Harkleroad (1993) also documented this partial rearing life history pattern in Calf Creek, a relatively small (12,000 acre) tributary of the upper North Umpqua basin. Smolt trapping efforts conducted in Little River should provide a more complete picture of the juvenile steelhead life history patterns within this basin. It is likely however, that the rearing patterns are similar to those seen in other tributaries of the North Umpqua basin.

As of July 15, 1995, the rough breakdown of juvenile steelhead trapped leaving the Little River system is 73% age 1+, 24% age 2+, and 3% age 3+ or older. This is similar to what was seen in the other basins mentioned above.

Rainbow Trout

Resident rainbow trout within the Little River system are found to dominate the small streams and headwater areas of the upper portion of the mainstem Little River drainage. No estimates of the total population size, structure, or general health exist at this time. It is thought that the majority of these populations are of natural origin, with numerous exceptions being found in areas where offsite strains of fish were stocked into ponds, fire sumps, and water holes for recreational purposes and may have escaped into downstream areas. Examples of introduced hatching populations are found in Dutch Creek, upper Emile Creek, and Hemlock Creek. It is not known to what extent these foreign stocks have interacted with local indigenous populations of rainbow trout, but based upon the small size and large spatial separation of the stocked areas, it is likely that the majority of the resident rainbow trout present in this basin are indigenous.

Nongame Species

In addition to a relatively diverse assemblage of salmonids, there are numerous nongame species found within the Little River drainage. Probably the most abundant of the nongame species is the sculpin (Sheehan 1993). To date, only one species of sculpin in Little River, the riffle sculpin, has been identified down to the species level. Based on current literature from western Cascade stream ecosystems in the nearby Willamette River basin (Sheehan 1993), it is likely that there are at least 2-4 species of sculpin within the Little River drainage.

Little River and Cavitt Creek also support populations of both speckled and Umpqua longnose dace, redside shiner, Umpqua squawfish, and the largescale sucker. Little is known about the life histories or habitat utilization of these species within the basin. From general observations, however, they tend to prefer the warmer waters of the mainstem streams (both Cavitt Creek and Little River) and can be found utilizing the lower mainstem areas of these streams even when the water temperatures become too high for salmonids to inhabit the area. The distribution and abundance of these fish may have increased as a result of management activities that have resulted in the artificial increase of the warmer water habitats that favor these species. Little River also supports populations of Pacific lamprey, brook lamprey, and possibly Umpqua chub.

Recent information obtained from smolt trapping efforts in Little River indicates that there are more Pacific lamprey in the system than previously thought. In the first 90 days of trap operation (February, March, and April) over 500 juvenile lamprey (or amoceates) were trapped as they drifted downstream. This trap only fishes a small percentage of the water column, and therefore, it is likely that this number represents a small percentage of the total emigration.

This information on Pacific lamprey is of interest for several reasons. First and foremost, ODFW has documented declining numbers of adult Pacific lamprey across Winchester dam, as well as around the region (Loomis 1995 personal communication), and they are on the state sensitive species list. The reasons for this decline are not well understood at this time. Secondly, Little River appears to be a relatively productive system in terms of lamprey numbers, and much of the habitat possesses the characteristics that juveniles prefer (slow moving water, abundant sands + silts in the streambed substrate). For comparison purposes, very few lamprey were caught in traps located on Steamboat Creek and Calf Creek.

Non-native Salmonids

While brook trout and kokanee salmon are not native to the area, they have been introduced for recreational fishing purposes in many areas including the Little River Basin. Brook trout were stocked in the upper headwater reaches of Emile Creek, in a small, artificial impoundment known as the Willow Flats sump. These fish were able to survive and reproduce, and eventually worked their way downstream into the upper mainstem of Emile Creek. Within upper Emile Creek, they are found in approximately 2 miles of stream habitat (see Figure 28). The majority of the habitat they now occupy is relatively low gradient, and is characterized by beaver ponds and small marsh-like stream channels. However, they are also present downstream of this area in an extremely rugged and steep canyon area, covering approximately one mile of stream channel. No brook trout have been documented downstream of these areas, although it is likely that an occassional fish does migrate downstream.

Kokanee salmon, a landlocked variety of the anadromous sockeye salmon, were stocked in two lakes within the Umpqua River drainage: Lemolo Lake and Hemlock Lake. Hemlock Lake is a small (roughly 30 acres) artificial impoundment near the headwaters of mainstem Little River. As with the brook trout, these fish survived, and were able to successfully reproduce, often spawning near the margins of the lake or near the inlets of small tributary streams. While these fish are still present in Hemlock Lake, apparently they do not attain a large enough size to make them a sought after gamefish. No kokanee have been sighted downstream from Hemlock Lake, however, several adult sockeye salmon have been documented crossing Winchester dam. These adult sockeye may be a result of juvenile kokanee that had migrated to the ocean, and thus took on an anadromous from, returning to their "natal" stream to spawn.

Other Non-native Species

A variety of warmwater gamefish species have been introduced into many of the small ponds and lakes scattered throughout the watershed. The majority of these sites are located towards the northwestern end of the watershed, on private land. As a result, a complete inventory of all these sites, as well as the species that inhabit them, was not possible. However, largemouth bass, black crappie, white crappie, brown bullhead, mosquitofish, bluegill, and other sunfish species are all known to be present.

Wildlife Use of Aquatic Ecosystem

As mentioned in Chapter 3, approximately 76 percent of all wildlife species within this watershed need riparian habitats (river, streams or pond/lake) to survive. Of these, a few species live most or a critical part of their lives within the water column (Table 22).

Table 22. Various wildlife species that live most or critical portions of their lives within the aquatic ecosystem.

Common Name	Scientific Name	River or Stream	Head Water Stream	Pond or Lake
Northwestern salamander	*Ambystoma gracile*			✱
Long-toed salamander	*Ambystoma macrodactylum*			✱
Tailed frog †	*Ascaphus truei*		✱	
Western toad †	*Bufo boreas*			✱
Pacific giant salamander	*Dicamptodon tenebrosus*	✱	✱	
Dunn's salamander	*Plethodon dunni*		✱	
Pacific treefrog	*Pseudacris regilla*			✱
Red-legged frog †	*Rana aurora*	✱		✱
Yellow-legged frog †	*Rana boylii*	✱		
Cascade frog †	*Rana cascadae*	✱		✱
Bullfrog ‡	*Rana catesbeiana*			✱
Southern torrent salamander †	*Rhyacotriton variegatus*		✱	
Roughskin newt	*Taricha granulosa*			✱
Aquatic garter snake	*Thamnopsis couchi*	✱		✱
Western pond turtle †	*Clemmys marmota marmota*	✱		✱
Beaver	*Castor canadensis*	✱	✱	✱
River otter	*Lutra canadensis*	✱	✱	✱

† = Listed as sensitive ‡ = Non-native species

From the species listed above, the amphibians are most sensitive to water quality concerns because they (with the exception of Dunn's salamander) lay their eggs within the water column. Once the eggs hatch, the larvae live much as fish (breathing through gills) until they metamorphosize into adults. Sometimes this can take as long as 2 years. Many of the species above are listed as sensitive species or are candidates for federal listing.

In addition to amphibian and reptile species, several bird and a few mammal species rely heavily on the aquatic portion of the riparian area for their food. These would include birds like the great blue heron and American dipper (which feed on aquatic invertebrates and small fish), the osprey (feeds on larger fish) and fish and crustacean eating mammals such as the mink and river otter. Poor water quality and fish habitat can adversely effect these animal's food supply.

Trends in Aquatic Ecosystem Condition

Fish Spawning Habitat

Recent smolt trapping information may indicate that spawning areas in the mainstems, and possibly other areas, are in a degraded condition. Numerous coho, spring chinook, and steelhead sac-fry (larval fish) were captured in the trap from late February through May. It is not normal for sac-fry to be out of the gravels since they are not developed enough to swim or feed. During the period of their capture, there were no large storm events or severe water temperature swings that could have forced these developing fish out of the gravels within their redds. Studies of chinook spawning in highly sedimented streams in Idaho (Tappel and Bjornn 1983) have shown that often times alevins and sac-fry can be forced out of gravels before they have absorbed their yolk sacs as a result of inordinately high levels of fine sediments present in the gravels. The specific mechanism responsible for the premature emergence of these small fish from the gravels is likely a lack of oxygen caused by fine sediments that have filled in the interstitial pore spaces of the redd (gravel nest), thereby reducing the amount of subgravel flow, and consequently, the amount of oxygen delivered to these fish. Weaver and Fraley (1993) also documented that cutthroat trout fry emergence from spawning gravels decreased as the amount of fine sand and silts in these gravels increased.

It is possible, however, that these fish were mechanically displaced from the gravels by steelhead that had chosen the same gravels in which to spawn, washing the small fish into the water column as a result of their powerful tail strokes during redd construction. However, the large number of sac-fry captured over a 3.5 month period would tend to reduce the likelihood of this explanation.

Fish Rearing Habitat and Use

There is very little historic information available with regard to fish habitat quantity and quality within the Little River basin. While most all of the fish-bearing streams within the basin have been surveyed, all of these surveys have been conducted within the last 5 years. To date, 139 miles of stream have been surveyed using two different variations of the Hankin and Reeves (1988) survey methodology. Of this data, 97 miles (or 70 percent) were surveyed in 1994, primarily to gather data for this watershed analysis. The only portion of a large fish-bearing stream in the basin that has not been surveyed is the lower 10 miles of mainstem Little River, from the mouth up to the confluence with Wolf Creek.

Of the 139 miles of stream survey within Little River, approximately 79 miles were surveyed using Oregon Department of Fish and Wildlife survey methods, while the remaining 60 miles were surveyed using U.S. Forest Service (Region 6) survey methods. While these individual methods are based on a similar foundation, there are significant differences that make comparing the two surveys difficult. However, rough comparisons of the two data sets can be made based upon general trends observed, such as the amounts of large wood present in streams, the extent of fish distributions, and the rough percentages of basic habitat types, such as pools, riffles, and glides.

Roper and Scarnecchia (1995) have documented consistency problems associated with utilizing these somewhat subjective methods of data collection. Stream survey monitoring and quality control efforts conducted on the Umpqua National Forest have documented similar concerns with regard to accuracy and precision (Burns 1994; Harkleroad 1993; Lightcap and La Marr 1993). With this in mind, even the comparisons of general trends observed in the data must be used with caution.

Since data is lacking on fish populations in the basin, the majority of the relationships described or inferences made concerning habitat conditions and their effect on fish populations are based primarily on professional judgement and reference to the scientific literature.

Also, there was a "qualitative" survey of potential barriers to anadromous fish migration conducted in 1962 by the Oregon Game Commission. This survey identified significant barriers (logjams + waterfalls) and proposed management options for dealing with them. In most cases the recommendations were to remove the barriers, and the majority of these recommendations were carried out. Therefore, the distribution of some species may be extending upstream in some places.

Mainstem Little River

Where the mainstem channels of both Little River and Cavitt Creek flow through the older geologic terrain (Colestin Formation, colored brown on the geology map--Appendix A-4), the valley floor profile is often wide and characterized by paired terraces (abandoned floodplains) . Within the more recent geologic past, the mainstem channels of Little River and Cavitt Creeks have become locally incised or entrenched by an average of 30 to 40 feet forming bedrock gorges with narrow floodplains and relatively steep stream gradients. The cause of the entrenchment is thought to be a result of regional uplift over the past several million years. The uplifting caused a gradual increase in stream gradients which increased stream flow energy ultimately leading to the entrenchment. These gorges, or canyon habitat, offer important habitat for juvenile salmonids (see Aquatic-19 for description). In comparison, the younger Western Cascades volcanic terrain

(Little Butte Group, colored medium purple in Appendix A-4) typically has V-shaped canyons with little to no floodplain.

In addition to changes that have occurred over geologic time, aquatic habitat within the mainstem of Little River is vastly different today than it was before significant settlement and management activities took place within the basin. Historical accounts from long-time residents of the Little River area indicated that in-stream wood accumulations used to be much more frequent in the main stem, as well as other fish bearing tributaries found throughout the basin. Literature specific to western cascades stream ecosystems (Dose and Roper 1994) also tends to support these accounts.

According to these sources, large wood was more abundant in streams prior to significant road construction and management of the basin. Smaller fish bearing channels were said to have numerous pieces of wood both in and spanning the stream channel, often making travel (and fishing) difficult. In the larger streams, such as the mainstems of Little River and Cavitt Creek, large wood was also quite frequent, but it was arranged in a somewhat different manner. There were fewer individual pieces of wood spanning the channel or present down in the stream channel. The wood that was present tended to be found in large groups or small jams near natural "nick" points in the stream (ie. where the channel narrowed, or flowed around a very sharp bend). Oftentimes these areas coincided with very deep pool habitat and were favorite local fishing spots.

These residents remember the Oregon State Game Commission, along with Forest Service personnel and others, removing many of these small wood jams and individual pieces from the stream channel (a process known as "stream cleanout"). Oftentimes these jams were either blasted with dynamite, or cut into smaller pieces with chainsaws, allowing winter flows to wash the cut up pieces of wood away. These activities were done, apparently, to allow easier fish passage and to prevent the logs from plugging culverts and jamming under bridges, potentially causing property damage to the residents of the area. However, many of these residents (primarily those that fished) were opposed to this practice and had serious concerns since most of the best fishing was found around these wood jams.

While no quantitative information is available for the lower ten miles of Little River, data collected from surveys of the upper mainstem supports what the residents had observed years ago. Wood is no longer abundant in larger stream channels due to stream cleanout activities. Table 23 below summarizes some of the key habitat elements for the mainstem of Little River above Wolf Creek. Little River was surveyed in 1994 using Forest Service methods. Figure 29 shows specific reach delineations.

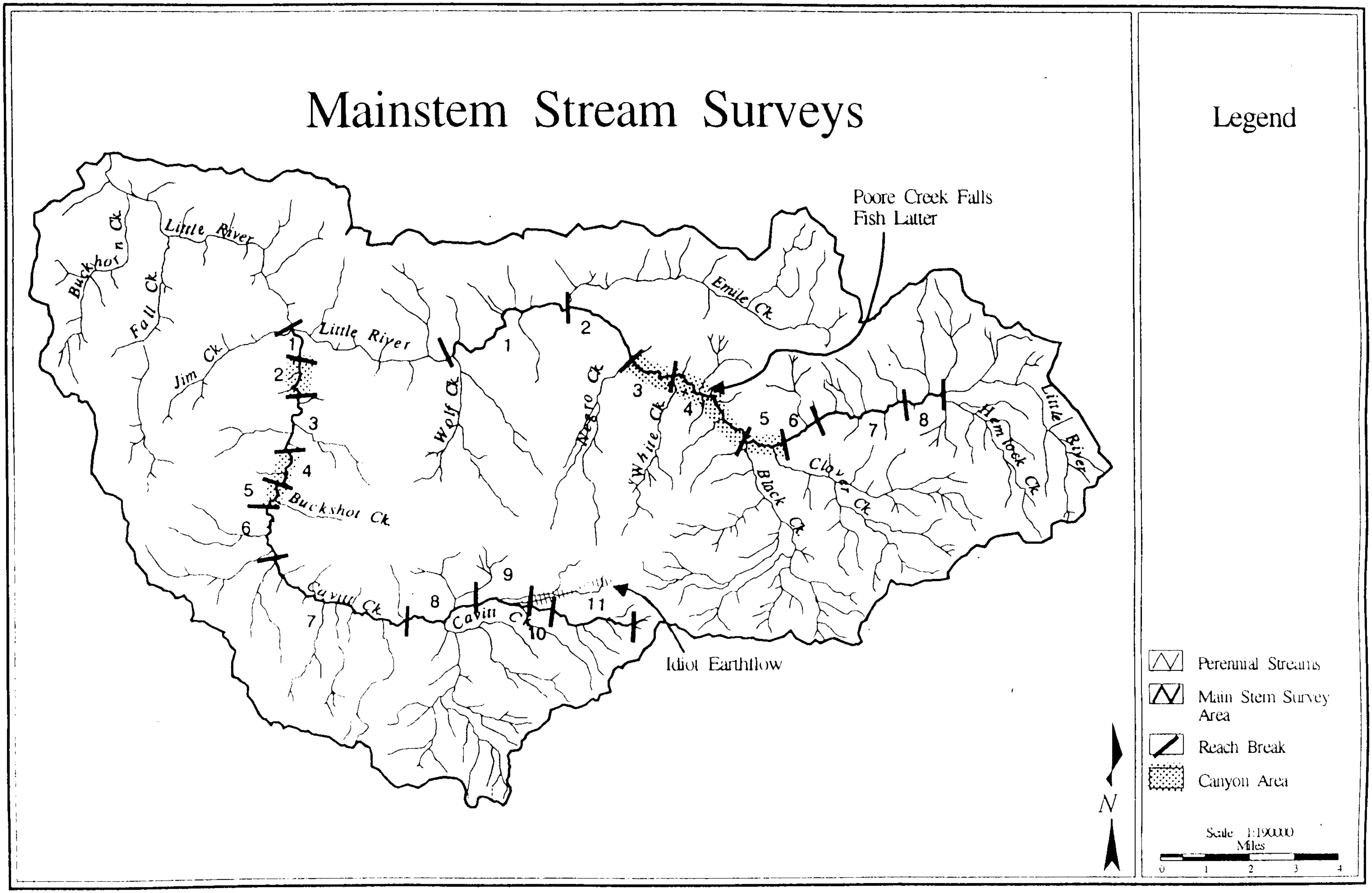
Table 23: Mainstem Little River Habitat (upstream of Wolf Creek). Co = coho, Ch = chinook, St = steelhead, mCt = migratory cutthroat, Rb = resident rainbow. Fish species distributions are based on limited information and are subject to change. Large Wood is classified as being > 50 feet in length and > 24 inches in diameter.

Reach	Length (miles)	Salmonid Species	% Reach Gradient	% Pools	Large Wood Per Mile	Valley Width
1	3.2	Co, Ch, St, mCt	1%	58%	0 pieces	300-600 ft.
2	1.8	Co, Ch, St, mCt	2	53	3	300-600 ft.
3	1.0	Co, Ch, St, mCt	2	48	6	100-300 ft.
4	2.4	St, Rb	2	67	19	< 100 ft.
5	0.9	St, Rb	3	65	21	< 100 ft.
6	0.9	St, Rb	3	35	67	100-300 ft.
7	2.4	St, Rb	3	49	21	100-300 ft.
8	1.4	Rb	3	36	17	< 100 ft.

The one exception to the overall lack of instream wood in the mainstem of Little River is in reach 6, where trees killed in a fire in 1987 have recently fallen into the channel, resulting in a much larger amount of in-stream wood. However, for comparison, large wood values ranged from 50 to 110 pieces per mile in roadless area stream reaches in other subbasins of the North Umpqua River (Harkleroad, 1993) These roadless streams are smaller second and third order channels with watershed sizes ranging from 542 to 8,676 acres.

Recent observations of portions of the unsurveyed, lower 10 miles of Little River also revealed that little or no large wood (>50 feet and >24 inches in diameter) is present. In addition, the wood that does get deposited in these lower river areas on an annual basis disappears rather quickly due to the continuing practice of private land owners removing it from the channel.

Figure 29



Mainstem Stream Surveys

Mainstem Cavitt Creek

Cavitt Creek, with a drainage area of roughly 33,000 acres, is the largest tributary stream within the Little River drainage. It's an important drainage because of its size, and because it is distinctly different than most of the other tributaries within the basin. Cavitt Creek is characterized by an abundance of gravel, a relatively low gradient, and by the presence of large amounts of fine sediment, compared to the main stem of Little River. The Cavitt Creek subbasin has extensive areas of dormant, large-scale landslide complexes and massive earthflow deposits, both active (idiot slide) and inactive. The ancient, deep-seated landslide complexes have historically interacted with the stream channel changing the profile of the drainage. Landslide obstructions have caused the formation of wide, alluvial valley bottoms, with sinuous stream channels that meander back and forth across these low gradient reaches. The majority of these localized flat valley areas are small, averaging about 0.25 to 0.5 mile in length. However, a significant landslide deposit at the mouth of Buckshot Creek restricted flow in Cavitt Creek which resulted in a large sediment accumulation. This 2 mile long segment of flat valley bottom represents the largest such section along Cavitt Creek (Figure 29, stream segments 6 and 7).

These low gradient, meandering channels in the mainstem of Cavitt Creek tend to be some of the most productive in terms of aquatic insects and fish populations. This is because water velocities are slower, habitat complexity (ie. large wood, pools, undercut banks, etc.) is usually higher, and more of the nutrients that enter the aquatic system are retained on-site as a result (ie. leaves collect on woody debris, high water velocities don't wash everything downstream, etc.).

Much of this potentially productive habitat, however, is in a degraded state because the channel has lost one of the key components of its former productivity-- large wood. Large wood was removed from the stream channel and the future source of large wood (as well as stream shade) was removed from riparian areas as a result of intensive timber harvest. As a result, the stream is continuing to meander back and forth across its valley, but the large wood component that formerly added stream bank stability and in-channel habitat diversity, is no longer there to fall in. Consequently, banks continue to erode as the stream channel moves laterally with no resistance (ie. no trees holding the banks together). This results in a widened stream channel that contains more sediment, is exposed to more sunlight, and has no large structural elements to aid in the formation of complex habitat (Figure 39).

Table 24 below summarizes some of the key habitat elements for the mainstem of Cavitt Creek. The upper most reaches in Cavitt Creek generally have more large wood. These are areas where the source of large wood has not been removed. This stream was surveyed in 1993 using ODFW methods. Figure 29 shows specific reach delineations.

Table 24. Mainstem Cavitt Creek Habitat. Co = coho, St = steelhead, mCt = migratory cutthroat, rCt = resident cutthroat. Wood volumes are based on total amounts, not individual key pieces, and include pieces equal to or greater than 6 inches in diameter and 10 feet long. Valley Width Index is a ratio of the width of the valley floor to the width of the active stream channel. ODFW 1993.

Reach	Length (Miles)	% Reach Gradient	Salmonid Species	% Pools	Wood Volume (ft^3)/100 yards	Valley Width Index
1	0.6	1.0	Co, St, mCt	68	3.5	6.5
2	1.0	1.0	Co, St, mCt	48	7.1	1.6
3	1.3	1.1	Co, St, mCt	46	7.1	4.1
4	0.9	1.7	Co, St, mCt	57	106.0	1.8
5	1.5	1.8	Co, St, mCt	53	158.9	2.8
6	0.8	0.6	Co, St, mCt, rCt	75	187.2	5.4
7	3.7	1.5	Co, St, mCt, rCt	36	42.4	3.8
8	1.3	4.7	St, mCt, rCt	39	483.9	1.1
9	2.1	8.4	rCt	27	1377.5	1.1
10	0.1	0.7	rCt	50	130.7	6.0
11	1.5	5.5	rCt	24	745.2	1.2

Several large sources of fine sediment are present today in upper Cavitt Creek drainage. One of these sources, a large active earthflow known as Idiot Slide (Figure 29), continues to contribute sediment on an annual basis. This earthflow was not caused by management activities, however activities that increase peakflows may lead to an increase in the stream's ability to erode the toe of the earthflow resulting in an increased yield of sediment from this naturally occurring feature. The other major source of sediment is located along the western edge of Cavitt Creek, where highly erosive granitic bedrock is present. Granitics are well known for their highly erosive nature. Soils derived from granitic parent material are highly susceptible to weathering because of the granular texture and widespread fracturing and jointing of this terrain. This terrain is subject to both large amounts of surface erosion, as well as debris avalanches and debris flows on steep slopes. Much of this granitic terrain has been intensively managed for timber with high road densities. These land management activities have greatly accelerated natural erosion processes, scoured streams on steep slopes and deposited the sediment in low gradient channel segments.

The presence of large sediment sources, combined with physical habitat that has been simplified, results in stream channels that contain extremely large amounts of fine sediment. These "embedded" streambeds do not promote diverse or abundant aquatic insect communities. Numerous studies have shown that high levels of fine sediment can have serious detrimental effects on aquatic communities (various authors in Meehan 1991).

Mainstem Canyon Habitats

Studies conducted within Steamboat and Jackson Creeks (large 5th order watersheds on the Umpqua National Forest) indicate that a substantial portion of the juvenile salmonid rearing, in particular, age 1 and older steelhead juveniles, occurs in the larger habitat complexes of mainstem "canyon" areas. These constricted channels tend to provide habitat units characterized by their large size and depth, as well as diverse nature, often resulting in inordinately high densities of steelhead.

Diverse canyons are present in Little River and, to a lesser extent, Cavitt Creek. While no quantitative fish numbers exist for these areas, anecdotal observations made while snorkeling in each of these streams can be made on relative abundances, species composition, and general habitat utilization patterns.

Within the upper mainstem of Little River, there is a 4.5 mile section, between Negro Creek and Clover Creek (Figure 29), that is similar to canyon areas of Steamboat and Jackson Creeks (This section of stream is represented by reaches 3, 4, and 5 in Table 23). It is characterized by diverse habitats formed primarily by bedrock outcroppings and large boulders within the "inner gorge" stream channel. A high percentage is dominated by deep plunge pools that provide excellent rearing habitat for a variety of juvenile fish age classes. In addition, there is a relatively contiguous stand of old growth conifer along this stretch of stream, providing a significant source of large wood that could enter the channel as well as provide shade. Stream temperature data collected in 1994 (a drought year with warmer than average water temperatures) showed that this area reached a maximum of 70 degrees F near its upper end and 73 degrees F at its lower end on one day during the warmest portion of the year. This data also showed that water temperatures cooled down to the low 60s or high 50s in the evenings during this warm period, well within the tolerance range of most salmonids. As a result of these factors, it is suspected that a large portion of the juvenile steelhead within the basin rear in this area. Future fish population estimates will attempt to determine if this prediction is accurate.

It should be noted however, that this segment of Little River is above Poore Creek Falls, which likely served as a partial barrier to steelhead before the fish ladder was constructed. Therefore, juvenile steelhead densities in this area may be higher than what has occurred historically.

The lower mainstem areas of Little River also contain isolated stretches of relatively complex habitat that are found within smaller segments of canyon-type habitat. These areas are also characterized by very large plunge pools and bedrock trench pools. In a less disturbed condition, it is likely that this area would support large numbers of salmon and steelhead juveniles. However, this area is currently in an unhealthy condition throughout much of the summer, with high water temperatures that often exceed 80 degrees F. These conditions render the habitat in these areas virtually uninhabitable by salmonids in summer. However, the majority of Little River's spring chinook spawn (in the winter) in these areas, and the juvenile fish have to migrate out of this area to survive through the summer months.

In addition, high pH values above the state standard maximum value of 8.5 have been recorded in these areas. It is not known to what extent these pH conditions influence fish populations, but these high values may serve as another indicator of poor overall water quality.

In the lower to middle mainstem of Cavitt Creek, there are short segments of relatively diverse habitat found within the incised stream channel. Although the large wood has been removed from virtually the entire stream, these areas still possess moderate diversity as a result of large boulders of bedrock outcroppings. These complex areas are not present to the extent seen in upper Little River, but still provide localized patches of diverse rearing habitat. They are primarily found in reaches 2, 4 and 5 of mainstem Cavitt Creek (Figure 29). As with the lower mainstem of Little River, however, water temperatures and pH values in 1994 sometimes exceeded 80 degrees F and 8.7 respectively.

Based on the habitat and water quality conditions described above, the lower to middle mainstem reaches of Little River and Cavitt Creek are not believed to support large populations of juvenile salmonids during the summer months. Within the basin overall, it is likely that the majority of the summer rearing takes place in the upper watershed areas, upstream of lethal water temperatures.

Smaller Fish Bearing Tributaries

The Little River watershed was divided into seven vicinities based on watershed boundaries to help describe the resources for this watershed analysis (Figure 30). Many of the tables in this chapter are referenced to these seven vicinities. There are 36 identified (named) tributaries (Figure 31) and 23 of these support populations of fish, having drainage areas ranging in size from 839 to 9,661 acres.

Due to their relatively small size, and the abundance of migration barriers (waterfalls), these 23 tributary streams do not provide a large proportion of the anadromous fish habitat found within the Little River basin. Of the approximately 48 miles of anadromous fish bearing waters in the basin, these tributaries only provide around 8.5 miles, or 18 percent of the anadromous habitat. In contrast, virtually all resident trout (resident cutthroat and rainbows) habitat (about 70 miles) is found within these small streams.

Figure 30

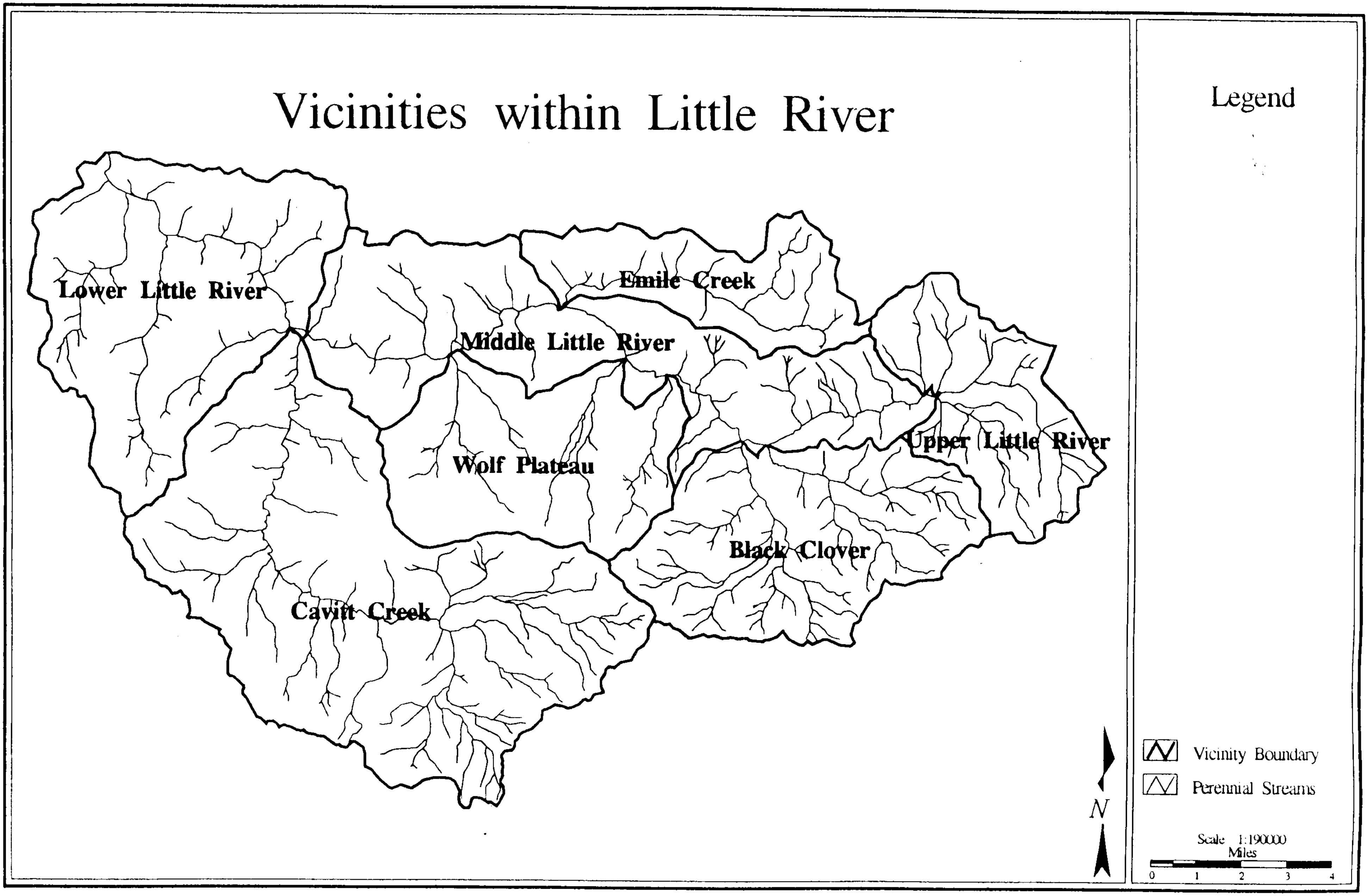
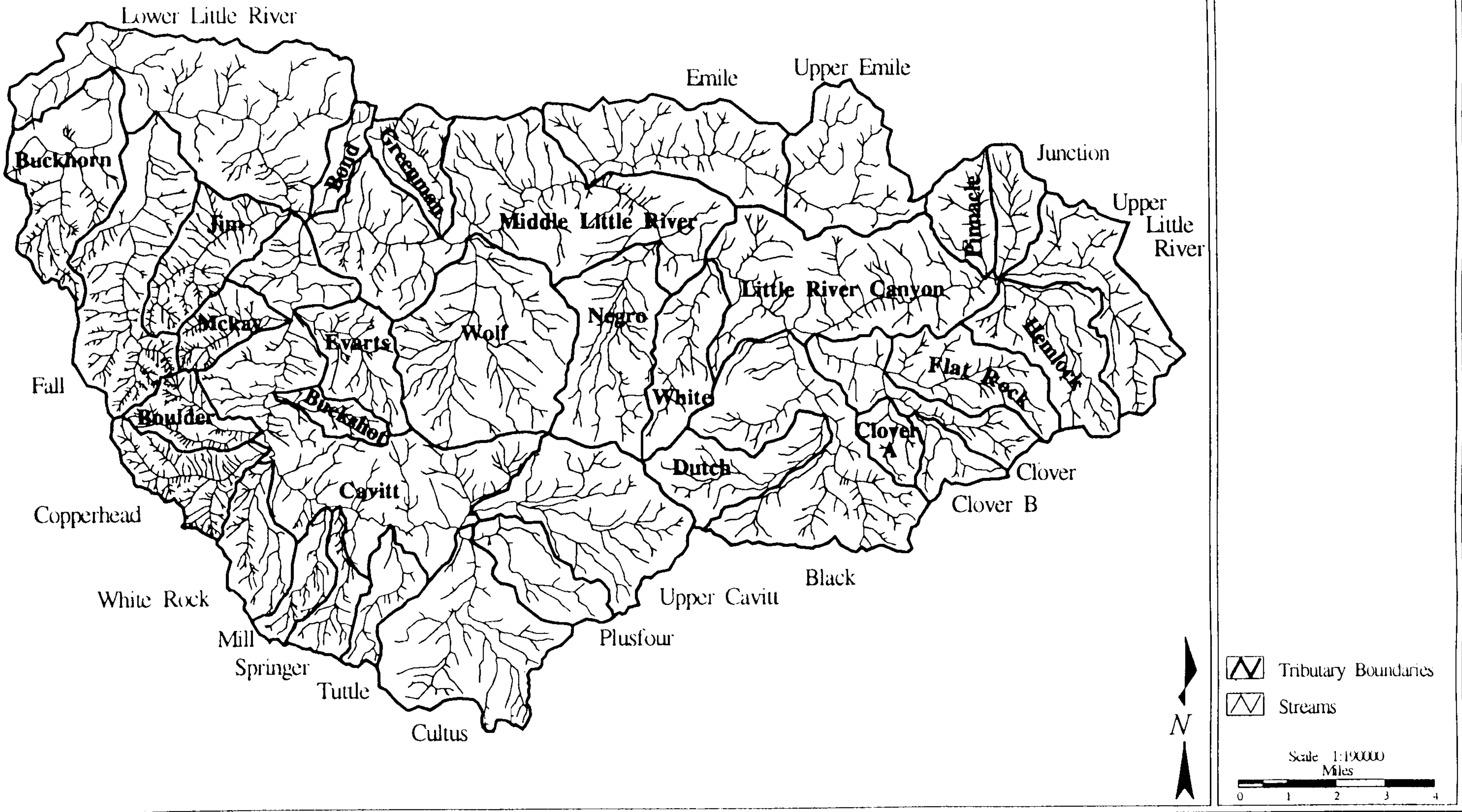

Vicinities within Little River
Lower Little River
Middle Little River
Emile Creek
Wolf Plateau
Upper Little River
Black Clover
Cavitt Creek
N
Legend
Vicinity Boundary
Perennial Streams
Scale 1:190000
Miles
0
1
2
3
4

Figure 31

Tributaries of Little River



In terms of physical habitat conditions, these tributaries range from highly degraded (such as Black, White, Jim, Fall, Copperhead, and Boulder Creek) to relatively pristine (Flat Rock Branch, Middle Emile Creek, Cultus Creek). The majority of these systems however, are considered to be in a degraded condition (Appendix F). As with the larger mainstems of Little River and Cavitt Creek, many of the drainage areas in these smaller systems experienced intensive timber harvest (both upslope and riparian), road construction, and stream cleanout. All of these management activities, along with floods in the 50s and 60s and fires prior to the 1950s, have had varying degrees of effects.

Many tributaries now lack sufficient stream shade, as well as riparian and in-channel large wood, necessary to keep water temperatures cool, and provide complex fish habitat. Harvest and road construction activities have also increased the amount of sediment delivered to each respective channel. Impacts from this can be seen in several of these tributaries, but the bulk of the negative impacts are believed to be showing up downstream, in the larger mainstem channels.

For more in-depth discussions concerning each of these tributaries, refer to the individual stream writeups contained in Appendix F.

Aquatic Insects

Many aquatic insects have been shown to be sensitive to changes in aquatic habitat, and therefore, serve as a valuable tool in assessing potential problems with water quality and aquatic habitat conditions. They are also the primary food source for fish, playing a critical role in stream ecology. The variety of species present at any given site, as well as the feeding groups (ie. shredders, filter feeders, predators, etc.) of the overall aquatic insect community at that site, can provide valuable insights into the dominant processes occurring at any given site.

As with other aquatic resources within the Little River drainage, there is very little information available concerning aquatic insects. Monitoring of these insects has been a part of the Umpqua National Forest plan for approximately five years, but unfortunately, no sites in Little River have been previously sampled. To help accomplish watershed analysis, eight sites were sampled in 1994. Five in mainstem segments of Little River and Cavitt Creek, and three in larger mid and upper basin tributaries.

A summary of the findings from the Little River 1994 samples show that aquatic insect communities are, for the most part, moderately impacted (Table 25). For a more comprehensive look at the sampling methodologies and the data summaries, see Appendix F.

Table 25. Summary of aquatic insect sampling results. This data only represents one year's worth of information, and not all vicinities are represented.

Vicinity	Sample Site	Overall Condition of the Macroinvertebrate Community
Lower Little River	Lower Little River (near mouth)	**Fair to poor**. Low richness (number of species) in mayfly:stonefly:caddisfly populations, indicating impaired habitat/water quality. Numerous aquatic worm species were also present, indicating an abundance of fine sediment.
Middle Little River	Middle Little River (above Cavitt)	**Fair to poor**. This site was very similar to the lower Little River site.
Middle Little River	Upper Little River (near Negro Creek)	**Fair**. High richness in mayfly:stonefly:caddisfly populations, indicating relatively good habitat and water quality, but also a moderate abundance of tolerant snails, black flies, and craneflies which tend to indicate depressed habitat and/or water quality. These tolerant species are indicative of excessive filamentous algae production and/or disturbed or enriched streams.
Cavitt	Lower Cavitt Creek (near mouth)	**Fair**. Moderate to low richness in mayfly:stonefly:caddisfly populations, but some highly sensitive species, not tolerant of certain degraded habitat conditions, were found in all the samples. Moderate amounts of black flies were also found, indicating somewhat depressed habitat and/or water quality.
Cavitt	Upper Cavitt Creek (1.0 mile above Cultus Creek)	**Moderate to good**. High richness in mayfly:stonefly:caddisfly populations, with several sensitive species that correspond to high habitat complexity and integrity. A few tolerant species were also found, possibly indicating declining habitat and/or water quality.
Emile	Emile Creek (0.35 mile upstream from mouth)	**Fair**. Low richness in mayfly:stonefly:caddisfly populations, with only a few sensitive species being found. Indicators of poor conditions included aquatic worm species, and dragonflies that are tolerant of warm water, fine sediment, and low levels of dissolved oxygen.
Black Clover	Clover Creek (0.25 mile upstream from mouth)	**Fair**. Low to moderate richness in mayfly:stonefly:caddisfly populations, however several sensitive species were found. These species prefer cool water, and won't tolerate fine sediments and high winter scour or gravel re-sorting. Moderate numbers of tolerant caddisflies were also found, pointing to a general decline in habitat or water quality.
Black Clover	Black Creek (0.25 mile upstream from mouth)	**Fair to poor**. Low richness in mayfly:stonefly:caddisfly populations, with very few sensitive species being found. Moderate numbers of tolerant dragonflies, snails, caddisflies, and aquatic worms were found at this site. These organisms, when found in small streams, are usually indicative of high summer water temperatures, nutrient enrichment, sediment input and/or low flows.

Riparian Conditions

The condition of riparian areas varies widely across the basin. In general, riparian areas located in downstream areas within Little River and mainstem Cavitt Creek have undergone the largest change from what are believed to be natural, reference conditions (evident from past aerial photos). The majority of the riparian areas can be characterized as having narrow bands of small hardwood and conifer species. Where buffer strips have been left, they have been narrow, with the larger trees having been selectively removed. These altered riparian areas are not currently sources of large wood that could enter the stream, and they do not provide the cooler, moist microclimate characteristic of many healthy, functioning riparian ecosystems.

Based on interpretation of historic stand conditions from aerial photos, 72 to 88 percent of the riparian areas within 360 ft. of fish bearing streams in the basin was in a late seral condition with large conifers and large hardwoods dominating the stands. Today, however, roughly 30 percent of riparian stands along fish-bearing streams in the watershed are considered to have late seral characteristics. Roads are also present in riparian areas with a long-term loss of vegetation. These conditions vary by vicinity in Little River (Table 26).

Table 26. Condition of riparian forests within 360 feet on either side of fish bearing streams within the seven vicinities of Little River, present and past.

Vicinity	Miles of fish bearing tream	% of Riparian in late seral (Reference range-- late 1800s-late 1930s)	% of riparian in late seral (1995)	Miles of road located within 360 feet of fish bearing streams
Lower Little R.	22.4 miles	81-86%	7%	21.9 miles
Cavitt	33.5	78-87	24	21.0
Middle Little R.	21.7	72-88	32	5.5
Wolf Plateau	4.7	79-86	23	1.5
Emile	11.2	58-81	49	5.5
Black Clover	13.1	64-80	47	8.7
Upper Little R.	13.0	80-85	59	5.2

The condition of riparian areas is important when considering the contributions of riparian areas to the overall health of a watershed, and how those contributions have changed since management activities began in the basin. The functions provided by riparian areas include stream shade, which helps regulate water temperatures and maintain the moist riparian microclimate; large woody material, which provides in-channel habitat stability and complexity; nutrient inputs in the form of litter-fall and whole trees; stable rootmasses that provide streambank stability and resist erosion; an effective vegetative water filter that filters out much of the suspended sediments present in overland flow during storm events; and moist fire breaks that slow the spread of fire and lessen the intensity of fire.

Shade and Stream Temperature

The width and height of riparian vegetation on either side needed to provide effective shade varies depending on the width of the stream, the direction of flow (orientation to the sun), and the steepness of the streambanks. In general, the vegetation width needed, solely to serve the function of stream shading, can be narrower than riparian widths needed to serve the other functions listed above. Also the age of the riparian trees (height) can typically be younger and still effectively provide shade.

There are many studies that have documented the effectiveness of riparian shade to maintain cool streams in the forests of the Pacific Northwest. Locally, Holaday (1992) evaluated the water temperature in the Steamboat watershed for the 1969 to 1990 period and found a significant trend of decreasing maximum summer temperatures for some of the tributaries. He associated the decreasing temperature trend with recovering riparian vegetation which had been removed by flooding, debris flows, or timber harvest. Brown (1983) concluded that the heating of small mountain streams during the summer is primarily from direct sunlight. The loss of riparian shade also increases the diurnal (day to night) water temperature fluctuation. In a managed basin such as Steamboat, diurnal fluctuations have averaged from 7° to 11°F, while the smaller, 20,000 acre, Boulder Creek wilderness, averaged 4°F (Holaday 1992).

The entire Little River watershed has about 336 miles of perennial streams which includes both fish and non-fish bearing segments. For this total, approximately 77 percent of the perennial stream length is effectively shaded by riparian canopy that is at least closed pole structure (25 to 30 years old) or older.

Table 27. **Effective riparian shade along perennial streams within the vicinities of Little River, 1995 and Past.**

Vicinity	Miles of Perennial Stream	% Perennial Stream Effectively Shaded (late 1800s, late 1930s)	% Perennial Stream Length Effectively Shaded, 1995	Range of % Shaded Tributaries, 1995 (# of tributaries)	% Perennial Stream Miles on Private Land
Lower Little River	43.7	84-99	74%	26-94 (4)	90
Cavitt	106.2	81-97	64%	4-87 (13)	35
Middle Little River	52.6	88-95	72%	34-76 (3)	31
Wolf Plateau	28.9	88-99	70%	50-87 (3)	38
Emile	20.9	78-85	76%	70-83 (2)	9
Black/ Clover	66.4	82-99	80%	73-94 (6)	2
Upper Little River	38.2	88-93	83%	77-96 (4)	0
Totals	336		77%		

In all vicinities, perennial streams have less effective shade today compared to the historic reference points (Table 27). The amount of effective shade along individual tributaries within the vicinities is highly variable. For instance, in the four tributaries that make up the Lower Little River vicinity, Jim Creek only has 26 percent of its perennial length shaded while Fall Creek is 94 percent shaded (Appendix I). This variability is primarily a result of the age of harvested stands the amount of roads along streams, and in some locations, recent fires. The amount of shade provided by forested stands increases as harvested riparian areas grow. Streams are considered shaded when the adjacent trees are approximately 25 years old. This will vary by site class. Where roads closely parallel streams or where riparian forests have been converted to pasture, there is a long-term loss of portions of the riparian shade. The valley bottom road along lower Little River is an example of where potential shade recovery has been partially limited.

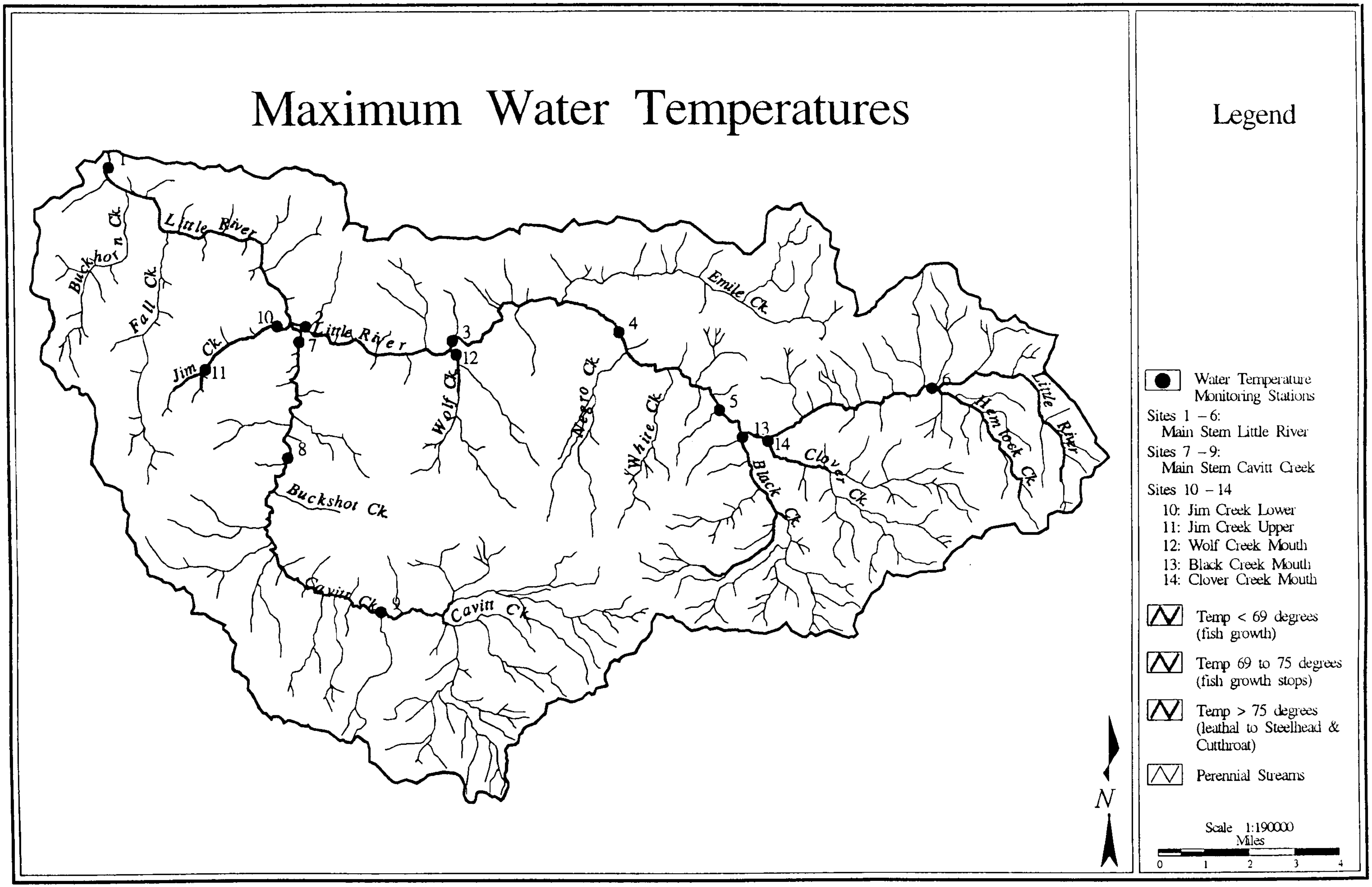
Stream Temperatures

Stream temperatures were monitored at 14 sites (in riffles) during the summer of 1994 to help characterize this watershed. This is only one summer's data and it is not meant to represent a baseline. The drainage areas above these monitoring sites represent a mixture of federal and private lands. Six monitoring sites were in the main stem of Little River from the mouth to just below Junction Creek (25.5 miles). Three of the sites were in the mainstem of Cavitt Creek. Smaller tributaries monitored included Jim Creek (upper and lower sites), Wolf Creek, Black Creek, and Clover Creek (Figure 32 shows all 14 monitoring stations).

The summer of 1994 was one of the lowest flow and warmest stream temperature years on record. Little River was warmer than other large streams that were also monitored. The maximum temperature at the mouth of Little River and other nearby streams are as follows:

STREAM NAME	MAX TEMP 1994	DRAINAGE AREA
Little River	84°F	206 square miles
South Umpqua River	82°	449
Steamboat Creek	80°	165
Jackson Creek	78°	160
Canton Creek	77°	62
North Umpqua River (above Rock Cr.)	73°	886

Figure 32



Maximum Water Temperatures

Lower and Middle Little River Vicinities

The maximum temperatures in the mainstem of Little River showed continued warming in the downstream direction (Figure 33). On July 21, peak maximum temperatures occurred at the six monitoring sites on Little River. Over approximately 18 stream miles, Little River warmed 20 degrees and peaked at 84°F in 1994.

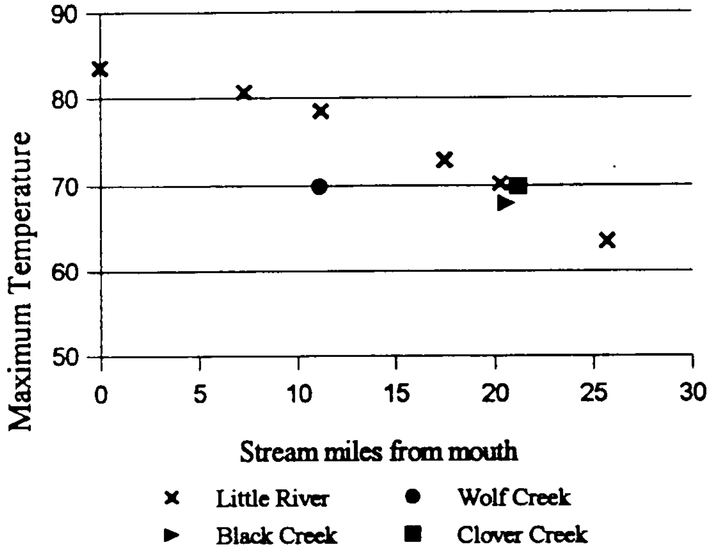


Figure 33. Little River Maximum Temperature Profile (x) and Maximum Temperatures of 3 Tributaries at Their Mouths - Wolf, Black, and Clover Creeks

While single maximums provide an indicator of extreme heating, the length of time high temperatures are sustained is an important consideration of aquatic life. The average maximum temperature for the warmest 2 week period in 1994 was used for this evaluation. The mainstem of Little River from the mouth to the monitoring site below White Creek (17 miles) averaged 70 degrees or warmer. The mouth of Little River over the warmest two week period averaged 80 degrees.

Also important to aquatic organisms and overall water quality is the diurnal fluctuation in temperature from day to night. Night time recovery of cooler water puts fish and other organisms under less stress than where night cooling is limited. In the lower 20 miles of Little River, from Black Creek down to the mouth, the night time minimums during that 2 week period never got cooler than 58°F (Figure 34). This 58°F threshold is a common reference point considered the upper temperature preference for most salmonids. Little thermal recovery occurred in the summer of 1994 for organisms that require cool water to maintain health in the lower 20 miles of mainstream Little River.

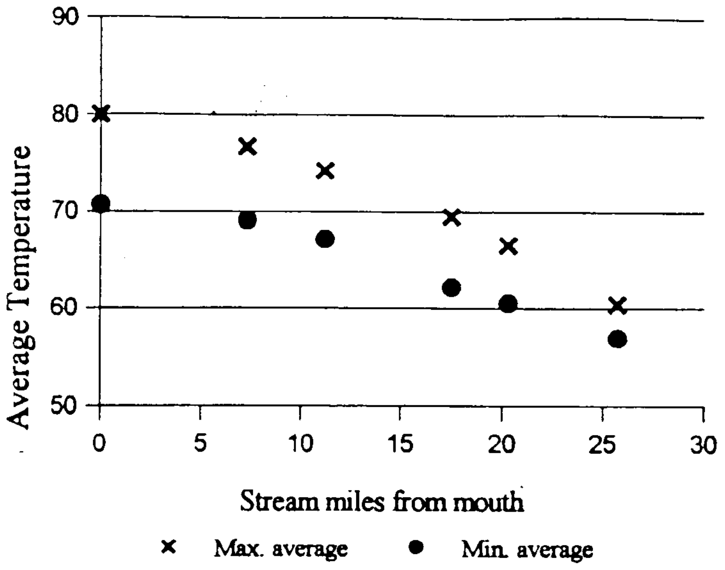


Figure 34. Average Maximum and Minimum Water Temperatures In Mainstem Little River During The Warmest Two Week Period In 1994.

Cavitt Creek Vicinity

The maximum temperatures in Cavitt Creek did not progressively increase downstream as in Little River (Figure 35) Cavitt Creek was monitored by three sites. The upper site, which was just above Tuttle Creek, reached a maximum temperature of 75°F, while approximately 6 miles downstream, the site at Cavitt Falls (recreational site) reached 80°F. At the mouth, Cavitt Creek cooled to 78 degrees. The 2 degree cooling of this segment occurs over a relatively short distance of 3 miles. This type of cooling may be explained by cool ground water input in addition to riparian shade and a narrow channel in lower reaches of Cavitt Creek.

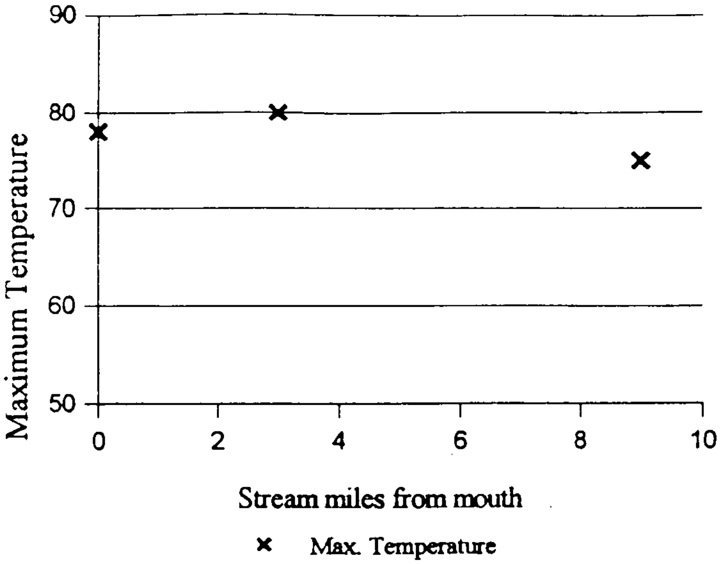


Figure 35. Cavitt Creek maximum temperature profile.

The mainstem of Cavitt Creek only has 57 percent of the perennial stream length shaded. This gentle gradient stream segment is also wide with shallow flow and slow velocity which contribute to stream heating. The perennial tributaries lower in the vicinity generally have the least shaded stream length. The maximum water temperatures in the main stem reflect this accumulative condition of riparian shade loss. The upper watershed of Cavitt has more than 80 percent of the perennial stream length shaded. However, water temperature is warm compared to a similar point in Little River (ie. Little River below Junction Creek). This difference may be related to ground water flows in response to the overall land unit capability.

The diurnal fluctuations in Cavitt Creek also did not follow the progressive downstream warming trend. The greatest fluctuation was measured at the upper Cavitt Creek site. During the 14-day warmest period, the upper site fluctuated 12.8°F. This diurnal fluctuation is by far the greatest fluctuation measured in 1994. The 10.3°F diurnal response at the falls site was the second largest in this vicinity and the complete watershed. At the mouth, Cavitt fluctuated 7.5°F. Streamflow may help to explain these responses however, flow data are not available.

The daily minimum water temperatures during the 14-day warmest period were greater than 58°F at the mouth and the falls sites. However, upper Cavitt recorded 7 consecutive days (during the warmest period) that the temperature was below 58°F, so a portion of Cavitt Creek may provide a limited amount of thermal refuge for "cold water" organisms.

Wolf Plateau, Emile, and Black/Clover Vicinities

These vicinities represent the larger tributaries in the middle segment of Little River. The 1994 temperature monitoring did not include all of these tributaries, but more a representative sample: Wolf, Clover, and Black Creeks. The maximum temperatures were similar for these tributaries, 68-70°F. Figure 33, which displays the maximum temperature profile of Little River, also includes these tributaries for comparison. At their respective confluences with Little River, Wolf Creek was 8°F cooler than Little River, while Black and Clover Creeks were both about the same temperature as Little River. The nighttime minimum water temperatures for Clover Creek during the hottest 2-week period where all warmer than 58°F. Wolf Creek had 11 nights and Black Creek had five nights where the minimum temperature remained warmer than 58°F.

The diurnal fluctuations during the 14-day warmest period were 6°F for the three monitoring sites. These diurnal fluctuations were on the low end of the overall responses. When compared to percent of perennial stream length shaded, the fluctuations are not explained merely by shade. The average percent of perennial length shaded for Clover Creek (four tributaries) is 86 percent compared to 76 percent for Black Creek (two tributaries) and 77 percent for Wolf Creek (Appendix I). The Wolf Creek basin is completely dominated by the moist/ warm and wet-dry/warm land units that produce sustained summer flows. Cool ground water from the deep soils of these land units may explain the cooler water temperatures found in Wolf Creek. Both Black and Clover Creek basins have more of the dry/warm land units. The shallow soils of this land unit have low moisture storage and can be expected to contribute less to summer stream flows.

The volume of water in Little River is probably too great to allow Wolf Creek to cool it. Fish access to Wolf Creek is very limited during summer flows, limiting its availability as a thermal refuge for fish.

Upper Little River Vicinity

Although no specific tributaries were monitored within this vicinity, the upstream-most site in Little River (below Junction Creek) provides an accumulative look at three of the four tributaries (Junction Creek, Hemlock Creek, and Upper Little River) that make up this vicinity.

The maximum stream temperature measured here was the coolest Little River site sampled in 1994 (Figure 33). The peak was 64°F. The higher amounts of shade in upper Little River help to maintain the existing cool water temperatures. Also the upper Little River Vicinity has a preponderance of the moist/cool land unit where snow melt sustains summer flows and cool stream temperatures. The diurnal fluctuation for the 2 week warmest period was 3.5°F which was the smallest in the Little River basin. Only four consecutive nights were water temperatures warmer than 58°F during the hottest 2-week period. Minimum temperatures averaged in the low 50s for most of the summer of 1994.

Stream pH

The Oregon Department of Environmental Quality (DEQ) has set pH standards for the Umpqua Basin at 6.5 to 8.5 for the protection of aquatic life. pH levels above 9.0 (more alkaline) and below 6.5 (more acidic) have adverse effects on some life cycle stages of certain fish and aquatic macroinvertebrates (MacDonald et al. 1991). pH is measured in logarithmic scale. For each additional pH unit of change, the Hydrogen activity changes an order of magnitude. For example, a pH of 8 has ten times more Hydrogen activity than a pH of 7. While a pH of 7 to 8 represents one order of magnitude change, the change in hydrogen activity from a pH of 7 to 9 is two orders of magnitude or 100 times difference in Hydrogen concentration. Because of this logarithmic relationship, fractions of pH are significant changes in concentration.

Accumulations of stream algae can cause streams to become more alkaline through the process of photosynthesis. Photosynthesis during daylight hours consumes Hydrogen ions and elevates pH levels. At night the pH decreases. On cloudy days or in shaded stream reaches not as much photosynthesis occurs and pH levels are lower. Diurnal algae-driven pH cycles in Little River can be as extreme as 9.1 in the late afternoon to 7.8 in the morning (Appendix I).

Conditions that promote algae growth and accumulation are: 1) lack of riparian shade allowing the sun to stimulate algae growth; 2) the presence of bedrock streambeds which is ideal habitat for algae and poor habitat for algae-eating aquatic insects; and 3) a nutrient supply. Conditions that promote lower pH are: 1) effective riparian shade; 2) streambeds with large wood and associated gravel/cobble substrate where algae-eating insects thrive; 3) upslope forest stands that use (cycle) nitrogen and store it in the soil and vegetation, so nitrogen is not as available to runoff into streams, and 4) acidic volcanic geology.

Nutrient runoff into streams from harvested areas can play a role in increased algae and pH levels. In the Coyote Creek experimental watershed, in the South Umpqua, Greene (personal communication, Environmental Protection Agency) found a 70 percent increase in algae growth in waters from a small clearcut watershed compared to partial and no cut basins. Others (Brown and Binkley 1994 and MacDonald et al. 1991) also reported increased nutrient loading in streams following timber harvest and road building.

The first 18 miles of Little River's mainstem, in the lower and middle vicinities, was outside state water quality standards for pH during August of 1994. Lower Cavitt Creek, Little River's largest tributary, also had pH levels between 8.5 and 8.7 which is over the DEQ standard. Several tributaries to Little River and Cavitt Creeks were also sampled during the summer of 1994. Wolf Creek was the only tributary of Little River that exceeded 8.5. Other tributaries that had elevated pH peaks were Emile, Black, and Negro Creeks. Algae accumulations were observed in streams where pH was higher (>8.0). The effects to aquatic life in Little River as a result of these pH levels is presently unknown.

Clover Creek and the Flat Rock branch of Clover Creek, in the Black Clover vicinity, peaked at 7.93. The upper reaches of Little River mainstem, in the upper Little River vicinity, also had lower pH peaks. Algae accumulations were not as evident in these basins.

Historical information on stream chemistry was not available for this watershed analysis. However, pH levels in the Boulder Creek Wilderness basin, a tributary to the North Umpqua, were used as a reference point during the summer of 1994. Boulder Creek, flows into the North Umpqua River 30 miles upstream from Little River's confluence with the North Umpqua. Boulder Creek has comparable geology (all in the Western Cascades provence) but it is only 20,000 acres in size compared to Little River's 132,000 acre drainage area. So its usefulness as a reference stream may be limited. Boulder Creek peaked at 8.0 near its mouth. Boulder Creek has bedrock reaches and sun exposure in its lower, wider reaches but excessive algae was not found there (Appendix I).

Streamflow

Streamflow plays an important role in the maintenance of water quality and the beneficial uses of water. There are extreme differences in streamflows between summer and winter in Little River. Such extremes are typical of mid and lower elevation streams in the southwestern Cascades, where the majority of the precipitation falls as rain or snow in winter months. During summer, streamflows progressively dwindle as the long summer drought continues well into September.

In late summer, low flows in Little River averaged 25 cubic feet per second (cfs) between 1954 and 1987 at the Peel gaging station located 6.3 miles up Little River from the mouth. During the same period, winter base flows were typically in the range of 200 to 300 cfs, with flood peaks measured as 22,700 cfs in 1955 (Little River's flood of record), 21,100 cfs in 1956, and 20,900 cfs in 1964. Peakflows for Little River were gaged (6 miles up from the mouth) from 1953 through 1986. A graph of the annual peaks is in Appendix I-11.

Flow characteristics can be expected to vary by individual subwatershed in Little River and can be explained, in part, by the predominance of certain land units in certain watersheds. With the greater snow accumulation on north aspects and gentle slopes characteristic of moist/warm land units, winter flows from basins with a lot of this land unit may be expected to be lower and more prolonged compared to more flashy winter flows in basins with a predominance of dry/warm land units. This relationship between land units and winter peak flows is complicated where moist/warm predominates because of the abundance of harvest related openings and road construction that exists today. Summer low flows in basins with a lot of moist/warm land units are expected to be greater than in basins with more dry/warm land units because the trees don't require or use as much water so there is a surplus of soil moisture and runoff. Also, the moist/warm weathering environment increases soil depth and soil water storage. So excess water is continually released into streams even during the summer drought. In moist/cool land units (located at higher elevations), deep snow accumulations lead to snow melt in the spring that sustains summer low flows and cooler stream temperatures. Basins with a lot of wet-dry/warm land area have similar hydrologic flow behaviors as those with moist/warm land units: lower more prolonged peak stream flows and sustained low flows during summer. In addition the wet-dry/warm units have a relatively low stream density and an abundance of ground water runoff because of earth flow and landslide terrain. The Wolf Plateau is a vicinity dominated by both wet-dry/warm and moist/warm land units.

Streamflows have not been systematically measured in the tributaries of Little River, however the above generalizations on the relationships between streamflows and land units initially appear to be supported by flow measurements taken during the summer of 1994, and the hydrologic literature on streamflow and soil depth.

Summer low flows in the lower reaches of Cavitt Creek and Little River may be affected by human water withdrawals. The volumes withdrawn and the consequences are not known, but water removal during the summer can potentially decrease available habitat for aquatic life, increase summer water temperatures and pH simply because less water is in the channel. The actual degree of impact from water withdrawal is probably not, by itself, a significant factor limiting aquatic health. Added to other more significant factors such as temperature, algae growth and pH, water withdrawal may be an additive factor of concern.

Effect of roads on peakflows

Recent analysis of long term hydrologic records has demonstrated detectable changes in the timing and magnitude of winter peakflows that appear to be associated with road construction and harvesting. Recent research in Willamette River tributaries have documented peak flow increases of 30 to 50 percent or less in managed watersheds (Jones and Grant, submitted).

For long term stability and extended use in a wet climate, roads have been constructed to efficiently drain water away from road surfaces and subgrades. In the natural environment, there is nothing that mimics a road. The majority of roads within the watershed are constructed with ditches and/or insloped road surfaces that are intended to control water flow from the road surface, upslope overland flow, and ground water that is intercepted and brought to the surface. Once it is in the ditch, water reaches the local stream channel faster than in an unroaded situation. In fact, some ditchlines effectively function as stream channels, so the actual length of flowing "streams" during rain storms is extended in the form of road ditches. Often, the same effect occurs below outlets of ditch relief (cross-drain) culverts where the concentrated outflow of water erodes a gully and reaches a stream channel without infiltrating into the ground.

Wemple (1994) developed a process and investigated the effective extension of stream networks resulting from road drainage. She estimated that roads in her study area extended the stream network 60 percent over winter base flow stream lengths and 40 percent over storm event stream lengths. Wemple's process was applied as part of the Jackson Creek watershed analysis, in the South Umpqua Drainage (1995). That effort found that the existing road system extended the stream network by 26 percent, based on winter base flow stream lengths. They also discovered that 10 percent of the length of unsurfaced roads and 31 percent of the length of surfaced roads had ditchlines that functioned as "streams" during winter storm events. This difference results from road design characteristics, not the road surface.

The Wemple model and Jackson Creek inventory results were applied to Little River. For the roads where surface type information was lacking (private land), 20 percent of the road length was assumed to have ditchlines that functioned as streams. Our analysis found that there are stream extensions in Little River that range from 12 percent to 57 percent in various tributaries (Table 28 and Appendix H). With an increase in surface flow as a result of ditchlines in a watershed, the rain or melting snow gets into streams quicker.

Carlston (1963) determined that in drainages up to 100 square miles in area, that the mean annual flood is proportional to the square of the area's stream density. Based on field research, he showed that this relationship holds true regardless of topographical relief, hillslope, stream gradient, and amounts or intensity of precipitation. The dominant factor affecting peak flows in these smaller basins is basically just how quickly the water gets to the channels via gravity.

Carlston's equation was used to relate increases in effective stream length (and therefore stream density) to increases in mean annual floods. This revealed that small increases in stream length can result in relatively larger increases in peak flows. The 12 percent to 57 percent increases in stream lengths due to roads may result in as much as 26 percent to 148 percent increases in the mean annual flood in various individual subwatersheds in Little River (Appendix H). These increases are based on an assumption that the mapped natural stream lengths truly represent the stream network during the mean annual flood. If stream lengths are actually greater than what is mapped, the relative extension due to road ditchlines is less. In Jackson Creek, the mapped length of natural streams that flow during winter rain storms was thought to be underestimated; therefore the Forest Hydrologist suggested that actual stream extension due to roads during storm events may be approximately one-half that determined in their inventory. Reducing Little River's estimates by one-half results in stream extensions of 6 percent to 29 percent and mean annual flood increases of 12 percent to 66 percent which is more in line with what Jones and Grant (submitted for publication) found in tributaries on the Willamette River.

The findings for larger vicinities may mask the site specific effects found in some smaller tributaries. Some localized tributaries have highly variable amounts of roads and natural stream lengths. Therefore, the estimated increase in flows as a result of roads are highly variable among tributaries (Figure 36 and Appendix H).

Other factors may explain the in-channel effects observed in Little River, such as the increased velocity of water in channels due to loss of instream large wood, the frequency of stream crossings and other complex processes not well understood. The intent of Table 25, Figure 36, and Appendix H-29 is to highlight trends and help focus restoration inventories. This is not meant to be a categorical explanation of the effects of roads on peakflow changes.

Table 28. Estimated Stream network extension and possible peakflow increases in the seven vicinities of Little River.

VICINITY	MILES OF NATURAL STREAMS	MILES OF ROAD FUNCTIONING AS STREAMS	STREAM NETWORK EXTENSION (%)	ESTIMATED RANGE OF FLOW INCREASES AS A RESULT OF STREAM EXTENSION (%)
LOWER LITTLE RIVER	146.4	35.2	24	27-57
CAVITT CREEK	258.1	73.6	24	27-65
MIDDLE LITTLE RIVER	120.3	41.3	34	40-80
WOLF PLATEAU	80.3	28.3	35	41-83
EMILE CREEK	42.5	14.4	34	39-79
BLACK/CLOVER	91.8	29.6	32	37-75
UPPER LITTLE RIVER	62	17.9	29	33-66

A particular basin's sensitivity to increased peakflows depends, in part, on the natural drainage density of the basin. Drainage basins with fewer streams per square mile will experience higher peakflow increases as a result of roads than will basins that naturally have a lot of streams. Plusfour and Dutch Creeks, for instance, have very low stream densities because they are in the gentle earthflow and upland plateau terrain of the wet-dry/warm land units. There are fewer streams to handle the rapid runoff so stream flow increases are greater, potentially leading to relatively more downcutting, bank failures, bed scour and mass wasting where streams undercut adjacent slopes. The gentle terrain that is most prone to experience higher peakflows from roads also has the most sensitive stream channels. The deep, fine textured soils typical of the ancient land surfaces and earthflow terrain are susceptible to stream downcutting and bank erosion. The phenomenon of rapid runoff delivered to those highly sensitive channels is further exacerbated by the fact that so much of this gentle terrain was harvested by tractors. Tractor harvest can compact soils, decreasing the capacity for water to infiltrate into the soil, further adding to surface runoff.

At the other end of the scale, Copperhead and Fall Creek basins naturally have very high stream densities because they are in the highly dissected granitic terrain where streams have readily formed on steeper erosive surfaces. Since there are more streams to handle the rapid runoff, the increase in peakflows caused by roads is not as extreme or potentially damaging to stream channels.

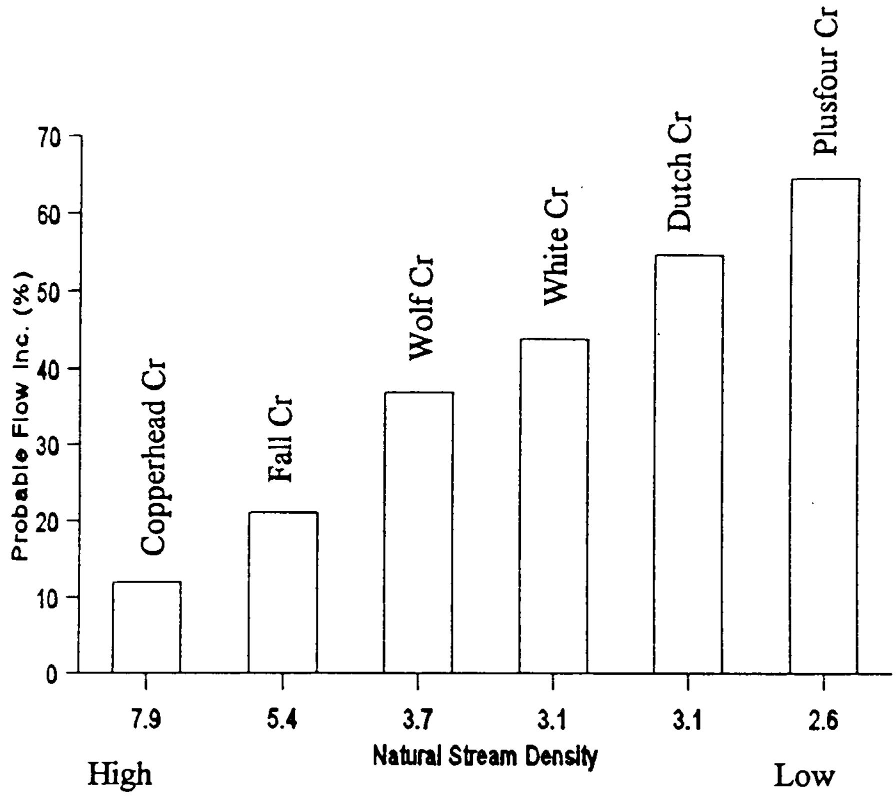


Figure 36. Potential mean annual flood increase resulting from extension of stream network from road ditchlines for selected tributary basins of Little River.

The percent increase in peakflows as a result of roads in Figure 36 is based on the assumption that our stream mapping underestimated the length of flowing streams during winter storms.

Carlston (1963) and Rosgen (1993) suggest the importance of assessing the magnitude of the mean annual flood (recurrence interval = 2.33 years) because most of the work of stream erosion (over time) is done by flows of moderate magnitude with recurrence intervals of one to two years. A significant amount of the sediment in some streams may be coming from the streams or tributary streams themselves as a result of entrenchment, bed scour, bank failures, and mass wasting as a result of undercutting adjacent slopes. Ongoing, elevated peak flows in some of the smaller drainages may also hinder natural adjustment and recovery processes within the streams. Recovery is hindered by the prevention of aggradation and sorting of bed material, hindering revegetation and stabilization of streambanks, and by reducing establishment of stable, regularly inundated floodplains adjacent to active channels (Rosgen, personal communication).

Effect of canopy closure on peakflows

Forest canopy removal can also affect peakflows. Where the forest canopy is absent or partially gone due to harvest, fires or roads, snow accumulates in a snowpack rather than being intercepted and held in tree crowns. Snowpacks in forest openings are exposed and more susceptible to rapid melt during warm winter rain storms than snow stored in tree canopies or under canopied stands with at least 70 percent crown closure (Coffin and Harr, 1992). Forest stands with less than a 70 percent crown closure (generally about 40 years of age or less) have the potential to deliver a greater amount of water to the soil which contributes to increased peakflows. This phenomena occurs in the transient snow zone where snow can accumulate and rapidly melt off several times each winter. In Little River, the transient snow zone is between approximately 2000 and 5000 feet in elevation which makes up 69 percent of the watershed (Figure 37). The amount of created forest openings that have less than a 70 percent crown closure are greater today than during the two historic reference points (Table 29). Hydrologic recovery of an opening improves as the stand regenerates through time. For instance, a brand new clearcut has no hydrologic recovery while a 25 year old stand is about 60 percent recovered. The values in Table 29 should be used as a yardstick to compare to historic conditions, not as a calculation to predict peakflow increases that can be done at the scale of a subwatershed during project area planning.

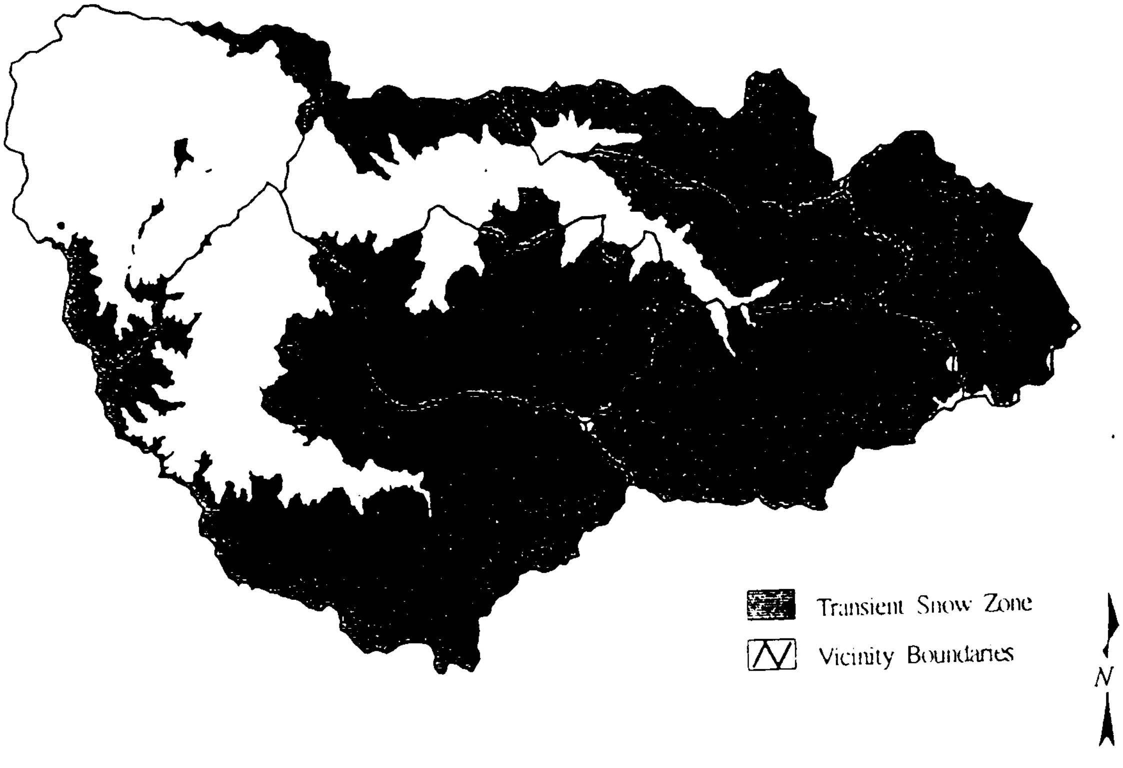


Figure 37. Transient snow zone of the Little River watershed.

Table 29. **Hydrologically recovered acreage in the transient snow zone within the seven vicinities of Little River, 1995 and past.**

Vicinity	Acres within transient snow zone	% of vicinity in transient snow zone	% of snow zone hydrologically recovered, 1995	% of snow zone hydrologically recovered, late 1800s - late 1930s
Lower Little River	3,625	16	58	87 - 99
Cavitt Creek	26,568	70	74	78 - 97
Middle Little River	12,913	60	77	92 - 98
Wolf Plateau	12,548	86	71	85 - 99
Emile Creek	7,957	91	79	76 - 94
Black/Clover	16,729	98	80	75 - 97
Upper Little River	10,279	99	93	86 - 93

Sediment Regime

Geomorphic (or land shaping) processes of surface erosion and landslides are natural cyclic processes that strongly influence hydrologic patterns and water quality. Roads also have the potential to affect the sediment regime but are not linked to a natural process.

Surface Erosion

The types of surface erosion include: rill and gully (channelized erosion); sheet erosion (non channelized overland flow), and soil creep or ravel (moved by gravity). Surface erosion increases on hillslopes where soils are compacted and lose the ability to absorb water (infiltration). Soil compactions occurs when tractors operate on fine textured soils. Livestock grazing and intense fire can also reduce the soil infiltration capacity. In areas underlain by granitic bedrock, where soils dry out early in the summer and lack cohesion, dry ravel can be a significant source of local surface erosion.

Landslides

The mass movement of soil is a major component of hillslope erosion and sediment transport to streams in mountainous terrain. Erosion and sedimentation are natural processes. When landslides occur at a natural rate, they provide an important supply of gravel and large trees from upslope locations, necessary to create stepped channel profiles and suitable habitat (Naiman 1993). Landslides (slumps and earthflows, debris avalanches, and debris flows) contribute significant amounts of sediment to streams in managed watersheds such as Little River.

Slumps and earthflows are deep-seated, land movements that develop in deep, fine textured soils where groundwater movement is restricted. The distinction between these two types of landslides are that slumps involve the movement of intact blocks of soil that fail by a backwards rotation into the hillslope in addition to downslope movement; whereas earthflows involve movement by flowage due to excess water saturation. Earthflows are seasonally active with most displacement occurring during winter and spring after soils become thoroughly saturated and high water tables develop. Although slumps and earthflows are generally slow moving, sediment delivery to stream channels can be quite high and chronic. The channel obstruction caused by an earthflow pushing into the channel results in bedload deposition upstream, creating new or revitalizing existing spawning gravels. Downstream effects of an obstruction usually results in blankets of fine sediment and organic detritus overlying the streambed. Idiot slide is an example of an active earthflow located in upper Cavitt Creek.

Debris avalanches are shallow, rapid landslides resulting from the failure of a block or wedge of soil, rock, and organic debris that occur outside of stream channels.

Debris flows (or torrents) are rapid movements of large volumes of water mixed with soil, rock, and organic debris down steep stream channels. Debris flows are one of the most common forms of landslides in our region and act as the primary agent transporting sediment and large wood to lower order stream channels. Although debris flows occur less often than debris avalanches, the effects caused by debris flows may dominate local channel morphology for centuries and exert a strong influence on aquatic ecosystems upstream and downstream of the point of entry. Because of the high velocities and volumes of sediment and debris, the erosive power generated as the debris flow moves downstream can scour hundreds of yards of channel to bedrock. The detrimental effects of debris flows include significant alteration of stream channels reducing habitat diversity, loss of riparian vegetation, large-scale movement and redistribution of gravels and large woody debris, damming and obstruction of channels, and accelerated bank erosion and undercutting. Adverse effects to fish habitat and water quality include elevated water temperatures resultant from loss of riparian vegetation, and subsequent algal blooms. Loss of gravels along the scoured tracts of debris flows reduces suitable habitat for aquatic insects that consume algae and help keep pH levels within normal ranges. Downstream effects include fine sediment accumulation in spawning gravels. In those instances where debris flows are deposited at the point of entry, they often form blockages that can isolate upstream resident fish populations plus prevent adult anadromous fish from using this habitat. Therefore, resident and anadromous salmonid distributions are relatively dynamic in these areas, shifting up and downstream in response to large scale landslides and debris flow events.

Reference and Existing Landslide Conditions

Aerial photos were used to map both the recent and historic landslides in the Little River watershed over four different time periods: pre-1946, 1947-1966, 1967-1982, and 1983-1991. Landslide features identified in the 1946 photos are assumed to represent failures that occurred during the previous couple of decades; vegetative growth eventually masks recognition. A map showing where the slides are located within the watershed is in Appendix A-14. The landslide mapping has some limitations. Only a minor amount of field checking was done to verify the existence of landslides due to time constraints. Aerial photo coverage of the BLM and private lands west of Cavitt Creek is lacking for the 1946 flight year and thus underestimates the reference condition in that particular area prior to significant land management. Also, different scales of aerial photos were used. For example, the 1965/66 photos were low level flights that revealed much detail; as opposed to higher elevation flights that disclosed less detail. And finally, landslides occurring in old-growth and mature forests may be masked by the surrounding canopy.

Based on the aerial photo analysis, the frequency of landslides has increased substantially since the advent of intensive land management activities. Of the total 1,134 landslides in the basin, 73 percent were linked to management activities. (Table 30).

Table 30. Estimated landslide occurrence and suspected cause based on aerial photo interpretation in Little River basin.

Time Period	Natural Landslides	Management Related Landslides	Total Landslides
pre-1946	(104) 98.1%	(2) 1.9%	(106) 9.3%
1947-1966	(163) 21.3%	(601) 78.7%	(764) 67.4%
1967-1982	(22) 11.8%	(165) 88.2%	(187) 16.5%
1983-1991	(12) 15.6%	(65) 84.4%	(77) 6.8%
TOTALS	(301) 26.5%	(833) 73.5%	(1,134) 100.0%

The pre-1946 time period is the baseline or reference condition. At that time, less than 2 percent of the drainage was developed by roads and timber harvests. Most of the landslides occurred during the 1947-1966 time period. This represents a seven-fold increase from the pre-1946 period. The high number of landslides that occurred from 1947 to 1966, both natural and management-related, is considered to be a consequence of the dramatic increase in road construction and timber harvest (Table 32), coupled with storm events. Road construction techniques during this period were poor and led to a preponderance of road-related landslides. Also, there were five, 5-year or greater flood events during the period of 1947 to 1966

(Appendix A-15). During the other two time periods, 1967-1982 and 1983-1991, landslides appeared to be associated with roads and timber harvest. Substantial winter storms also occurred in 1971 and 1982 (Appendix I-11, less than 5 year events) that may have contributed to slides during these periods.

The number of landslides in a given area (landslide density) is useful to determine areas that may be prone to future landslides and where impacts have already occurred (Table 31).

Table 31. Landslide density and suspected cause in the vicinities of Little River. Density is reported as landslides per square mile.

Vicinity	**Natural (slides/square mile)**	**Management related (slides/square mile)**	**Combined (slides/square mile)**
Lower Little River	0.6 slides/square mile	4.5 slides/square mile	5.2 slides/square mile
Cavitt Creek	1.6	3.8	5.4
Middle Little River	1.3	3.3	4.6
Wolf Plateau	1.1	5.2 *	6.2
Emile	1.0	3.4	4.3
Black/Clover	3.6 *	4.2	7.8 *
Upper Little River	1.6	3.5	5.1
BASELINE MEAN	1.5	4.0	5.5
TOTALS	(315)	(819)	(1,134)

* denotes highest density

Table 32. Cumulative percent of harvest in the vicinities of Little River.

Vicinity	Acres Harvested	% Harvested	pre-1950	1950-1960	1960-1970	1970-1980	1980-1990	1990-1995
Lower Little R	11,898 acres	54.4%	7.7%	36.5%	58.4%	66.6%	94.1%	100%
Cavitt Creek	22,694	60.2	2.6	13.5	55.4	80.3	96	100
Middle Little R	12,316	48.7	6	29.5	60.6	76.2	93.8	100
Wolf Plateau	11,377	78.4	1.1	24.9	62.4	84.4	96.4	100
Emile	4,245	48.7	0	30	60.2	78.4	97.8	100
Black/ Clover	6,176	36.2	1.6	16.6	45.7	64.5	93.7	100
Upper Little R	3,662	35.2	0	30.6	47.9	70	91	100
Decade Totals			1.9	11.9	17.5	10.5	10.4	2.7
Cumulative Totals	131,825	54.9	1.9	13.8	31.3	41.8	52.2	54.9

Both natural and management-related landslide densities are displayed for all the tributaries within the Little River watershed in Appendices A-20 &21. The granitic terrain (found in Fall, Jim, Copperhead, Boulder and Upper Mckay Creeks, colored green in Appendix A-4) has the highest landslide density of all rock types at 12.1 landslides per square mile (Appendix A-18). The next highest landslide density is found in the highly altered tuffaceous volcanic rocks of the Colestin formation, at 7.9 landslides per square mile. This rock unit is primarily found paralleling the mainstem areas of Cavitt Creek (colored brown in Appendix A-4).

Landslides not related to management activities can point out inherently unstable areas within the landscape. The Black/Clover vicinity has the highest natural landslide density. Two Clover Creek tributaries within this vicinity have 5.1 and 4.9 slides per square mile which were not related to management activities in the photo analysis. Both these subdrainages are in very steep terrain (many slopes are greater than 60 percent).

The high density of management related landslides in the Wolf Plateau may be explained by the high amount of timber harvest there. This vicinity has been 78.4 percent cut, while the Upper Little River and Black/Clover vicinities experienced the least amount of harvest (Table 32). The Cavitt Creek vicinity ranks moderately with respect to management-related landslides, however the Buck Peak Creek subwatershed within that vicinity has the highest overall rate of 17.7 landslides per square mile. This is attributed to extensive clearcut logging and roading in a watershed that is primarily in granitic terrain. Similarly, the Fall Creek subwatershed which is underlain by granitic bedrock, has a landslide density of 9.9 occurrences per square mile. Of 1,134 total landslides identified in the watershed, some 829 or 73 percent lie within the riparian areas, and therefore were probably a direct source of sediment input to streams (Appendix A-19).

Erosion Potential and Sediment Delivery

Natural Erosion Processes

The potential to accelerate erosion processes, that would result in yet more sediment delivery to streams in Little River, was assessed in terms of relative probability. The relative risk of sediment delivery from landslides was determined using a weighted ranking system. The ranking was based on the findings of the landslide analysis, field observations, and review of the scientific literature. Criteria for this evaluation include: geologic map units grouped by landslide density, slope class, and geomorphic map units weighted by potential of sediment delivery (Appendix A-22). The five categories of risk are: high 25-30; moderate to high 18-23; moderate 12-17; low to moderate 6-11; low 0- 5. These classes are displayed by vicinity in Table 33. The erosion and sediment delivery risk map is in Appendix A-24.

Table 33. Percent of land area falling within 5 erosion risk classes in the vicinities of Little River.

Vicinity	Low	Low-Moderate	Moderate	Moderate-High	High
Lower Little River	38.1%	22.6%	11.7%	10.4%	17.3%
Cavitt	30.8	36.2	22.4	4.4	6.3
Middle Little River	25.2	36.2	20.6	6.7	11.3

Vicinity	Low	Low-Moderate	Moderate	Moderate-High	High
Wolf Plateau	51.6	35.2	9.3	2.5	1.5
Emile	42.1	14.5	13.9	11.1	18.5
Black-Clover	18.8	31.1	23.2	15.4	11.7
Upper Little River	30.7	37.5	15.2	12.0	4.4
Totals	32.6	31.9	17.8	8.1	9.8

The Emile and Lower Little River vicinities have the highest percentage of land that fall within a high rating for erosion and sediment delivery. The Black/Clover and Middle Little River vicinities follow next.

Sediment Delivery From Roads

There are 960 miles of roads in the Little River watershed, with 630 miles under either Forest Service or BLM jurisdiction. For this watershed analysis, all the Forest Service and BLM roads were inventoried for their potential to produce sediment at stream crossings. Information gathered at the crossings was used to determine: 1) the potential for culverts to plug, 2) culvert flow capacities compared to predicted stream peak flows, and 3) the potential for streams to be diverted out of their channels as a result of stream crossing failures. A total of 1,051 crossings were verified and assessed in the field. Appendix H contains a description of the inventory methods and additional findings.

Six hundred and fifty-nine or 63 percent of the crossings were determined to have a high (>50 percent) probability of failing during a 100-year flood. Roads of all maintenance levels (maintenance level 1 = physically closed; maintenance level 2 = open for high clearance vehicles only; maintenance level 3 + = maintained for passenger cars) have some crossings at high risk of failure. If these crossings failed, 154,569 cubic yards of sediment could wash into streams (Table 34). This volume is comparable to more than 12,000 dump truck loads of soil, or enough to fill a football field, end to end, to a height of 87 feet. Crossing failures are typically the result of culvert inlets becoming plugged with debris and sediment or simply because culverts are not large enough to handle peak flows. Results may include wash-out of road fill at the crossing itself or road fill and hillslope erosion resulting from the stream being diverted out of its channel.

Table 34. Erosion potential at stream crossings on Forest Service and BLM roads in the Little River watershed.

		High		Medium		Low	
Operational Road Maintenance Level (ML)	Total Crossings	Number of Crossings	Total Potential Volume, cubic yds	Number of Crossings	Total Potential Volume, cubic yds	Number of Crossings	Total Potential Volume, cubic yds
ML na	31	19	2646	10	781	2	17
ML 1	62	32	4606	15	3250	15	271
ML 2	544	333	82,252	179	43,612	32	974
ML 3+	414	275	65,065	106	22,677	33	10,331
Total	1051	659	154,569	310	70,320	82	11,593

Culverts with drainage areas greater than 100 acres were assessed for their ability to carry a variety of peak flows. Stream discharges for flood events of 100, 50, 25, and 10 years were calculated for 189 culverts. Eighty-one percent of these are not big enough to handle a 100-year flood (Table 35). The effects of floods on culvert washout are not fully predictable. However, the field assessments of these culverts show that as much as 64,805 cubic yards of soil could be delivered into streams in a 100-year storm. The proportion of culverts that would fail under lesser storms is also substantial. Under a 10-year flood, 61 percent or 116 culverts with drainage areas of at least 100 acres could fail, delivering as much as 30,357 cubic yards to streams in Little River (Table 35). These culvert assessments only analyzed the capacity of culverts to pass water, not the additional need for passing debris and bedload mobilized within the streams during peak flow conditions. Sediment volume estimates are based on site-specific assessments of either road fill wash-out at the crossing or erosion resulting from stream diversion.

Streams diverted out of their original channels may sometimes flow down the road grade and enter the channel of another stream. This can lead to high and unnatural flow conditions with significant erosional results within the stream itself. Three hundred fifty-nine (34 percent) of all inventoried crossings have the potential for stream flow to be diverted out of their natural channels and into other streams. Volumes of sediment associated with this type of in-stream erosion were not estimated, but would be in addition to the figures reported.

Table 35. Potential culvert failures and erosion potential in flood events on Forest Service and BLM roads in Little River.

		100 year flood		50 year flood		25 year flood		10 year flood	
Vicinity	No. Culverts with drainage area> 100 acres	No. of Culvert Failures	Volume of soil washout cubic yds	No. of Culvert Failures	Volume of soil washout, cubic yds	No. of Culvert Failures	Volume of soil washout cubic yds	No. of Culvert Failures	Volume of soil washout, cubic yds
Lower Little River	5	3	784	2	512	2	512	2	512
Cavitt Creek	54	45	10,473	43	9,579	39	7,513	36	6,984
Middle Little River	39	33	16,624	32	16,184	30	7,061	26	5,780
Wolf Plateau	30	25	12,890	24	11,414	20	8,374	18	7,491
Emile Creek	10	9	3,186	9	3,186	8	2,137	7	2,063
Black/ Clover	27	19	9,783	18	7,704	16	5,716	14	3,159
Upper Little River	24	19	11,065	18	10,611	16	8,396	13	4,368
Total	189	153	64,805	146	59,190	116	39,709	116	30,357

Numerous studies and investigations have been conducted to determine sediment delivery to streams resulting from surface erosion of cut slopes, fill slopes and driven surfaces of roads. Generally, they have shown that erosion of cut and fill slopes occurs mainly within the first few years after construction, decreasing greatly as the slopes stabilize with vegetation (Burroughs and King 1989). Erosion of driven road surfaces varies greatly with the type and amount of traffic, season of use, and the type and quality of road surface material (Reid and Dunne 1984). No inventory of these types of road-related surface erosion was made as part of this analysis. Nearly all roads within Little River are older than five years and have well vegetated slopes. Generally, roads that lack high quality road surfacing material are used for commercial haul only during the dry season of the year when potential for sediment delivery to streams is low. An erosion inventory and assessment of roads within the Dumont Creek watershed, just south of the Little River watershed, addressed sediment delivery from cut slopes. During normal climatic years, an estimated 200 cubic yards of sediment is annually delivered to the Dumont stream system as a result of cut bank erosion on 114 miles of road (USFS files). If conditions are similar in Little River, approximately 1700 cubic yards of annual sediment delivery results from cut banks on the watershed's 960 road miles. Rates of cut bank erosion are likely higher on the granitic soils within Cavitt Creek and Lower Little River Vicinities. Overall, the total quantity of sediment annually entering streams from road-related surface erosion is relatively small compared to the amount of sediment associated with mass wasting and potential stream crossing failures. Chronic delivery of those surface erosion related quantities may, however, be of significance in some locations in the watershed where aquatic systems are particularly sensitive to small influxes of fine sediments.

Interactions of Landscape Processes and Ramifications to the Aquatic Ecosystem

The various landscape scale features present throughout the Little River basin, such as geology, elevation bands, slope steepness, fire disturbance, moisture and temperature conditions are in large part responsible for many of the physical habitat features visible today.

Describing each of these features in the context of how they influence the aquatic system is essential in order to understand the diversity of the watershed. Therefore, features that interact together to form relatively predictable responses to aquatic or terrestrial ecosystems will be discussed together in the context of the general vicinities in which these responses are occurring. This will allow a broad based discussion of some of the landscape scale processes that are occurring throughout the watershed.

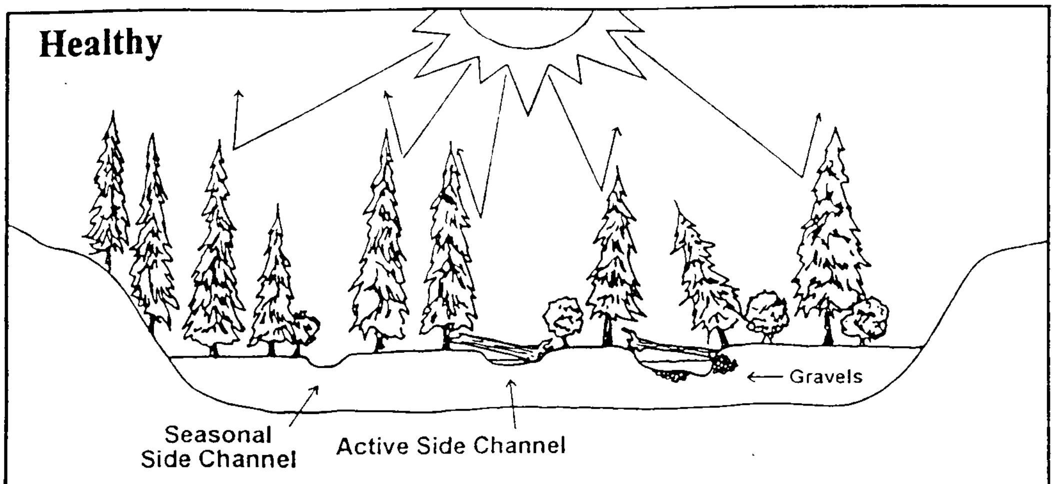
Cavitt Creek and Lower Little River Vicinities

Investigations looking at fish species distribution within Little River and comparing it with major geologic rock types, slope steepness, and moisture/ temperature patterns in the basin have revealed some interesting trends. For instance, of the stream miles dominated by resident cutthroat trout within Little River, 31 miles, or 90 percent, are found within the Cavitt Creek and Lower Little River vicinities, which are dominated by a relatively gentle to moderate sloped landscape, with slopes usually less than 60 percent.

These vicinities are also dominated by the dry/warm land unit, receiving substantially less precipitation than those areas in much of the upper Little River watershed, with much of it falling as rain instead of snow. As a result of these precipitation patterns, soil types, and geology, Cavitt Creek contributes a much smaller proportion of the summer low flow than a similar sized area of the upper Little River watershed.

From a flood or peak flow standpoint, the Cavitt Creek and Lower Little River vicinities have a relatively small percentage (roughly 50 percent) of their combined drainage area in what is known as the transitional snow zone (elevations between 2,000 and 5,000 ft.). As a result, many streams in these areas would not be as susceptible to the larger flood events brought about by warm, rain-on-snow storm events.

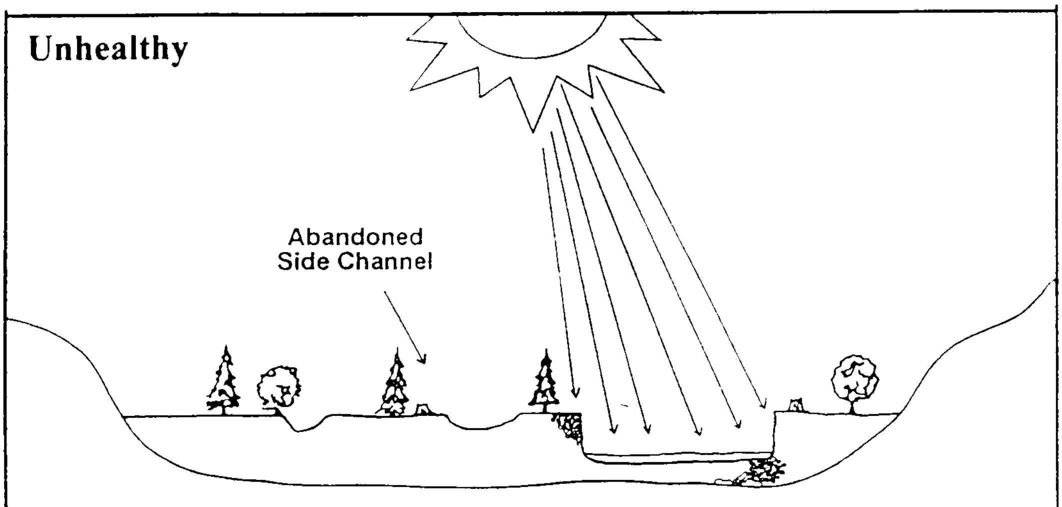
Larger stream channels flowing through these gentle terrain areas tend to have certain identifying characteristics that distinguish them from channels in the steeper areas of the upper watershed. These streams tend to be of lower gradient, have wider valley bottoms, meander back and forth across the valley bottom, contain more alluvial substrates (deposited by water), and contain higher levels of fine sediment (silts, sands, and clays) within their streambeds (Figure 38).



Healthy Channel:

- ✓ Complex habitat
- ✓ Low gradient channel
- ✓ Meandering
- ✓ Excellent Shade
- ✓ Wood found individually & in jams
- ✓ Many pools
- ✓ Narrow, deep channel
- ✓ Predominantly gravel substrates
- ✓ Numerous active side channels
- ✓ Stable banks

Figure 38. Example of a healthy "unconstrained" (wide valley) channel type.



Unhealthy Channel:

- ✓ Simplified habitat
- ✓ Downcut, widened channel
- ✓ Fewer meanders
- ✓ Little shade
- ✓ Little large wood
- ✓ Fewer pools, shallow
- ✓ Gravel, sand, and silt substrates
- ✓ Fewer active side channels
- ✓ Unstable banks, more downcutting and erosion

Figure 39. Example of an unhealthy "unconstrained" (wide valley) channel type.

There are a variety of processes responsible for forming the specific stream channel types seen in these areas. The localized areas of earthflow geology along the mainstem of Cavitt Creek have contributed large landslides directly into the stream channel over time. These slides have had the effect of "damming" portions of the stream, which resulted in large amounts of sand and gravel depositing on the upstream sides of these dam features. These sediment depositional areas caused the formation of wide valley bottoms that can still be seen throughout much of this area.

In the mainstem channels found in Buckhorn, Fall, and Jim Creeks, however, the presence of wide valley, unconstrained channels is more a result of the older land surfaces found there. The landscape in these areas (Coastal and Klamath geologic provinces) has been exposed to erosional forces for a much longer period than the relatively "new" rock units of the western cascades geologic province. As a result, the stream channels have had more time to erode, aggrade, widen, and generally form the wider valley characteristics that are associated with more "mature" stream channels.

Large wood is extremely important in these low gradient systems that contain an abundant source of fine sediment. Log jams, and to a lesser extent, individual pieces of large wood, both act as a source of roughness that traps sediment and helps to moderate its progression down a given stream channel. In streams with extremely high sediment loads, the few areas of quality spawning gravels are often only found in association with these wood formations where the wood increases localized flow enough to flush clean an area of gravel. Much of the wood naturally found in these systems has been on site for many years. The combination of a wide valley bottom, low gradient, and meandering channel result in a system that tends to retain its large wood, rather than wash it downstream.

These gentle terrain areas have a frequent, but low intensity fire regime, so the primary mechanism of large wood input is not directly correlated with large, stand replacing fires, as it is in the upper Little River basin. Fires in this area tend to burn the smaller fuels along the ground, leaving the large conifer overstory relatively intact. Large wood enters the system at a slower rate, usually in association with windstorms, natural mortality, and stream bank cutting as the channels meander back and forth across the floodplain.

As mentioned previously, these low gradient, meandering stream channels are oftentimes some of the most productive areas within any given stream system. The primary mechanism causing this high productivity is the fact that a large percentage of the nutrients that enter these systems tend to be retained on-site. In addition, the low gradient nature of the channel, combined with the extensive floodplains and side channels, tends to provide excellent over-wintering habitat for juvenile fish, allowing them to survive the rigors of high winter and spring flows.

Wolf Plateau Vicinity

From a fisheries standpoint, the Wolf Plateau is an area of transition. The resident salmonid communities gradually shift from a resident cutthroat domination to a mix of resident rainbow and resident cutthroat trout. White Creek, the furthest upstream tributary of this plateau vicinity, is the uppermost tributary providing habitat for cutthroat trout. Only one cutthroat was found in Taft Creek (located upstream of White Creek).

In addition to the resident fish, the anadromous fish community also changes in this vicinity. Above White Creek, a large natural falls known as the Poore Creek falls likely served as a complete barrier to chinook and coho salmon, and was likely a partial barrier to steelhead historically. However, a fish ladder was constructed at the falls in 1988, allowing chinook, coho, and more steelhead to access habitat above that they were not able to use historically. Since the installation of this ladder, however, chinook and coho escapements into the Little River basin have not been large enough to fully seed this habitat, and the anadromous waters above this falls are still dominated by steelhead trout juveniles. Recent snorkel surveys of this area did not identify any juvenile salmon.

The Wolf Plateau is an elevated plateau, where surface and stream erosion have been slowed by resistant rock types. The topography of the area ranges from gentle to moderate, primarily due to the resistant rock "band" that has essentially contained the landscape of the area, and limited the extent to which erosional processes have influenced it. This "resistant rock band" is found throughout the vicinity, resulting in numerous rock outcrops, and waterfalls in the respective stream channels. Because of this, the stream network has not been incised to the extent seen in other vicinities throughout the Little River basin. Therefore, over the long term, this habitat has been difficult to access and has probably not been available for fish to utilize to the extent seen in other areas. This vicinity represents 11 percent of the land within the basin, but only represents 4 percent of the fish bearing miles of stream found within the basin.

Stream channels found within this vicinity exhibit a range of characteristics, but tend to contain a mix of bedrock and gravel/cobble substrates which are often dictated by the presence or absence of large wood. In the absence of large wood, many of these relatively steep channels tend to be dominated by bedrock substrates due to the high energy nature of the flow and past debris flows, which tends to scour out streambed substrates. In those areas where large wood is present however, localized areas of gravel and cobble substrates can be found on the upstream sides of these deposits, resulting in the formation of a "stepped" channel profile (Figure 40).

Upper Little River, Black/Clover, Emile, and Middle Little River Vicinities

Streams in these four upper watershed vicinities generally share similar characteristics. In contrast to the groups of vicinities mentioned previously, all of the stream miles in these uppermost vicinities are dominated by resident rainbow trout. The resident rainbow are associated with landforms that are relatively moderate or steep, with slopes usually greater than 50-60 percent. Geology types of the area, in general, form terrain that is characterized as having highly dissected, steep slopes that are more prone to landslide and debris flow erosional events. Similar to the streams found in the Wolf Plateau, areas of exposed bedrock and waterfalls are relatively common in the channels draining this landscape. In addition, the channels are characterized as being narrower, more incised into small canyons, and having a "stepped" profile similar to the one depicted in Figure 40. Substrates in these channels are dominated by boulders and cobble, with much of this material entering the stream as colluvial input (coming off of slopes) from landslides and debris flows.

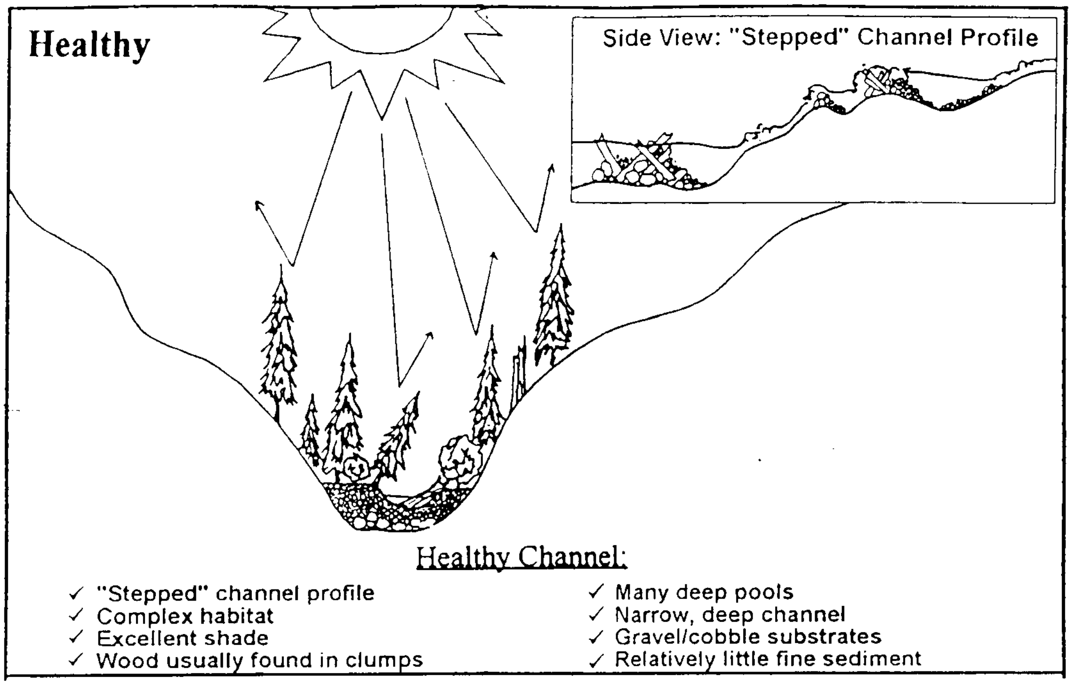


Figure 40: Example of a healthy "constrained" (narrow canyon) channel type.

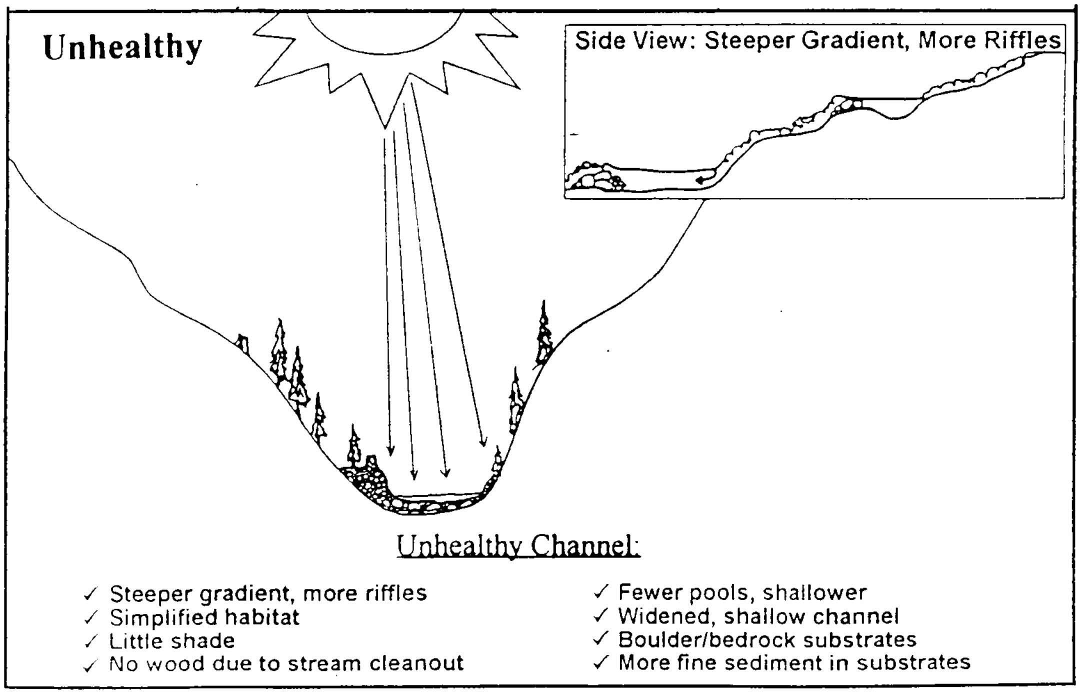


Figure 41. Example of an unhealthy "constrained" (narrow canyon) channel type.

Many of the processes responsible for the formation of this habitat are the same as those mentioned above, in the Wolf Plateau section. With these upper watershed vicinities being dominated by steep slopes, the fire regime is such that they experience relatively frequent, high intensity fires that often kill groups of large trees, as opposed to a low intensity underburn that consumes the smaller fuels along the ground (as seen in much of Cavitt Creek). This pattern of relatively frequent burns has important ramifications for large wood entry into the streams of this area.

The combination of steep slopes, with frequent groupings of fire killed trees, results in large wood entering the channels in pulses, as either the fire killed trees fall into the channel, or the destabilized upper slopes fail, resulting in landslides and/or debris torrents that usually contain large amounts of wood. These "pulses" of large wood entering the channel result in a channel profile that is "stepped" in nature (Figure 40). Recent examples of this mechanism of large wood entry can be seen in the area of the Clover fire, which burned in 1987 near the mouth of Clover Creek. In this area, numerous fire killed trees have fallen directly into the channels and several debris flows from upslope areas have also deposited large amounts of both sediment and wood into these systems as well.

From a streamflow standpoint, the upper vicinities of the Little River basin provide the majority of the flow during the summer months. In particular, the Upper Little River vicinity provides roughly five times the flow per square mile of land than most other portions of the basin. This is likely due to the fact that this area receives the largest amount of precipitation within the basin (with much of it falling as snow) and has deep soils and highly fractured geologic rock types that tend to hold substantial amounts of water, gradually releasing it over time.

This upper portion of the Little River watershed is also susceptable to larger peak flows due to the fact that much (99 percent) of its drainage area is within the transitional snow zone. Rain-on-snow storm events are likely to be more common in this upper watershed, and would have the tendency to influence the nature of the channels in this area. These high flow events, contained within relatively narrow, steep, constrained stream channels, would likely result in high water velocities with the ability to transport much of the sediment and large wood to downstream areas. As a result, a portion of these channels are likely to be relatively "simple" in nature, with bedrock being a common streambed substrate.

Effects of Land Management on Aquatic Habitat and Aquatic Communities

As mentioned previously in this document, roughly 60 percent of the basin area has been clearcut harvested, and over 900 miles of road have been constructed within Little River. In addition, there are numerous other management activities located throughout the lower Little River and Cavitt Creek watersheds, such as agriculture, livestock grazing, domestic water withdrawals, etc., that have influenced aquatic habitat and aquatic communities.

Studies of anadromous fish species diversity in Oregon coastal basins, conducted by Reeves et al. (1993), have shown that basins with less than 25 percent of the basin area harvested have more diverse anadromous salmonid communities than those basins with over 25 percent of the basin area harvested. If anadromous fish communities within Little River follow this pattern, it is likely that the anadromous salmonid community existing today is less diverse than it was prior to significant management activities.

Sediment Regime

One of the primary landscape processes that has been altered to some degree is the sediment regime. As mentioned in the section on sediment regime, the frequency of landslide and debris torrents throughout the basin has increased substantially since significant land management activities began within the basin. Of the total number of landslides that have occurred in the basin since the 1940s, roughly 73 percent have been linked to timber harvest and road construction. While not all of these management related landslides delivered sediment directly to stream channels, the majority of them appear to have. It is difficult to quantify the extent to which aquatic habitat and aquatic communities have been altered by this change in the sediment regime due to the fact that each respective subbasin is likely to react differently.

Within Cavitt Creek, a system with a naturally high sediment load due to the presence of active earthflows, as well as relatively unstable and erosive granitic geology types, it is virtually impossible to determine in-channel changes brought on by an increase in sediment contributions. In this case, investigations of the extent to which land management has effected landslide rates, combined with information on aquatic conditions, provides the best indication of links between stream conditions and land management activities.

In upper Little River however, there is visible evidence of large amounts of fine sediments present within the spawning gravels, in a high gradient channel type that normally tends to transport its sediment load to downstream areas. This is an indication that there is more fine sediment entering this upper system than it is capable of transporting.

Anecdotal observations from long time residents of the area also support the statements mentioned above. These reports indicate that both Little River and Cavitt Creek have changed dramatically with regard to the amount of sediment produced from each system. These long time residents say that stream turbidities, as well as fine sands and silts in the spawning gravels of the basin, are much higher today than in the early 1950s and 60s.

Large Wood Regime

Compounding the problem of increased amounts of sediment entering the stream courses is the pattern of aquatic habitat simplification. As mentioned earlier in this section, a large percentage of the fish bearing habitat within the basin has had its large wood removed. The primary management activities responsible for this loss of wood include the direct harvest of riparian trees and the removal of in-channel large wood (stream cleanout). These activities have had profound negative impacts on the constrained channel types found in upper Little River, as well as the unconstrained channels found in much of Cavitt Creek, and the lower watershed. Figures 39 and 41 illustrate some of the different responses of each channel type to riparian harvest and stream cleanout.

In addition to direct riparian harvest and stream cleanout, upland activities have also resulted in an indirect reduction of large wood contributed to streams. In the steeper areas of the upper watershed, landslides and debris flows originating from upslope areas (particularly after fires) are often responsible for contributing large amounts of wood to individual stream systems downslope. With many of these areas being harvested, however, this mechanism has been altered. The number of landslides and debris flows originating from harvested areas has increased dramatically, and they no longer contain the large wood component that once existed. As a result, landslides now contribute large amounts of sediment, without the large structural pieces that served to moderate its progression downstream.

Water Temperature

As discussed above, the direct removal of riparian trees has resulted in a net loss of effective stream shade. In addition, channels that have widened as a result of stream cleanout and changes to sediment and flow regimes, have more of their surface area exposed to direct solar input, resulting in increased water temperatures. In 1994, water temperatures in excess of 80 degrees F were documented in the mainstems of both Little River and Cavitt Creek, with a maximum of 84 degrees F being measured at the mouth of Little River.

Water Chemistry

Increased levels of nutrients delivered to streams as a result of timber harvest activities, combined with simplified channels and more sunlight reaching the streams, can result in large algal blooms. These blooms have been found to elevate water pH above state standards in Little River and Cavitt Creek. In addition, there may also be large swings in dissolved oxygen levels brought on by the large amount of algae in the system (ie. these organisms produce oxygen during daylight hours, but use oxygen at night).

Peak Flows

Removal of forest canopy in the transient snow zone, ground compaction caused by tractor harvest and road construction, interception of ground water at road cut-slopes, and extension of the channel network as a result of road ditchlines and relief culverts, have all been shown to increase the rate at which water drains from a given land area.

While there are different mechanisms responsible for increasing the rate of runoff, the end result is an overall change in the timing and magnitude of peak flow events. The significant amount of land management that has occurred within the basin appears to have caused storm flows to peak more quickly, and at a higher flow than they would historically for any given storm event.

Low Flows

Changes to the summer low-flow regime have also occurred in Little River for a variety of reasons. The removal of large wood from the channel had the effect of releasing stored sediments from the upstream sides of these wood jams, as the stream cut its way down through these accumulations of sand, gravel and cobble. The downcutting of these channels caused the stream to widen and drop away from its natural floodplain area (Figures 39 & 41). In a healthy channel, these gravel storage areas and floodplains act as large sponges, holding cool ground water and releasing it slowly. Intragravel flow (water slowly percolating through gravels) also helps in maintaining cooler water temperatures. In the impacted channel depiction, the gravel deposits are gone and the floodplains are no longer inundated with water during high flows. Intragravel flow is greatly diminished and overall water temperatures have increased.

Road construction causes compaction, and intercepts surface and subsurface water, causing much of this water to run off of the landscape instead of slowly filtering into it, recharging groundwater reserves. In addition, domestic water withdrawals, irrigation, agriculture, and livestock watering have all contributed to the lower volumes of water being present in the stream channels during the summer months.

Critical Aquatic Habitat Deficiencies

On an individual basis, it is likely that the current conditions of most of the attributes discussed previously are well within the range of natural variability over time. In a "naturally variable" system, however, it is **not** likely that all of these attributes would be in a degraded condition at the same time, across a large watershed. For example, while large fires can cause an increase in landslides, debris flows, and peak flows, they also result in an increase in channel complexity due to increases in large wood delivered to the channels. Likewise, when large floods occur, they often result in the simplification of some habitat, but also result in increased complexity forming in other areas due to landslides, large wood entry, debris jam formation, and channel migration.

When considered separately, it is not likely that each of these "impacted" attributes is solely responsible for the degraded conditions of the habitat. However, when considered cumulatively, each of these degraded habitat factors add up to an aquatic environment that is significantly out of balance, and one that is likely causing stress to the organisms that reside there.

It is well known that acute or chronic stress approaching or exceeding the physiological tolerance limits of individual fish will impair reproductive success, growth, resistance to infectious diseases, and survival (in Schreck and Moyle, 1990). The cumulative effects of even sublethal stress factors may reduce recruitment to successive life stages and eventually cause populations to decline (Vaughn et al. 1984; Adams et al. 1985, in Shreck and Moyle).

Some indications of the cumulative stresses occurring in Little River have only recently been discovered, and are discussed below. For the sake of brevity, only those habitat factors that are believed to be of "critical" importance to the health and abundance of salmonid populations will be discussed in depth. It is believed that these are the primary limiting factors to fish populations within the basin, and it is likely that these habitat problems are having a negative impact on many of the other aquatic species (insects, amphibians, reptiles, etc.) found within the basin as well.

Water Temperature and Water Chemistry

As discussed previously in the sections on stream temperature and pH, water quality in the mid to lower mainstems of Cavitt Creek and Little River is in a degraded condition for much of the summer, and is of serious concern with regard to the effects on aquatic life.

In both mainstem Cavitt Creek and mainstem Little River, water temperatures exceeding 80 degrees and pH values greater than 8.7 were measured in 1994. As a reference, the lethal temperatures for cutthroat trout and rainbow trout are 73 degrees and 75 degrees respectively. Appendix I contains this information for each of the temperature and pH monitoring stations.

When looking at the fish and aquatic insect communities of these areas during the summer months, it becomes apparent that they are impacted. Fish densities appear to be extremely low, and aquatic insect communities are in poor condition. Because of this, much of the habitat found in the lower mainstems of both Little River and Cavitt Creek is not currently of any significant use to salmonid rearing or diverse aquatic insect production.

Sediment

Relatively high levels of fine sediment appear to be present in spawning gravels found within Little River and Cavitt Creek. While much of this sediment is a result of natural processes and geology (see discussions on mainstem Little River and mainstem Cavitt Creek), management activities have also contributed a large portion as well. As reported in sediment regime section, 73 percent of the landslides and debris flows that have occurred within the basin since 1947 were judged to be related to land management activities. In particular, the flood events of the 50s and 60s triggered the largest number of these management related failures. This increase in the number of large scale erosional events has resulted in the contribution of virtually thousands of cubic yards of both fine and coarse sediments to the various stream channels of the Little River basin.

Anecdotal accounts from long-time residents of the area indicate that the amounts of suspended sediment, as well as sediment in the gravels, have increased dramatically over the last several decades. These observations tend to support the landslide figures reported above.

The spawning gravels are suspected to be of marginal to poor quality due to the number of sac fry that prematurely emerged from the gravels. The premature emergence was presumably caused by too much sediment in the gravels (see the section on Fish Spawning Habitat).

Simplified Habitat and Altered Channel Morphology

Debris flows that scour channels and stream cleanout activities combined with the reduced potential for large wood recruitment caused by significant riparian and upland harvest have resulted in simplified channels that lack complex rearing habitat. This trend is especially true in, or adjacent to, anadromous fish bearing streams throughout the basin.

Of the 48 miles of anadromous fish habitat found within Little River, virtually all of it has experienced some level of stream cleanout. A large portion of the resident fish bearing streams have had their wood removed as well. As a result, stream channels have widened, water temperatures have warmed, and bedrock channel substrate has become much more common.

These simplified habitat conditions provide excellent growing substrates for blooms of filamentous aquatic algae, which in turn can have a negative effect on water quality/chemistry. In addition, the lack of complex rearing habitat is likely having an indirect negative impact on aquatic communities that are exposed to the rigors of increased peak flows, without the complex cover that is critical to their survival.

Stream Flow Changes

Changes to the natural streamflow regime within Little River can be broken down into two major categories; increases in peak flows and decreases in summer low-flows.

In this case, peak flow changes are essentially increases in the amount of flow traveling down a respective streamcourse during any given storm event. There are numerous mechanisms that have been shown to cause these changes, as mentioned previously. Natural peak flows occur in winter and spring months, and have often been determined to be one of the critical "limiting factors" to the survival of juvenile salmon and steelhead in basins throughout the northwest. Artificially increasing peak flows combined with the simplified channel conditions present within the basin (as mentioned above), may be having a detrimental effect on the over-winter survival of these small fish. Juvenile fish that spend the winter in Little River need the refuges provided by large wood and its associated habitat complexity to keep from getting washed downstream during floods.

In addition, extreme summer low flows caused by oversimplification of the physical habitat, and water withdrawals in the lower mainstems of Cavitt Creek and Little River, may be contributing to the degraded condition of the habitat in these areas.

CHAPTER 5

ANSWERS TO KEY QUESTIONS

Socio-Economics

Jobs

1. What were the historical employment opportunities and how do they differ from today?

Historically, jobs were focused in the timber industry. Logging and mill work provided the bulk of the employment options available. Ranching and farming also were important. Today, many jobs are still timber related. However, new industries to are starting to spring up. Recreation and tourism have been a small, but important contributor to today's job market.

2. What future job opportunities may exist in the watershed?

Future employment opportunities will continue to include jobs in the timber industry. Recreation and tourism jobs will also continue to be important. Additionally, small numbers of jobs in watershed restoration will continue to utilize workers retrained in programs such as Jobs in the Woods.

Recreation

3. What were/are the recreational opportunities in Little River?

Recreation has traditionally focused on camping, hiking, hunting, fishing, and driving for pleasure. These continue to be important today. Mountain biking and horseback riding have recently become more popular.

4. What future recreational opportunities exist and will there be a demand for more opportunities in the future?

Trends in what recreational users will desire will continue on much of the same path they are on today. Recreational opportunities that are easily accessed by roads will become more important. Additional developed facilities will be needed to meet the demand that is expected to increase.

Road Management

1. What types of roads are most important in providing access for all users and uses?

There are 960 miles of road in the watershed, 630 miles of which are under government management and jurisdiction, including 27 miles managed and maintained by Douglas County. The majority of BLM and Forest Service roads were planned and developed in conjunction with timber sales. The remaining 330 miles of road are privately owned, developed and utilized mainly for private forest land management. Approximately 15 miles of privately owned road are primarily used, along with County roads, to access residential and agricultural lands in the lower portion of the watershed. A few BLM and Forest Service roads also provide residential access.

BLM lands are generally intermixed with private forest lands. In those areas, by agreement, the BLM and private landowners mutually utilize roads under jurisdiction of both parties for commercial use (mostly hauling of forest products) and for administrative access. A similar situation exists in some areas of Forest Service land, where access for commercial use involves both Forest Service and private jurisdiction roads. On these shared use roads, responsibility for maintenance is with the commercial user and is commensurate with use.

For roads under federal (BLM and Forest Service) jurisdiction and for some other roads utilized by the federal government, maintenance levels (ML) are assigned. These roads are assigned a level of 1 through 5 and reflect required maintenance standards necessary to meet documented management objectives for each road or road segment. Categorizing roads within the watershed by maintenance level is one effective way to develop an understanding of the character, function and use of the transportation system. Refer to Appendix H for road distribution maps and detailed description of maintenance levels.

Of the approximate 600 miles of federal roads, 440 miles, or 73% are maintained as open for public use, designated as ML 2, 3, 4 or 5. ML 3 and higher roads have management objectives to maintain them as driveable by a standard passenger car during those times of the year when not closed by snow accumulations. Most of the important roads linking Little River watershed with adjacent watersheds and linking Little River subwatersheds together are ML 3. ML 2 roads are maintained to a standard for use by high-clearance (four-wheel drive) vehicles only. ML 2 roads are typically dead end roads or short side routes between larger road systems, built to access timber harvest units and provide shortened haul routes. Open federal roads are very evenly distributed, providing access to virtually all public lands. Included in this description of open roads are 30 miles of ML 2 roads that have signs in place restricting use during December through April each winter to reduce disturbance in big game winter range areas. The remaining 160 miles, or 27%, of federal roads are ML 1, physically closed to traffic year-round. These closed roads, typically less than one mile in length and without rock surfacing, are also well distributed across public lands and do not significantly restrict vehicle access to most areas of the watershed.

Approximately 34 miles of county and federal roads within the watershed have been identified by the Forest Service as part of the "regional network", a system of government roads that provides primary access to large areas of National Forest lands. Included in Little River watershed are Douglas County Road 17, and Forest Service Roads 25, 27, and 2715. Together these roads serve as transportation links between the North Umpqua and upper South Umpqua river basins, and as part of secondary routes between the communities of Glide, Myrtle Creek, Tiller, and Toketee.

The vicinities that have a high priority for maintaining access for fire suppression efforts are: Cavitt Creek, Black/Clover, and Lower Little River. Cavitt Creek and Black/Clover have extensive acreages of land in fuel model 9 and 10. These fuel models have increased down woody fuel associated with them as compared to other fuel models present in the watershed. These two vicinities also have high fire occurrence rates. The third vicinity, Lower Little River, has extensive acres in fuel model 2 (grass) which has rapid rates of spread. This vicinity has a low fire occurrence rate; however, the primary ignition source is human caused fire and it is the most densely populated vicinity.

2. Which roads and vicinities pose the greatest risk for landslides and stream sedimentation?

Landslide analysis indicates that the vicinities with the greatest potential for road related landslides to occur are Black/Clover and in the areas of Cavitt Creek underlain by granitic bedrock. Areas of geologic risk, ranked by low, medium and high probability for mass failure, are described and mapped in Appendix A. In general, roads located on slopes in excess of 60% and within 200 feet of streams have the greatest potential to deliver landslide-generated sediment to streams. Identification of specific roads at risk requires field inventory and assessment and is not within the scope of this analysis.

In addition to roads located in areas of high geologic risk, roads that significantly extend the stream network length, those with stream crossings at risk of failure during large storm events, and those with poor quality surfacing materials subjected to high traffic volumes during wet weather also have great potential to add sediment to streams.

3. Which roads are a potential for closure or decommissioning?

Identification of specific roads for potential closure or decommissioning requires further field inventory and assessment. Funding and personnel were not available to conduct such field work as part of this analysis or for an area as large as the Little River watershed. However, a process for identifying closure and decommissioning opportunities was developed. This process identified Cavitt Creek and Wolf Plateau as areas of highest priority for further transportation system assessment and planning efforts. Road closures and decommissioning should emphasize effective expenditure of funds and the greatest benefit toward restoration and maintenance of high quality riparian and aquatic habitat. Refer to Appendix H.

4. Which roads are priority for remaining open, but require upgrading or storm proofing?

As with road closures and decommissioning, identifying specific roads with highest priority for road upgrading and storm proofing requires further field inventory and assessment. Cavitt Creek and Wolf Plateau are the areas of highest priority for further transportation system assessment and planning efforts. Roads identified as part of the Regional Network, roads providing access to private lands, administrative sites, developed recreation sites and roads likely to be used within the next ten years for forest management activities or forest product removal are highest priority for remaining open. Reconstruction of roads should emphasize effective expenditure of funds and the greatest benefit toward restoration and maintenance of high quality riparian and aquatic habitat. Refer to Appendix H.

Wildlife Habitat

Native Species and Habitat Diversity

1. What is the estimated historic amount (range) of seral stages in the watershed prior to fire suppression and timber management and how does it compare to current amounts?

Table 2 of Appendix E shows the range of seral stages and current conditions for each vicinity within the watershed. Overall, the watershed's current seral conditions are outside of the reference range conditions. The largest deviation is seen in the amount of late seral habitat which has decreased by as much as 40-50% from recent historical pre-intensive timber management levels. Mid seral habitat has increased by as much as 25-28% and early seral has increased by 9-25%.

2. How does the structure and composition of current seral stages of forest differ from those of pre-management times?

Six structure classes were defined based on stand age and moisture/temperature conditions. In areas that have been managed for timber harvest, structure differs to varying degrees from that of unmanaged stands of the same age. The main deviations are the lack of large woody material, in managed stands, such as snags and logs, which are typically left after natural disturbances. Another major deviation is the development of understory vegetation in unharvested areas (natural stands) and the resulting smaller diameter fuel accumulations to levels much higher than natural because of fire suppression.

3. What is the estimated historic condition of unique habitats in the watershed prior to fire suppression and timber management and how does it compare to current conditions?

Currently, there are approximately 2,000 acres of unique habitats (visible through aerial photograph interpretation) within Little River, which includes wet and dry openings, rock outcrops and hardwood stands. This acreage has decreased by 68% since the late 1930s because of clearcutting and road construction through and/or around these natural openings.

4. What is the degree of interior, late successional forest fragmentation in the watershed and how much interior forest currently exists and where? Is it stable or does it have a high probability of being disturbed in the near future?

Although overall fragmentation of the landscape has increased slightly from natural levels by about 5-10%, fragmentation of late seral habitat has been extensive resulting in a large decrease of interior forest habitat. Interior forest normally ranged between 40-51% of the total area of the watershed. Today it covers only 12% of the watershed, with much of it intersected by gravel roads.

Historically, interior forest habitat was most common within the moister, cooler areas especially on gentle slopes, and was uncommon on dry/warm steep slopes.

Today, as a result of harvesting the most accessible and largest timber (which historically occurred on the gentler slopes and moister areas), almost all of the remaining interior forest lies within the dry/warm land unit and on moderate to steep slopes, the opposite of what existed historically. Today's interior forest in Little River is at an elevated risk of experiencing high intensity fire, especially in light of heavier than natural fuel accumulations in these same areas as a result of fire suppression.

Game Species

1. What effect will changing timber harvest rates and prescriptions have on game species?

Clearcutting over the last fifty years has provided an abundance of forage habitat for both elk and deer. This forage habitat is well distributed among hiding and thermal cover and has been attributed to the increasing numbers of these animals within the watershed. Elk numbers within the Watershed seem to have increased noticeably within the Cavitt Creek and Lower Little River vicinities since the early 1980s.

Even with a decline in timber harvest on federally managed public lands, numbers of elk and deer are expected to increase on private lands in the short term. Future expected harvesting on private lands in the next 10 years will provide "bursts" of forage. In the long term, numbers will stabilize to match the habitat conditions. Herds occurring in areas with higher densities of humans and agriculture land will result in an increase in animal damage complaints as seen among the valley bottom residents today.

Marten are negatively impacted by timber harvesting and are probably close to becoming extirpated from the watershed. A decrease in harvesting will allow the redevelopment of suitable habitat and possible reoccupation by the species.

Timber harvesting has removed nesting and breeding habitat for band-tail pigeons. Reduction in harvest rates will reduce the further loss of this habitat.

2. What is the estimated historic population of game species in the watershed and how does that compare with current populations?

The Wisdom elk model indicates that habitat effectiveness for elk was more viable in 1930s than today despite an increase in forage habitat. This implies that elk herd numbers should have been higher back then than they are now. However, elk populations have been increasing steadily within the watershed since the early 1900s and are higher now than in the 1930s. One possibility, for the lower numbers of elk during the middle part of this century, could be that elk were in the process of making a comeback from the impacts of man (as previously discussed) and that their numbers were still fewer than the habitat conditions in the late 1930s could sustain. The abundance of good habitat and small herd numbers may help explain their rapid increase from just under 500 head statewide back in 1926 to over 5,000 head on just the Umpqua National Forest today. Another possibility could be that the model is not adequately assessing historical habitat effectiveness due to a high cover:forage ratio (greater than 80:20).

A habitat suitability analysis for the marten indicates that the watershed could have supported around 20-25 marten during the reference period. Sightings as low as Cavitt Creek indicate presence during the middle of this century. However, it seems that marten mostly occur further to the east above 5,000 feet in elevation and populations within the Little River watershed were probably smaller than this. Conditions today show suitable habitat has decreased by about 30% and what remains is highly fragmented. No more than 4-6 marten are estimated to occur within the watershed at this point in time.

3. What are the factors limiting the production of game species and how can habitat management be used as a tool to increase or sustain populations?

The quality and locations of foraging and thermal habitat limit elk and deer populations. Roads are also a major limiting factor to habitat suitability for these species. Three areas are being proposed for the management of elk through manipulation of forage and cover and road conversions.

Generally, manage vegetation and roads to provide suitable feeding, breeding and hiding cover and areas that allow escapement and avoidance from human disturbances.

4. What is the existing forage/cover distribution in the watershed?

Elk habitat effectiveness model results (Wisdom et al. 1986) for reference conditions of the late 1930s was used to compare against toady's (1995) conditions by vicinity. The results are shown in Table 20 (Chapter 3). Generally, there is currently about a ratio of 25:75 for forage to cover.

High road densities throughout the watershed have large impacts on the effectiveness of this habitat.

5. Where are existing permanent forage areas and how can they be enhanced?

The existing permanent forage areas in the watershed are dominated by private pasture lands. Natural wet openings make up the bulk of the remaining permanent forage areas. Natural openings may be enhanced by removal of encroaching shrub/tree vegetation through the use of fire or by mechanical means. Fire would be the preferred method as it mimics natural processes. Where appropriate, forage and browse species can be planted. Fertilization of natural areas should be avoided. Use of fire under natural regimes should be adequate to maintain the vigor of the vegetation and remove thatch buildup.

6. Where are the best sites to create new forage areas (both transitory and permanent) and what species of grasses and forbs should be used for intensive forge production?

Future timber harvesting on federal lands will produce transitory forage through time but in much smaller areas than the last three decades. To help mitigate damage to private lands from increasing big game populations, certain areas within federally managed lands can be managed to provide quality elk and deer habitat. These areas are described in the recommendations chapter. Roads within these areas should be closed and converted into stringer meadows. These meadows would be managed intensively to keep them in high quality forage conditions. Native forage seed mix should be used when appropriate. The use of non-native forage seed (which are not aggressive invader species and with short seed viability) in areas which are already heavily established with non-native should be investigated, however, amendments to the Forest Plan would be required.

Non-native species

1. What ecological processes have been altered by non-native species that are present?

Non-native species, many of which are early seral species, have the potential to disrupt the process of succession. Aggressive non-natives such as gorse and scotch broom are capable of dominating a site and precluding other species from becoming established. In addition, unique habitats are affected by non-natives, filling in the habitat once occupied by native species.

The process of pollination may also be altered by non-native species. Displacement of native species may also displace their pollinators, leading to reduced diversity and possible extinction.

2. What non-native species are posing the biggest risk to ecosystem integrity?

Of the eleven non-native species known to occur in Little River, only diffuse knapweed has been identified as a priority species by the federal land management agencies. Other aggressive species of concern include meadow knapweed and Scotch broom.

3. What plant communities are most at risk and where are the areas of concern?

Early seral habitats can be aggressively invaded by non-native species. In addition, unique habitats, such as dry meadows and wetlands, are affected by non-native as their habitats are occupied by non-native, instead of native species. Areas of concern include disturbed areas such as clearcuts and road cutbanks, and known unique habitats.

4. What restorative actions are possible and where are the high priority areas for treatment?

Limiting further spread of non-native species is by far the simplest method of prevention. Maintaining interior forest stands (identified in recommendation chapter) where non-natives have not encroached also helps resist further spread. Specific management strategies for non-native species is listed in Appendix G.

Forest Productivity and Fire Management

1. Are there sites existing on public land that are growing at less than their potential and if so, why?

In order to develop and test approaches to the integration of intensive timber production with restoration and maintenance of high quality riparian habitat, it is necessary to develop an understanding of tree growth and the factors that affect growth potential. In Little River, compaction from ground based logging, removal of down wood, and hot broadcast burns have all been shown to have detrimental effects on site quality. The prevalence of these activities in the past suggests that site quality associated with some stands may be less than potential.

Stand densities in some locations are also affecting growth potential of young stands. In some stands, current stand densities have a multi-layered structure consisting of fire tolerant overstory species and fire intolerant understory species. Competition from understory growth or dense overstories create stressed plant communities on some sites. On Forest Service managed lands, 1,604 acres of the harvested areas (prior to 1970) are now considered understocked, while over 3,000 acres of young managed stands are overstocked. Under these conditions, growth of merchantable wood volume is compromised or the potential for growth is not realized. Understocked stands will not support the same thinning entries or accumulate the same growth as would stands that have medium to high stand densities.

Expectations from Little River are that the dry/warm, moist/warm and wet-dry/warm land units should reach breast height age within 15 years after harvest. However, of the over 10,000 acres of regeneration harvest land, approximately 3000 acres (on Forest Service managed land) have taken longer to reach breast height than the expected 15 years. Analysis of 275 trees within the Roseburg BLM Mt. Scott Resource Area shows that no stands took longer than 12 years to reach breast height; the average area trees needed only 5 to 6 years to reach breast height after planting, while only 11% took longer than 8 years. In addition, growth potential should be highest for site class 2 or 3 stands. However, over 21% of the young stands (some of which were site class 2 or 3) within Forest Service managed land in Little River that were cut before 1970 are growing at less than 3" per decade, a threshold determined as slow growth through field observations and stand exam records at the North Umpqua Ranger District.

In mature unmanaged stands, tree growth can be compromised by dense understory stocking (ingrowth) or by high overstory stand densities. Within the watershed, there are over 7,000 acres that are carrying high stand densities or that have dense understories and that are also at risk of experiencing a high intensity fire. In addition, in stands where sugar pine is a component, high stand densities are contributing to the decline of the sugar pine. Dense stands of trees are heavy competitors against the sugar pine, causing pine die off and increasing the risk of attack by mountain pine beetles.

2. Is vegetation in the Little River area matched to the site (representative of natural composition)? If not, are the discrepancies minor in occurrence or widely spread?

Species diversity has changed throughout the watershed. Introduction of non-native species has altered some plant communities, diminishing the occurrence of some native grasses, forbs, shrubs, and trees.

A minor amount of "off-site" ponderosa pine was planted in Little River. The western redcedar component of some forests has been replaced by Douglas-fir. In addition, non-native tree species that were planted in minor amounts throughout Forest Service managed land in the watershed are giant sequoia, Colorado blue spruce, Austria black pine, black locust, Russian-olive, Caragana, Jeffrey pine, western larch, knobcone pine and Japenese black pine. The black locust has shown the ability to reproduce itself in the Pinnacle Creek area, but its development is slowed by shading from the young Douglas-fir overstory. The giant sequoia is growing well on sites in managed older units within some riparian areas.

3. What proportions or areas of the landscape are the most/least productive for sustained timber management?

The land unit stratification addresses this: the most productive areas for sustained yield of timber are the wet-dry/warm and moist/warm land units. Areas where cold temperatures and a short growing season delay regeneration and growth in the moist/cool land unit and some portions of the dry/warm land units are the least productive areas.

4. Where are the priority treatment areas for increasing tree growth and for minimizing losses due to disturbances or growth losses associated with compaction?

Several areas are identified for treatment by priority in Chapter 6.

5. How will use of natural regeneration and/or uneven-aged management diversify stand structure and species composition?

Species composition is diverse within the Little River drainage with over 15 conifer species, many hardwoods, and over 90 shrub and forb species. Both the western hemlock and white fir plant series (which typify over 90% of the drainage) are rated in the Umpqua Plant Association Guide as moderate to easy for natural regeneration, which field experience has verified. Planting species similar to what occurred in the original stand will continue. In addition, using natural regeneration and/or uneven-aged management will allow some overstory species to remain present in the new stand. The moist/cool land units would react well to uneven-age management since conditions within the land unit are conducive to shade tolerant, fire intolerant species. The dry/warm land unit, as well as the drier portions of the moist/warm land unit, can be expected to be successful with naturally regenerated fire tolerant, shade semi-intolerant species like sugar pine and Douglas-fir.

6. What have been the cumulative effects on native plant species and their habitats, including federally listed and candidate species?

Native species have been displaced in various areas throughout the watershed by the encroachment of non-native species. Past revegetation efforts of disturbed sites have utilized non-native species, further reducing the presence of some native plants. Information on threatened, endangered, and sensitive plants is lacking for nearly all of the land within the Little River watershed.

Fire Management

1. What were the reference period fuel loads and vegetation patterns in the watershed and how does that compare to today's condition?

Fourteen percent of the watershed was estimated to be in high hazard fuel categories during the reference condition, while 63% is in high hazard categories today.

2. Is there a significant change in fuel loads and/or vegetation patterns which may influence the size or intensity of a wildfire?

There has been significant change in vegetation patterns that will influence fire size and intensity. The stand structure in mid seral stands is compact and dense. This allows for a vertical continuity of fuels referred to as ladder fuels. This type of fuel arrangement allows a low to moderate intensity fire to elevate to the level of the tree crowns, increasing tree mortality, spotting distances, flame lengths, and decreasing the ability to control fire spread. The small diameter dead and down fuel loads have also increased. These increases, combined with an increase in dense managed stands that spread fire rapidly, and a loss of old-growth fuel breaks in moist areas, will lead to more intense fire and larger fires during extreme weather.

3. What areas have high fire occurrence rates and high fuel hazards? Are there options to reduce the hazard?

The fire occurrence zones and occurrence rates are displayed in the fire occurrence zone map in Appendix B. The highest occurrence zones are in the eastern half of the watershed. See chapter 6 for areas recommended for treatment.

4. Is there a difference between the reference period fire regime and the existing fire regime?

The fire regime for the reference period was a moderate severity fire regime. Today, the fire regime has shifted toward a high severity fire regime.

Stream, Wetland, and Riparian Habitat

1. What is the extent and condition of aquatic habitat within the Little River watershed, including wetlands, riparian areas, and streams (historic, current, and trend)?

In general, the Little River basin provides roughly 48 miles of anadromous fish habitat, and 70 miles of resident trout habitat.

Cavitt Creek and Lower Little River Vicinities:

Habitat: Anadromous - 24.3 miles
Resident - 31.0 miles

The Little River and Cavitt Creek vicinities support a large portion of the basins anadromous and resident salmonid populations. Of the stream miles dominated by resident cutthroat trout within Little River, **90 percent** (31 miles) are found within the Cavitt Creek and Lower Little River vicinities.

In general, fish habitat conditions throughout these two vicinities are in a highly degraded state. Large amounts of fine sediment, high water temperatures, high pH values, potential increases in peak flows and decreases in summer low flows, combined with a lack of large wood and complex habitat, all lead to habitat conditions that are not conducive to healthy fish populations. These conditions are not likely to change in the near future without a concerted effort from all landowners and land managers within the basin.

Within the Cavitt Creek vicinity, portions of Cultus Creek and Tuttle Creek are in a relatively natural, healthy condition. These two areas will serve as important "references" for future stream restoration efforts.

Wolf Plateau Vicinity:

Habitat: Anadromous - 2.8 miles
Resident - 1.9 miles

From a fisheries standpoint, the Wolf Plateau is an area of transition. The resident salmonid communities gradually shift from a resident cutthroat domination to a mix of resident rainbow and resident cutthroat trout. White Creek is the furthest upstream tributary currently known to provide habitat for resident cutthroat trout within the main stem Little River drainage.
This vicinity represents 11% of the basin area, but only provides 4% of the fish bearing miles found in Little River.

Much of this habitat is considered to be moderately degraded with problems including large amounts of fine sediment, a lack of large wood, and high pH. The primary cause of this degraded habitat is believed to be timber harvest and road construction.

Upper Little River, Black/Clover, Emile, and Middle Little River Vicinities:

Habitat: Anadromous - 21.3 miles
Resident - 37.3 miles

Streams in these four upper watershed vicinities generally share similar characteristics, and are dominated by resident rainbow trout. Of the stream miles dominated by resident rainbow trout, **100% are found in these four vicinities**

In general, the majority of the fish habitat found within these vicinities is considered to be moderately degraded. Timber harvest and road construction activities are believed to have had the largest influence on habitat quality. Similar to all of the other vicinities, many of the fish bearing channels lack large wood, contain large amounts of sediment, and have impacted water quality in certain areas (both high water temperatures and pH). It should be noted that water quality is somewhat better in most of these areas in that the values are not considered to be near the lethal ranges for fish and other aquatic life, as seen in the lower watershed. However, many of the values measured in these areas are considered to be above normal, and are likely contributing cumulatively to the problems seen in downstream vicinities..

Within these vicinities, there are several examples of habitat that is believed to be in its near natural, healthy condition. These areas include the Flat Rock Branch of Clover Creek, a short stretch of upper Little River, and a steep canyon area within the Emile Creek drainage. These areas will serve as valuable "references" when attempting to restore degraded streams of a similar nature in the future.

2. What are the critical processes and landforms that shape aquatic habitat and biodiversity?

The interaction of four critical processes determine the diversity of aquatic habitat that is present in a watershed at any one time; riparian forest functions, disturbance, sediment-routing and stream flow.

The operation of these processes and their importance to the condition of aquatic habitat are a product, in large part, of landform and climate. The Little River landscape has been stratified into five landforms; dissected lowlands, dissected uplands, landslide complex, earthflow and upland plateau. The analysis also utilizes four climate units; dry/warm, moist/warm, wet-dry/warm, and moist/cool.

In a healthy watershed (the reference condition), the interaction of disturbance, sedimentation, stream flow and riparian forest functions produces a variety of habitats that change periodically in response to two randomly-occurring, unrelated events, fire and flood. The effects of these disturbances on patterns of vegetation, erosion, and stream flows create sub-basins in states of alternating disturbance. In other words, with the separate pattern of fire and flood disturbance, aquatic habitat shifts around in time, and all states are present at any one time in a large basin such as Little River or Cavitt Creek. Aquatic life in the Little River basin has adapted to this variety and change.

Overlay the disturbances associated with an extensive road system and clear-cut harvest and the result is pulses of sediment and increased storm runoff that are uniformly distributed in the watershed and relatively coincident in time. As a result, the conditions of an "ecologically healthy" watershed, where a variety of disturbance states exist both in time and in space, has been lost. Today, aquatic habitat in most sub-basins is highly disturbed and less diverse than it was historically.

The following statements summarize the effects of a management-related disturbance pattern on the critical processes influencing aquatic biodiversity in the Little River vicinities:

Cavitt Creek and Lower Little River Vicinities:

Riparian forest functions

* reduced shade along perennial streams, particularly on private land. Shade has recovered in riparian forests harvested prior to 1970 (48% of perennial stream miles shaded at present).

* reduced large wood and potential recruitment in mainstem segments where individual tree death and tip-over is the primary large-wood delivery mechanism.

* reduced nutrient retention by simplification of stream structure and riparian forest composition. Once productive, low-gradient stream segments have lost their nutrient-retention capability with loss of large woody material.

* reduced stream bank stability with recent riparian harvest and aggradation of stream beds where sediments are deposited in low gradient stream channels (Fall Cr. and mid-Cavitt Cr.). Unstable banks are characteristic of streams that flow through landslide complex prevalent in Cavitt Creek vicinity.

Disturbance patterns

* a late-seral forest matrix (more than 75% of vicinity historically) reduced to small patches (less than 10 % of vicinity currently).

* mean size of openings enlarged where, historically, openings were small (except in upper Cavitt Creek).

* tree harvest areas "blocked" on private land and harvest concentrated in the 1950s, 60s and 70s. Public land harvest "dispersed" in relatively small areas over four decades prior to present.

* landslide and debris flow frequency increased as a result of tree harvest and road construction, with the greatest increase on steep, dissected uplands formed in granitic rocks.

Sediment flow

* increased sediment delivery and flow as a result of increased landslide, streambank instability, increased winter stream flows and extension of drainage network by landslide and roads.

* a fine sediment load increase in lower Little River is indicated by macroinvertebrate sampling. Little information is available to assess the effects of increased sediment in Cavitt Creek where

sediment load was high in a reference condition due to the presence of landslide terrain and granitic rocks.

Stream flows and water quality

* summer low flows reduced from a relatively low reference condition in vicinities dominated by dry/warm land units.

* summer low flows reduced, stream temperatures increased and habitat reduced through water withdrawals and through a shift in riparian vegetation from late-seral to early and mid-seral conditions.

* water quality lowered through reduced low flows, increased water temperatures and elevated pH levels compared to a reference basin (Boulder Creek, North Umpqua river).

* increased winter storm peak flows.

Wolf Plateau Vicinity

Riparian forest functions

* shade has recovered in riparian forest areas harvested prior to 1970 (71% perennial stream miles shaded at present).

* reduced large wood and potential recruitment. Individual tree death and tip over is primary large wood delivery mechanism, except in high geologic risk areas in dissected uplands of White and Negro Creek watersheds where debris avalanche and flows are delivery mechanisms.

* reduced nutrient retention by simplification of stream structure through reduction of large wood input, increased peak flow and accelerated stream bank instability and debris flow frequency.

* reduced stream bank instability as a result of riparian forest harvest and chronic streamside erosion features.

Disturbance

* a late-seral forest matrix (more than 70% historically) reduced to a few, small patches and one large, fragmented patch in the canyon of Wolf Creek on BLM lands (less than 20% of vicinity currently).

* mean size of opening greatly enlarged where historically openings were small.

* tree harvest areas "blocked" as a result of simultaneous harvest on public and private lands concentrated in the 1950s, 60s and 70s.

* landslide frequency in riparian areas increased in a vicinity that is characterized by low and moderately-low erosion and sediment delivery potential in a reference condition.

Sediment Flow

* the increase in management-related sediment delivery is higher here than in any of the other Little River vicinities. Increased sediment delivery and flow as a result of increased landslide, streambank instability, increased winter stream flows and extension of drainage network by landslide and roads.

* fine sediment load increase is greater compared to the reference condition than other vicinities as a result of the interaction of the following:

1. Wolf Plateau has experienced the most extensive timber harvest (78% of total acreage).

2. moist/warm and wet-dry/warm land units on gentle slopes had a relatively low sediment delivery historically, the result of low intensity infrequent fire disturbance in riparian forest and low severity fires in the landscape at large.

3. earthflow and upland plateau have a relatively low stream density and a high amount of subsurface runoff, both attributes that have minimized the delivery of sediment from the uplands (in a reference condition).

4. road construction and increased management-related landslides have resulted in a stream network extension greater that other vicinities.

Streamflow and water quality

* summer low flows are relatively high compared to vicinities where dry/warm land units are prevalent.

* low flows reduced as a result of a shift in riparian vegetation from late-seral to early and mid-seral conditions.

* water quality lowered through reduced flows, high sediment flux and elevated pH levels compared to the reference basin (Boulder Creek, North Umpqua River).

* increased winter storm peak flows compared to historic condition even with a hydrologic recovery of 80% at present.

Upper Little River, Emile Creek, Black/Clover and Middle Little River Vicinities

Riparian forest functions

* shade reduction along perennial streams minimal compared to reference conditions and other vicinities (30 to 60% of riparian forest in late-seral vegetation at present).

* reduced large wood. Potential recruitment reduced from dissected uplands (via debris flow mechanism) as a result of harvest on slopes with high geologic risk.

* reduced nutrient retention by simplification of stream structure from accelerated debris flow frequency and elevated winter storm flow peaks.

* stream bank stability relatively unchanged as a result of bedrock-confined stream channels and a minimal amount of riparian forest harvest. An exception to this is Middle Little River and lower Emile Creek where riparian forest harvest has been relatively high compared to remainder of vicinity.

Disturbance

* late-seral forest matrix (50 to 80% historically) fragmented in Upper Little River and Black/Clover vicinities and reduced to patches in Middle Little River and in upper and lower areas of the Emile Creek vicinity.

* tree harvest dispersed in relatively small areas over four decades except blocks of private land in Middle Little River and lower Emile Creek vicinities.

* landslide and debris flow frequency increased as a result of tree harvest and road construction.

Sediment flow

* increased sediment delivery and flow as a result of increased landslide, streambank instability, increased winter stream flows and extension of drainage network by landslides and roads. Road construction and timber harvest in areas of high geologic risk in upper Little River and Emile vicinities have altered sediment regime.

* increase in fine-sediment flows primarily from inclusions of landslide complex and earthflow landforms in vicinities otherwise dominated by dissected uplands. Macro-invertebrate sampling suggests that there is a relationship between these landforms and fine-sediment delivery in Black/Clover and Emile vicinities.

Streamflows and water quality

* summer low flows sustained by runoff from moist/cool, elevated plateau's in Emile and Upper Little River vicinities.

* relatively small changes in water quality properties (temperature, pH, low stream flows) compared to other vicinities in Little River with the exception of lower Middle Little River and Emile Creek.

* increased winter peak flows.

3. Where are the diverse aquatic communities within the watershed and how do they relate to the habitat types and conditions?

From a fish population standpoint, the majority of the diverse communities in the Little River basin are found in the larger, main stem areas of both Little River and Cavitt Creek.. The lower main stem of Little River supports populations of coho salmon, spring chinook salmon, migratory cutthroat trout, steelhead trout, and a large variety of other non-game species such as sculpin, redside shiner, Umpqua squawfish, etc. The lower mainstem of Cavitt Creek supports populations of coho salmon, migratory cutthroat trout, and steelhead trout, as well as a variety of non-game species.

From a habitat standpoint, the Cavitt Creek and Lower Little River vicinities contain the largest segments of low gradient, unconstrained, wide valley stream channel types. In general, this habitat tends to be dominated by resident cutthroat trout, coho salmon, and steelhead trout. The remaining vicinities are dominated by steeper, constrained, narrow canyon stream channel types, with a few small inclusions of the lower gradient channel types. In general, these areas are dominated by a mix of resident rainbow trout and steelhead.

4. What are the primary limiting factors to fish populations within the watershed?

Critical aquatic habitat deficiencies that are likely limiting fish populations within the basin are poor water quality (high water temperatures, high pH, low dissolved oxygen), excess fine sediment, extensive areas of oversimplified habitat, and both increased peak flows and decreased summer base flows.

Fish Stocks At Risk

1. What is the condition and trend of "at risk" fish stocks, and their habitat, within the Little River basin?

Fish stocks "at risk" found within the basin include cutthroat trout, coho salmon, steelhead (winter and summer), and Pacific lamprey. Very little is known about these fish populations within the basin, but due to the degraded nature of the habitat found throughout the anadromous fish bearing portions of the watershed, it is likely that these stocks are all in a depressed condition.

In addition, if habitat conditions in these areas do not improve, it is likely that these stocks will remain depressed or decline further.

The habitat for these fish stocks has been degrading since the late 1940s, when intensive land management first began in the basin. Habitat complexity is likely to improve in the next few decades as a result of restoration efforts, new state forest practices rules, as well as riparian reserve guidelines found in the ROD for the Northwest Forest Plan. Water quality, specifically pH, will likely remain in a degraded state until current harvest and fertilization practices are altered to remedy this situation.

2. How are fish populations within Little River linked to the larger populations of the North Umpqua River downstream?

Historically, Little River was likely to be one of the most important spawning tributaries for coho salmon in the entire North Umpqua basin. Currently, the populations and habitat conditions within the Little River basin are in a depressed state.

Little River provides several miles of spawning habitat for spring chinook salmon. Based on the large numbers of juvenile chinook trapped leaving this system recently, it is probably one of the most important tributary streams of the North Umpqua River in terms of spawning and rearing habitat.

Based on stream surveys and anecdotal reports, Little River is also believed to have been a relative stronghold for resident and fluvial cutthroat trout. Populations of these fish still exist in the basin today, but they are believed to be in a depressed condition. It is not known to what extent searun cutthroat trout utilized this stream system however.

No historical information concerning Pacific lamprey was found, but recent trapping efforts have indicated that large numbers of juvenile lamprey rear in the Little River system, indicating that this basin is important to this declining species.

Very little information is available with regard to steelhead, but it is believed that Little River supports populations of both winter and summer steelhead. It is likely that very few adult summer steelhead oversummer in the basin however, due to the high water temperatures found there. It is also likely that Little River's contribution to the overall populations of the North Umpqua basin is relatively small due to the degraded nature of the habitat found there.

Resident rainbow trout are primarily located in the upper main stem of Little River. Little is known about the populations found within the individual streams of this upper watershed area. Based of the relatively limited movement patterns of resident fish in general, it is not likely that these populations contribute many fish to resident populations downstream or outside of the Little River basin.

Water Quality

1. What is the thermal profile of the watershed (historic, current, trend)?

Little River is currently one of the warmest streams found on the Umpqua National Forest, with a maximum stream temperature of 84 degrees F measured near the mouth in 1994. A large portion of the main stems of both Little River and Cavitt Creek had water temperatures in excess of 80 degrees. No historic temperature information is available, but since relatively recent management activities have lead to increased water temperatures (as shown in studies on Steamboat Creek), it is likely that Little River and Cavitt Creek were substantially cooler in their pre management condition. The long term trend is likely to be one of slowly cooling water temperatures as harvested riparian areas recover, public awareness increases, and new state forestry rules, and increased federal riparian protection standards are implemented.

2. Have other water quality parameters, such as dissolved oxygen, pH, and turbidity, affected aquatic communities? If so, how?

Based on high pH values measured, it is also likely that large fluctuations in dissolved oxygen are occurring as well. High turbidity and sediment loads have also been recorded in the basin. Aquatic communities in the basin may have changed in terms of species composition, and are likely declining as a result of the cumulative stresses brought on by the impacted water quality parameters mentioned above. Additional study is necessary to determine the extent of the impacts upon aquatic communities.

3. How do flow regimes interact with/regulate water quality within the Watershed?

Increased peak flows during winter and spring months can cause increased erosion and channel widening, which can result in increased turbidity and sedimentation. These effects to the channel can also negatively impact water quality during the summer months by causing increased water temperatures, high pH, and lower summer baseflows.

Decreased summer baseflows, caused by channel widening, habitat simplification, water withdrawals, and drought tend to worsen higher water temperatures, lower dissolved oxygen levels, and high pH levels.

In Little River, peak flows have increased and summer base flows may have decreased, resulting in a watershed with altered flow regimes. These altered flow patterns are likely having a negative impact to water quality within the basin, as well as the aquatic communities that reside there.

4. What, when, and where are the sedimentation/erosional processes occurring within the basin?

The majority of the chronic surface and fluvial (stream related) erosion is occurring on the relatively gentle landscape areas found in upland plateaus, landslide complexes, and earthflow terrain, where timber harvest and road construction have altered drainage patterns and runoff timing. Vicinities that have extensive amounts of these landform features include Cavitt Creek and Wolf Plateau. Other vicinities that have smaller inclusions of these features include Emile Creek (Willow flats area), Black/Clover (Dutch Creek area), and Upper Little River (upper Little River and Hemlock Creek tributaries). In addition, areas of granitic geology that have been subjected to intensive timber harvest and road construction, such as those in upper Fall Creek, and the western ridge of Cavitt Creek, are also highly susceptible to surface erosion processes. These areas were relatively stable prior to significant land management activities.

The majority of the landslide and debris flow erosional activity is occurring on the steeper, more dissected upland areas of the watershed, specifically, the Black/Clover (excluding Dutch Creek), Emile (excluding Willow flats), Lower Little River, and Cavitt Creek (granitic areas) vicinities. While portions of these areas were subject to relatively high landslide and debris flow occurrence naturally, in general across the watershed, the frequency of these events has been increased sevenfold as a result of land management within the basin.

CHAPTER 6

RECOMMENDATIONS*

*Recommendations apply only to federally managed lands

Terrestrial Ecosystem Recommendations

Late Seral Prone to Fire

Current condition: A high percentage of today's late seral habitat is found in warm/dry locations where it is prone to experiencing high intensity fires. This could limit future management opportunities, put remaining interior forest habitat and spotted owl activity centers at risk, plus accelerate debris flows into streams. The ROD requires protection of spotted owl activity centers in AMAs.

Objective: Reduce excess fuel loading in high risk stands while maintaining wildlife habitat and soil organic matter cycling. Restore mid and late seral stands in all land units to stand compositions, structure and density typical of natural fire regimes to improve resiliency to fire.

Methods: Maintain functioning late seral stands by under burning (when fuel moisture is appropriate) during the months of June through November. In stands with substantial fuel build-up, use a combination of understory thinning and small group openings with or without fuel breaks. Northern spotted owl activity centers may be areas where treatment is not applied or applied lightly based on a risk analysis and monitoring. Develop a strategy to place fuel breaks on the landscape where concentrated harvest or private residences interface. Treat riparian areas of intermittent streams with thinning and prescribed fire to reduce density and fuels. Treat the dry/warm areas on upper slope positions to create stand conditions characteristic of historic fire behavior. At the project planning stage, these riparian treatments must be balanced with the needs of mature and late seral species described in the ROD.

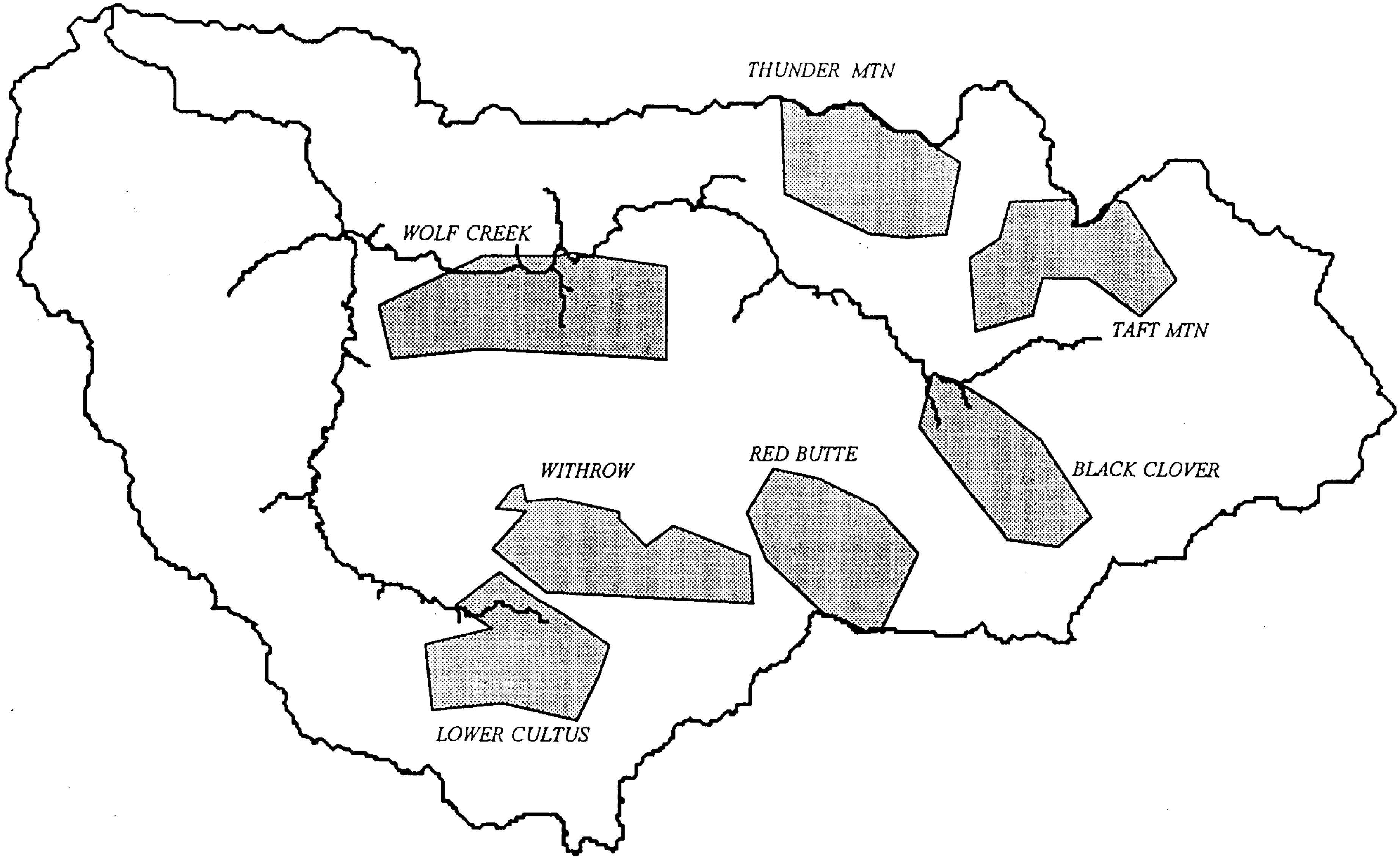
Areas: Potential treatment areas were determined by overlaying warm land units with steep slopes, fire occurrence, current interior habitat and spotted owl activity centers (Figure 42). The following priorities were assigned according to size, fire risk, and spotted owl occupancy:

1. Withrow Creek
2. Thunder Mountain
3. Red Butte
4. Taft Mountain
5. Black Clover
6. Lower Cultus
7. Wolf Creek

Monitoring: Possibilities include: The documentation of pre and post-treatment fuel levels following harvest and prescribed fire to assess effectiveness of treatments, pre and post-treatment effects of fire on species composition, stand structure, and reproductive success of spotted owls. Pursue answering the question: What management prescriptions can restore and maintain the natural fire regime and reduce the likelihood of large, catastrophic fires from a landscape perspective?

Figure 42

LATE SERAL PRONE TO FIRE



Pine Health

Current Condition: Conditions conducive to insect population buildups above endemic levels (particularly the mountain pine beetle) are beginning to occur. White pine blister rust is also present. There are approximately 4,400 acres where pine species were naturally numerous but are currently declining in numbers due to insects and disease.

Objective: Improve the vigor and presence of pines (mainly sugar pine but also white pine and ponderosa pine) by creating conditions for pine regeneration and reducing their susceptibility to fire, insects and disease.

Methods: Use stand treatments and prescribed underburns to encourage pine regeneration, reduce stress of remaining pine (due to unnaturally crowded conditions) and increase the stand's fire resiliency.

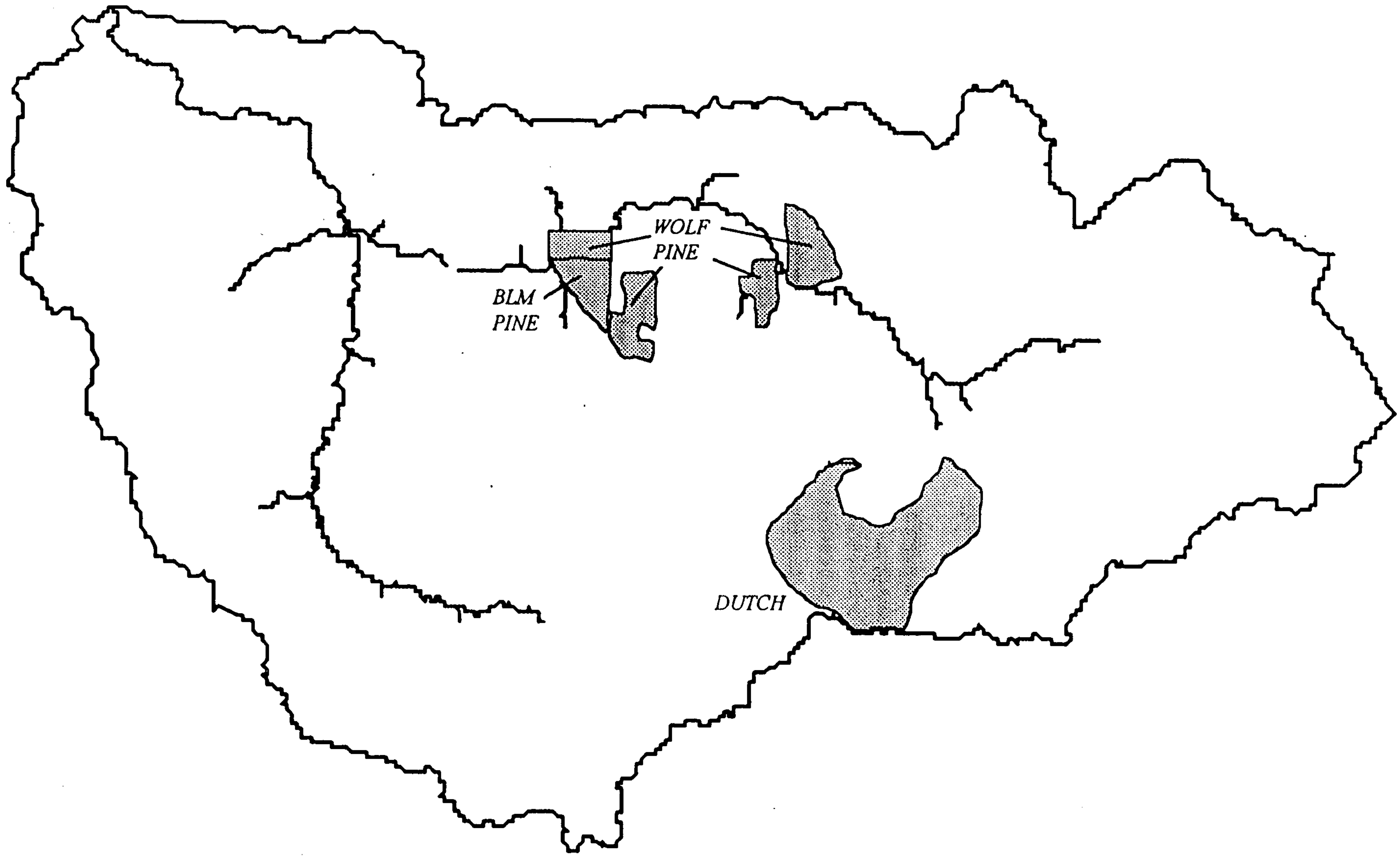
Areas: Potential treatment areas were determined through field assessment with the Regional Pathologist. Areas were prioritized by current density of pine and associated disease mechanisms (Figure 43). They are listed in order of priority:

1. Wolf Pine and BLM Pine
2. Dutch Creek
3. Upper Little River (not shown on map)
4. Willow Flats (not shown on map)

Monitoring: Monitor insect and disease effects and trends in populations concurrent with blowdown (falldown) and/or competition stress. Determine pre and post treatment basal areas for pine stands as an indicator of competition and drought stress; monitor post treatment effects and survival of established trees. Track the success of pine regeneration.

Figure 43

PINE HEALTH AREAS



Interior Habitat

Current Condition: Most of the areas within the watershed that historically persisted through time as late seral interior habitat (moist/warm and wet-dry/warm land units) were harvested and are now in early to mid seral conditions. These areas provided important connectivity of late seral habitat in low elevations through the watershed. This connectivity may be important to late seral species that do not occur in higher elevations (red tree vole and fisher). Adaptive Management Areas are intended to contribute substantially to the achievement of the standards and guideline for management of habitat for late successional and old-growth species. This includes provision of well-distributed late-successional habitat outside reserves (ROD D-2; Roseburg BLM 1994 RMP Appendix 143-144).

Objective: Protect remaining current late seral habitat within these areas and begin to restore the mid seral habitat to provide the potential for late seral interior habitat within 5 to 6 decades.

Methods: Accelerate the development of managed stands to late seral stage by thinning stands of all ages in a contiguous area to promote future interior habitat. Use variable levels of stocking and leave existing old-growth components on the site. The creation of small openings in managed stands is recommended, but inducing more fragmentation with large openings is not desirable. Reduce competition in unmanaged stands by cutting western hemlock and white fir in understory or intermediate layers of those stands. Avoid using treatments that create favorable habitat for non-native vegetation.

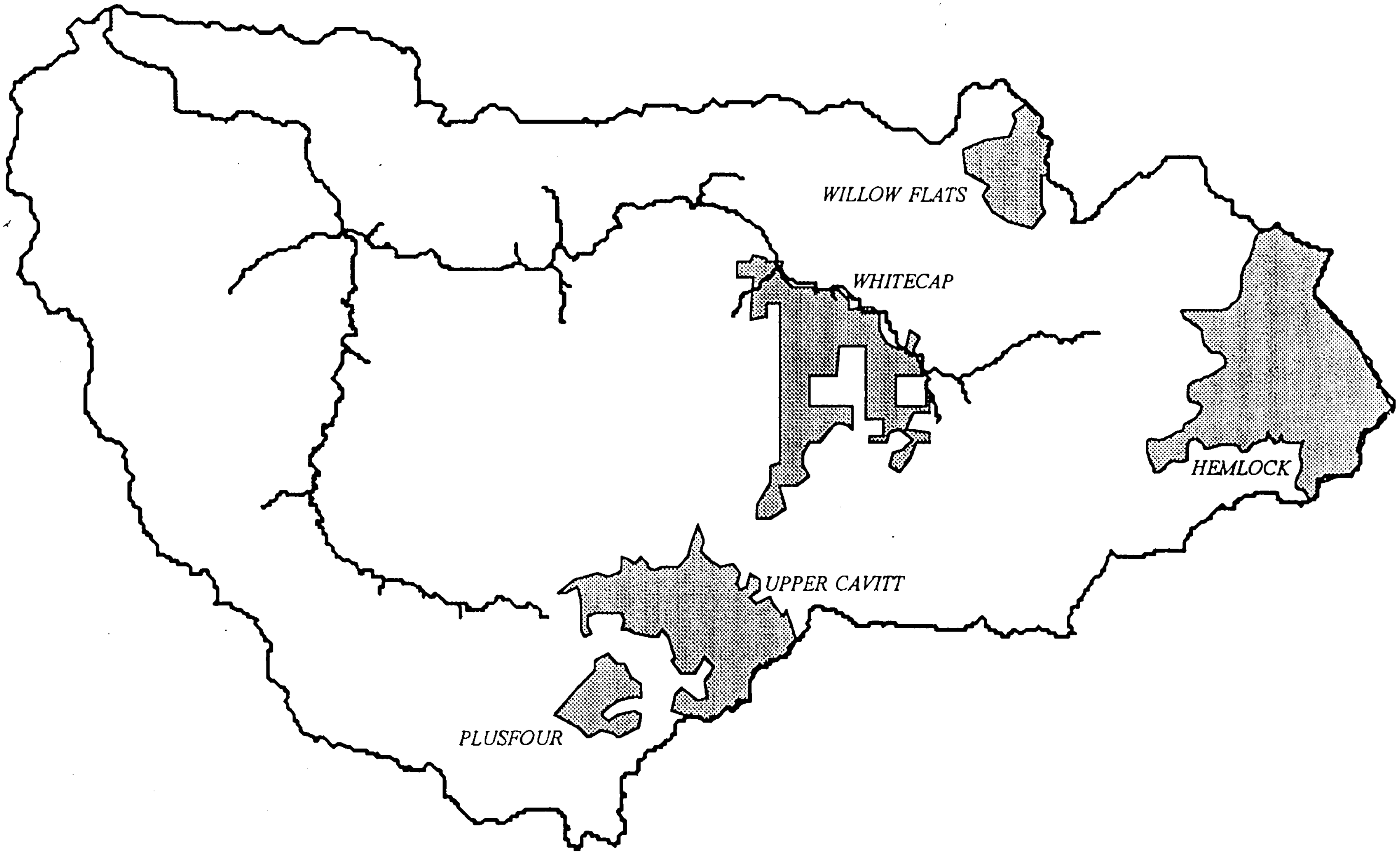
Areas: Potential treatment areas were determined by overlaying moist/warm, moist/cool and wet-dry/warm land units with gentle slopes with low fire occurrence (Figure 44). Areas are prioritized by size and location in relation to spotted owl sites and are listed in order of priority. Other areas may also exist outside of these mapped sites.

1. Willow Flats
2. Upper Cavitt Creek
3. Hemlock Lake- Flat Rock
4. White Creek
5. Plusfour Creek

Monitoring: Implement the DEMO study. Pursue answering the question: What silvicultural prescriptions enhance short and long-term biological diversity at the stand and landscape scales in upland and riparian Douglas-fir plantations?

Figure 44

INTERIOR HABITAT AREAS



General Landscape

Current Condition: Overall, watershed conditions are degraded. Forty-six percent of the forest along perennial streams (360 feet either side) and 62% of the stands along intermittent streams (180 feet either side) has been clearcut harvested. The landscape is more diverse and fragmented than during the reference conditions. There has been a large decrease in late seral and a large increase in early and mid seral. Patches of early and mid seral forest have generally decreased in numbers (patch density) but have increased greatly in patch size. Harvest of public lands since 1980 has totalled over 11,000 acres. These areas are, or will soon be, in need of precommercial thinning. Many of the older managed stands (of commercial size) are also over-stocked.

Objectives: Develop and test approaches to integration of intensive timber production with restoration and maintenance of high quality riparian habitat. Learn how to manage on an ecosystem basis. Shift landscape patterns back toward reference conditions (on Forest Service administered lands only) to the extent practical.

Methods: Over the next decade, focus activities on the watershed's managed stands (on Forest Service administered lands only). Avoid a pre-commercial thinning backlog by prioritizing funding for Timber Stand Improvement (TSI) Activities. Initial commercial thinning entries should focus on areas of highest site quality to maximize production of wood products (located mainly in the wet-dry/warm and the moist/warm land units around White Creek, upper Cavitt Creek and Taft Mountain). Thin in young growth riparian areas with high stem densities and where height/diameter ratios ≥90 with possible blowdown potential (stands along Emile, Black and White Creek have the highest concern). Increase the average tree diameter in a stand with each thinning treatment on all land units. Manage for variable stocking levels and tree distributions on dry land units, particularly steep slope areas and south facing drainages (these occur primarily in the middle and upper Little River Vicinities of the watershed). On managed and unmanaged stands, keep stand openings to less than 10 acres in size on the moist/cool land unit (found only on Forest Service administered lands) due to site limitations and slow development rates. Apply treatments to unmanaged stands that lessen the risk of wildfire from a landscape perspective. Take advantage of opportunities to apply natural regeneration of native vegetation in all land units. Develop fire suppression guidelines that address where minimum impact suppression tactics should be used, fire rehabilitation practices using non-native invasive plants, and the use of retardant in riparian areas.

Areas: Entire watershed

Monitoring: Monitor light levels and associated natural regeneration and release of advanced regeneration after over story treatments. Examine levels of large woody material associated with various land units and seral stages to develop management strategies. Use pre- and post-treatment stand exams to monitor individual stand development. Use satellite imagery to track landscape development. Pursue answering the question: What types of stand and landscape level manipulations to vegetative structure and composition can be carried out to provide both a sustainable level of timber harvest plus maintain, enhance, or restore species associated with old-growth forests?

Unique Habitat

Current Conditions: Slightly over 30% of the historic unique habitats remain somewhat undisturbed. These areas are providing important habitat for plants and animals.

Objectives: Maintain and/or restore meadows prone to tree encroachment, and those where the hydrologic processes have been changed. Restore historical unique habitats where possible.

Methods: Utilize prescribed burning to reduce or eliminate tree and shrub encroachment of meadows. Restore natural hydrologic functioning through road obliteration when feasible. Work to control non-native/noxious plants.

Areas: Unique habitats for treatment were selected by their location in relationship to past management activities (harvest units and roads). They are listed in order of priority:

1. Peter Paul Prairie
2. Willow Flats
3. Yellow Jacket Glade

Monitoring: Inventory unique habitats for species composition, management impacts and opportunities, and potential for restoration and native seed collection nurseries. Track plant community changes in habitats that are treated with prescribed fire.

Elk Management

Current Condition: Elk herds are increasing and concentrating on or near private lands. Animal damage to private lands is increasing and hunting opportunities are limited.

Objective: Provide good quality elk habitat and hunting/viewing opportunities through time on public lands.

Methods: Decrease open road densities by converting some roads to stringer meadows and trails. Develop a native forage seeding strategy. Utilize tree harvest when feasible to create forage. Maintain, improve, or rehabilitate historical meadows. Develop partnerships to implement coordinated plans including monitoring assignments.

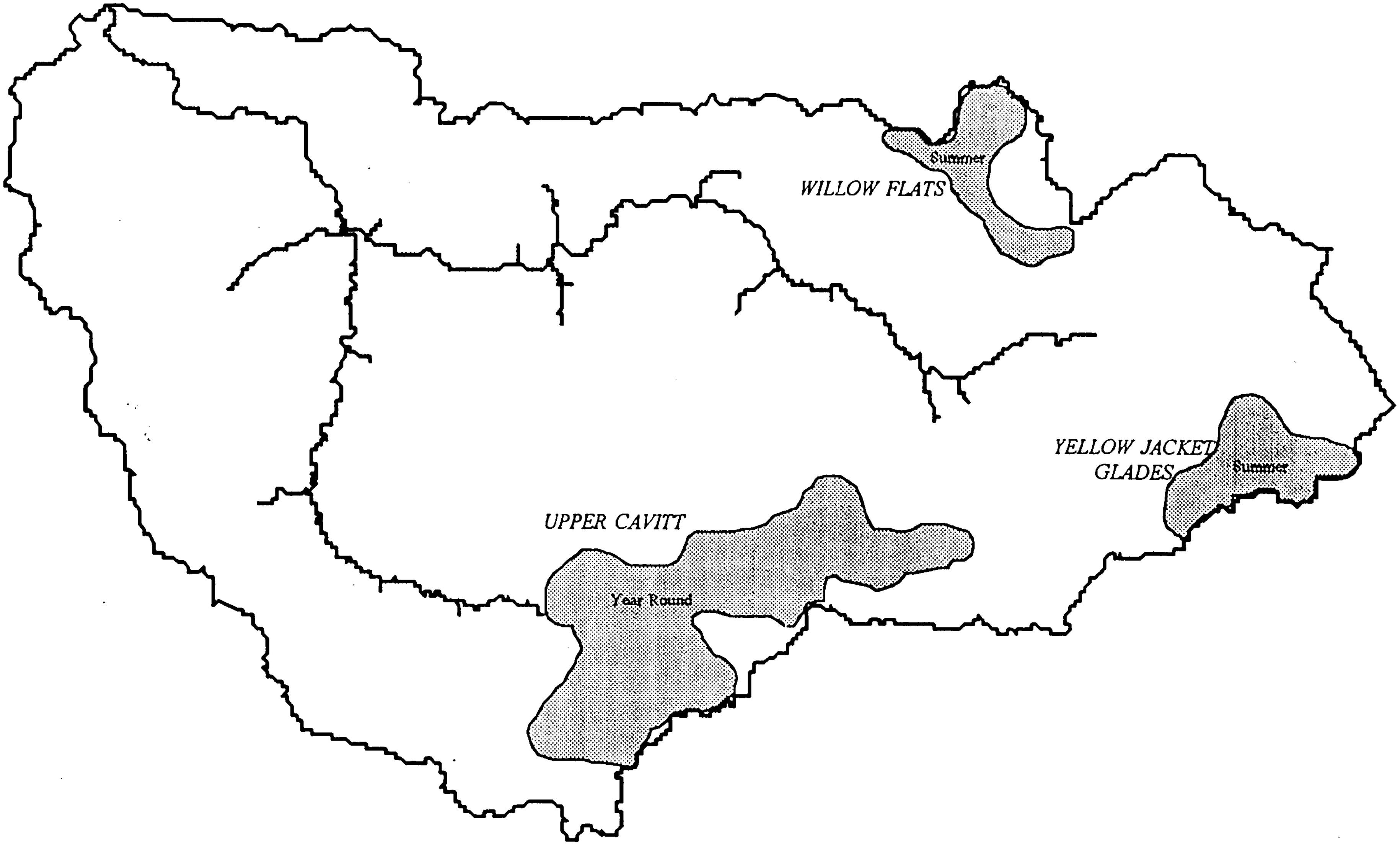
Areas: Three primary elk management areas (Figure 45) were selected based on the presence of gentle to moderate slopes, historical forage habitat, amount of current elk use and their distance away from private/residential and agricultural property. They are listed below:

1. Upper Cavitt Creek
2. Yellow Jacket Glade
3. Willow Flats

Monitoring: Monitor elk populations in these areas in cooperation with Oregon Department of Fish and Wildlife. Monitor the success of road to meadow conversion techniques. Pursue answering the question: Can populations of plants and animals associated with early successional conditions be maintained or enhanced by restoring and creating forest openings using fire and other silvicultural options?

Figure 45

ELK MANAGEMENT AREAS



Special Forest Products

Current Condition: Many grass, forb and shrub species are collected throughout the watershed. Record keeping on quantities of materials removed and the dollar value of these materials has only recently begun. Interest in beargrass is particularly high, with some interest in salal, boughs, posts, and firewood.

Objective: Determine how harvesting of beargrass and other products can be sustained and enhanced.

Methods: Survey for collected species and maintain information in a data base that is consistent between agencies. Issue permits on a consistent basis between agencies.

Areas: Locations where harvest of beargrass has frequently occurred.

Monitoring: Monitor beargrass collection sites to determine if over harvesting is occurring. Monitor RNA's for signs of unauthorized collection. Establish a monitoring scheme that examines how populations of special forest products should be harvested, sustained, and enhanced. Work with County Extension and others to find ways to keep beargrass money local.

Rare Plants

Current Condition: Information on the distribution of rare plant species that occur in Little River is generally lacking.

Objectives: Increase knowledge of location, abundance, and biology of rare plant species. Maintain viability of rare plants in the watershed.

Methods: Document known sites and update data bases. Identify management opportunities and threats to viability. Document location and numbers of species that may be at risk of becoming rare within the watershed. Identify unique habitats which contain rare plants.

Area: Unique habitats and known reference populations.

Monitoring: Inventory and monitor unique habitats. Establish specific populations and monitor trends of those populations. Monitor silvicultural treatments in mid-seral stands for understory regeneration of such species as lilies and orchids that appear to be absent in existing mid-seral stand structure.

Non-native species

Current Condition: Of the 48 species of noxious weeds that either occur, or have a significant potential to occur, within the state, ten of these species (disregarding the two native species) can be found in the Little River watershed. Five are considered to be so widespread (tansy ragwort, St. Johnswort, Canada thistle, bull thistle, and Scotch broom) that most disturbed ground is occupied by at least one of these species. Eleven more are known to occur in close proximity and have the potential to colonize the area in the foreseeable future. Of particular concern are gorse, yellow star-thistle, milkthistle and French broom.

Objectives: Slow and/or curtail the spread of non-native species.

Methods: Follow the integrated weed management guidelines listed in Appendix G. Follow the BLM Integrated Weed Control Plan and Environmental Assessment on BLM managed land. Develop a strategy for Forest Service managed land that ties in with the BLM's. Use native species for revegetation and restoration work, especially when revegetating sites that have experienced fire. Maintain accurate and up-to-date data bases.

Area: Areas with high road densities and where current management activity is taking place.

Monitoring: Monitor the spread of existing populations of non-native plants and the effects of control efforts. Monitor that quarries and stockpile sites are free from noxious and targeted aggressive plant species.

Aquatic Ecosystem Recommendations

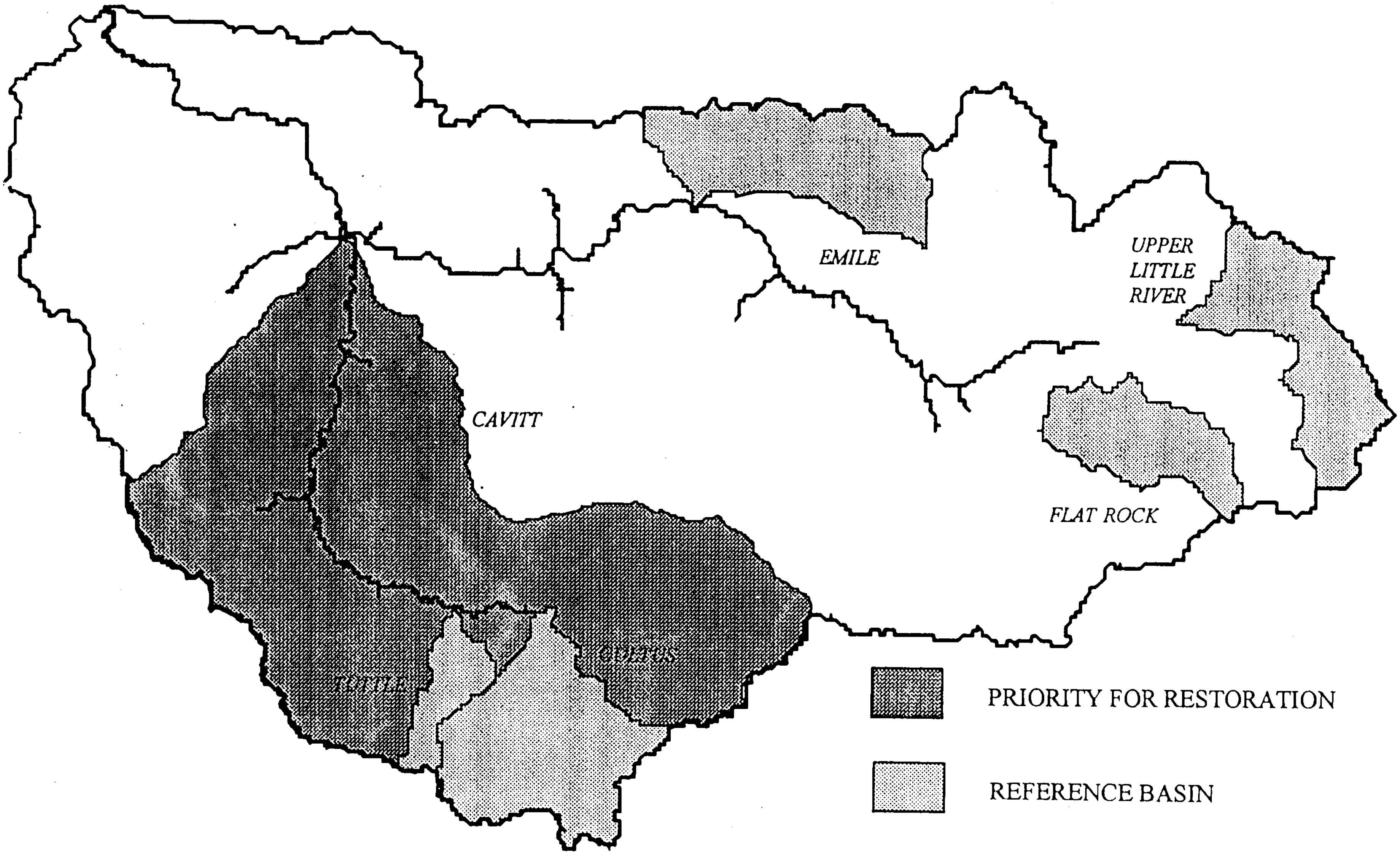
General priority areas for aquatic ecosystem restoration and protection

Priority	Vicinity or Tributary	Aquatic Rationale	Prioritized List of Restoration Objectives *
1	Cavitt Creek Vicinity	Cutthroat and coho stronghold within Little River basin	Restore sediment regime, water quality, and flow regimes
2	Lower Emile Creek Tributary (EMI)	High integrity stream and riparian conditions. ie. "Reference" area	Fuels reduction in high risk upslope rip. areas, restore sediment regime, restore water quality
3	Flat Rock Branch Tributary (FRB)	High integrity stream and riparian conditions. Serves as "roadless reference area"	Restore sediment regime
4	Upper Little River Tributary (ULR)	High quality streamflow contribution, and areas of unique high-elevation, unconstrained channels.	Restore sediment regime, restore previously managed riparian areas, protect unique channels
5	Wolf Plateau Vicinity	Contains coho and cutthroat habitat, large contributor to sediment cumulative effects problem in Little River basin	Restore sediment regime, restore previously managed riparian areas, restore water quality
6	Black/Clover Vicinity	Large contributor to sediment cumulative effects problem in Little River	Restore sediment regime, restore previously managed riparian areas, restore water quality

*Restoration project emphasis will be geared towards restoring upslope processes. Project types may include instream work **after** substantial progress is made on restoring upslope processes. The methods to achieve the restoration objectives listed in the above table are detailed on following pages.

Figure 46

AQUATIC PRIORITY AREAS



Riparian Areas adjacent to wide valley, gentle gradient channels

Current Condition: Over 90% of these wide valley, low gradient riparian areas are in degraded conditions. Most of these areas occur in the Cavitt Creek and Lower Little River vicinities.

Objective: Restore riparian functions by increasing the rate at which these riparian areas develop a larger tree, diverse stand structure that would provide both shade and large wood contributions to the stream.

Methods: Plant native hardwood and conifer tree species adjacent to wide channels with severe water temperature problems. Thin previously harvested riparian areas, where appropriate, to enhance the growth of large conifers. In addition, plant hardwoods and other conifer species in order to regain natural riparian diversity if necessary. In addition, manage older riparian stands that are unnaturally overstocked (due to fire suppression) in order to reduce the risk of catastrophic fire damage and function loss.

Areas: Treatments should be focused on areas that have been harvested as well as unnaturally dense stands of mid to late seral trees along these wide valley channels that are at an elevated risk of catastrophic fire damage. Vicinities with large amounts of these riparian conditions are prioritized below:

1. Cavitt Creek
2. Lower Little River
3. Emile Creek (Willow Flats area)

Monitoring: Inventory riparian stands and stands with hardwood components and identify management opportunities and strategies for both.

Riparian Areas adjacent to narrow valley, steep gradient channels

Current Condition: A large portion of the narrow valley, steeper gradient riparian areas are in a degraded condition.

Objective: Restore riparian functions by increasing the rate at which these riparian areas develop a larger tree, diverse stand structure that would provide both shade and large wood contributions to the stream.

Methods: Where prescribed fire is used, consider including riparian forests in order to mimic the pattern of "pulses" of large wood input to streams that occurred after fire burned these areas. Thin previously harvested riparian areas to enhance the growth of large conifers. Plant hardwoods and other conifer species in order to regain riparian diversity if necessary. In addition, consider managing some of the older riparian stands that are overstocked, in order to reduce the risk of catastrophic fire damage and function loss.

Areas: Previously harvested riparian areas, and overstocked late seral riparian areas found on steep ground that have the potential to be lost from a stand replacing fire. Vicinities with large amounts of this type of riparian area are prioritized as follows:

1. Emile Creek (excluding Willow Flats)
2. Black/Clover
3. Wolf Plateau
4. Upper Little River
5. Middle Little River

Monitoring: Track the recovery of degraded riparian areas under a variety of treatments compared to untreated control areas.

Existing Healthy Riparian Areas (reference basins)

Current Condition: There are substantial locations of healthy channel conditions and riparian areas in five tributaries that are functioning within reference conditions (Figure 46). These areas serve as important sources of aquatic biodiversity and high quality water.

Objective: Protect and maintain riparian areas where these functions are currently intact.

Methods: Maintain full riparian buffers on all streams in the mapped areas equal to the interim standard widths described in the ROD except where an imbalance of tree density and fuel conditions pose a risk to loss of riparian areas due to fire in steep terrain. Make these mapped areas a high priority for restoration work and erosion prevention in order to protect their healthy condition. Defer all new road construction.

Areas: Various refuge areas were identified throughout the basin (Figure 46). These areas include:

- Cultus Creek and Tuttle Creek tributaries
- Flat Rock Branch of Clover Creek
- The middle canyon areas of Emile Creek
- Little River subwatershed of the larger Upper Little River vicinity.

Monitoring: Monitor large wood numbers, water temperature, and stream shade values.

Water Quality

Current Condition: Water quality has decreased over the last five decades. High pH values and high temperatures have been observed.

Objective: Improve water quality by lowering pH, and water temperature.

Methods: Restrict the practice of fertilization to cumulative effects water quality studies, after which time, the cumulative effects data will be evaluated to determine if the practice should continue, or limits should be imposed. Restore aquatic habitat complexity and enhance infiltration of water in the uplands. Implement a watershed cooperative education program with the Natural Resources Conservation Service, OSU extension agents, and Umpqua Basin Fisheries Initiative. This program would inform landowners about the consequences of excessive water withdrawals, riparian harvest, yard and farm fertilization, and nutrient enrichment to the aquatic ecosystem.

Areas: Basin-wide.

Monitoring: Monitor parameters for pH, water temperature, and baseflows in the water quality/riparian areas mentioned above, and re-activate the USGS water quality gaging station at Peel. Pursue answering the questions: Does forest fertilization effect water quality? Do harvesting and regeneration prescriptions consistent with President's Plan guidance effect water quality?

Flow Regimes

Current Condition: Peak flows have increased.

Objective: Shift the peak flow function towards that which existed during the reference condition.

Methods: Increase water infiltration and flow dispersal by reducing soil compaction (where appropriate), minimizing flow concentration, reducing stream network extension and lessening rain on snow effects associated with very early seral stage development. Examples of specific methods to accomplish this are listed below:

- Reduce compaction by subsoiling and revegetating all or portions of roads that will be decommissioned and decompact soils within tractor harvested units.
- Outslope roads where appropriate.
- Shorten stream network extension by reducing road densities and by increasing dispersal of water off maintained roads (increase amount of relief culverts, dips, etc.).
- Consider landscape hydrologic recovery when planning future timber harvest.

Areas: Landforms that have low natural stream densities on gentle terrain without deeply incised streams. Landforms that are most susceptible include earthflow terrain, upland plateaus and landslide complexes. Vicinities that have extensive landforms with these features include:

- Cavitt Creek
- Wolf Plateau
- Emile (Willow Flats area)
- Black/Clover (Dutch Creek area)
- Upper Little River (Upper Little River and Hemlock Creek subwatersheds)

Monitoring: Monitor discharge at various locations including the USGS station at Peel. Use paired basin measurements to test assumptions about flow and sediment behavior of subbasins with different landform and geomorphic composition.

Sediment Regime

Current Condition: Accelerated rates of episodic and chronic erosion has increased sedimentation of stream systems.

Objective: Shift the sediment regime towards that which existed during the reference condition.

Methods: Reduce the potential for mass failures, severe erosion associated with stream crossings, sources of management related chronic sedimentation, restore altered drainage patterns and modify timber harvest practices on high risk terrain (Appendix A). Specific methods are listed below:

- Remove or stabilize unstable road fills or sidecast landing materials on steep slopes that are at risk of failing and have potential to reach streams.
- Harden, armor, remove or upgrade stream crossings that are at risk of failure due to inability to pass water, debris and bedload during storm runoff.
- Reduce potential for stream diversions at stream crossings by constructing drain dips, grade sags or outsloped road surfaces.
- Give special consideration to both construction materials and existing foundation conditions prior to design and construction of roads on hill slopes exceeding 60 percent slope.
- Avoid locating or relocating discharge of concentrated road drainage onto areas of slope instability or highly erosive soils.
- Enhance stabilization of cutslopes that have a natural tendency to revegetate.
- Utilize high quality aggregate surfacing or asphalt surfacing along critical road segments to reduce surface erosion.
- Utilize the "Guide to Transportation System Assessment and Planning" to help in the prioritization of road restoration objectives (Appendix H).

- Avoid management activities that alter slope stability in areas of high risk terrain.

Areas:

A) Landforms that are at a high risk of debris avalanche or debris flow sediment delivery to stream channels. Specific landforms at risk are debris slide basins within steep, dissected terrain. Vicinities that have extensive landforms with these features include:

- The "granitic" terrain within Cavitt Creek
- Emile (excluding Willow Flats)
- Black/Clover (except for Dutch Creek)
- Lower Little River

B) Landforms that are prone to chronic sediment delivery due to slump and earthflow movement into stream channels. Landforms most susceptible include upland plateaus, landslide complexes and earthflow terrain. Vicinities that have extensive landforms with these features include:

- Cavitt Creek
- Wolf Plateau
- Emile Creek (Willow Flats)
- Upper Little River (Upper Little River and Hemlock subwatersheds)

Monitoring: This outcome is difficult to monitor due to the relatively long time scales involved. Pursue answering the question: What combination of practices are most effective for controlling and preventing road-related runoff and sediment production during winter storms. Establish baseline habitat parameters in stream channels to track conditions and trends associated with peakflows effects, and track changes over time. Monitor quantities of fine sediments in fish spawning beds over time.

Other Recommendations

Recreation

Current Condition: Use of recreation areas throughout the watershed is increasing and will continue to do so. Barrier-free (wheel chair accessible) recreation opportunities are limited. In addition, budgets are declining for maintenance of both trail and facilities. As use increases in the future, conflicts may arise.

Objective: Maintain and increase recreation use and enjoyment. Encourage volunteer participation in trail maintenance, trail building, facility construction, etc.

Methods: Enter into partnerships with local clubs and user groups. Apply for matching funds to build more facilities as needed. Work with local groups to identify and construct barrier-free sites. Educate users as to proper etiquette when using facilities and trails. Create interpretive opportunities.

Areas: All public land within the watershed.

Monitoring: Continue documenting recreation use. Have sign up sheets with campground hosts for volunteer work.

Education and Information

Current Condition: There is a lack of readily accessible data on local watershed conditions and no centralized location for easy access by the public. Watershed dynamics and ecosystem management principles are not well understood.

Objective: Develop programs to educate and provide centralized areas for the dissemination of information and data to the public. Encourage local land stewardship.

Methods: Adopt local schools to encourage study of watersheds and ecosystems. Help form curriculums. Provide schools and libraries with local and regional watershed data that is easily accessed for individual or group independent study. Conduct training seminars for use of information software.

Areas: Areas which may be selected for this recommendation are:

- Douglas County Schools
- Douglas County Library
- Wolf Creek Job Corp Center
- Umpqua Community College Library

Monitoring: Provide public comment cards at these locations for opinions and requests.

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Likelihood of Occurrance : **Documented**

vascular

SCIENTIFIC NAME	FWS	ODA	ONHP	R6	BLM	ROD
Aster vialis	C2	C	1		Candidate	12
Calochortus umpquaensis	C1	LE	1	OR	Candidate	
Horkelia congesta ssp congesta	C2	C	1		Sensitive	
Romazoffia thompsonii			1	OR	Sensitive	

SCIENTIFIC NAME	FWS	ODA	ONHP	R6	BLM	ROD
Astragulus umbraticus			2	OR	Assessment	
Iliamna latibracteata			2	OR	Assessment	
Lewisia columbiana var columbiana			2	OR		
Polystichum californicum			2	OR/WA	Assessment	
Wolffia borealis			2	OR	Assessment	

SCIENTIFIC NAME	FWS	ODA	ONHP	R6	BLM	ROD
Minuarta cismontana			3		Assessment	

SCIENTIFIC NAME	FWS	ODA	ONHP	R6	BLM	ROD
Phacelia verna	3C		4		Tracking	

Likelihood of Occurrance : **Suspected**

fungi

SCIENTIFIC NAME	FWS	ODA	ONHP	R6	BLM	ROD
Oxyporus nobilissimus			1			123

lichen

SCIENTIFIC NAME	FWS	ODA	ONHP	R6	BLM	ROD
Nephroma occultum			1			1 3

SCIENTIFIC NAME	FWS	ODA	ONHP	R6	BLM	ROD
Sulcaria badia			2			

Likelihood of Occurrance : **Suspected**

lichen

SCIENTIFIC NAME	FWS	ODA	ONHP	R6	BLM	ROD
Lecidea dolodes			3			
Pilophorus nigricaulis			3			1 3
Pseudocyphellaria aurata			3			

liverwort

SCIENTIFIC NAME	FWS	ODA	ONHP	R6	BLM	ROD
Chiloscyphus gemmiparus			1			
Sphaerocarpos hians			1			

SCIENTIFIC NAME	FWS	ODA	ONHP	R6	BLM	ROD
Herbertus sakuraii			2			1 3
Porella vernicosa var fauriei			2			

SCIENTIFIC NAME	FWS	ODA	ONHP	R6	BLM	ROD
Gymnomitrion concinnatum			3			
Haplomitrium hookeri			3			
Herburtus aduncus			3			
Jamesoniella autumnalis var heterospora			3			
Lophozia laxa			3			
Marsupella condensata			3			
Marsupella emarginata var aquatica			3			
Metsgeria temperata			3			
Plagiochila semidecurrens var alaskana			3			
Scapania gymnostomophila			3			
Scapania obscura			3			
Schofieldia moticola			3			

moss

SCIENTIFIC NAME	FWS	ODA	ONHP	R6	BLM	ROD
Encalypta brevicolla var crumiana			1	OR		1 3
Tripterocladium leucocladulum			1			

SCIENTIFIC NAME	FWS	ODA	ONHP	R6	BLM	ROD
Andreaea schofieldiana			2			
Frunaria muhlenbergii			2			
Helodium blandowii			2			
Racomitrium pacificum			2			
Tayloria serrata			2			

AREAS NEEDING STABILIZATION AND REVEGETATION

Four areas on Forest Service administered land have been identified as needing stabilization and revegetation:

1. The bend in Little River Road, T27S R1E, Sec 17 in the NW 1/4.
2. Along the 2715 Road, T27S, R1E, Sec 15 in the SW 1/4.
3. Above the east boat ramp at Hemlock Lake.
4. Above the Hemlock Lake dam.

Exploratory botanical work has already been completed for these projects. Experimental efforts to produce appropriate stocking materials were successfully undertaken at J.H. Stone Nursery. It is recommended that planting be undertaken, monitored, and used to create a template for work at similar sites.

The Roseburg Bureau of Land Management has recommended that an area along Ace Williams Mountain, T26S, R3W, Sec 27, (approximately 15 acres), and along Jim Creek, T27S, R3W, Sec 3 (approximately 10 acres) be revegetated with native bunch grasses. This open meadow habitat is currently dominated by exotic grasses. This revegetation action would be consistent with the draft conservation strategy recommended for Calochortus umpquaensis.

LITTLE RIVER WATERSHED ANALYSIS
DATA SUMMARIES -VICINITY COMPARISONS

Table 1. Sites requiring special management

Vicinity	TES Sites	ROD* Sites	NOXIOUS Target Sites
Lower Little	6		1
Mid Little	3	2	
Upper Little	3		
Emile	4		
Wolf Plateau	3		
Cavitt Creek	2	1	
Black Clover	10	1	
Watershed	**31**	**4**	**1**

*ROD "Strategy 1" species

Table 2. Acres of watershed surveyed

Vicinity	FS TES	BLM TES	ROD*
Lower Little	0	?	
Mid Little River	148	?	2
Upper Little	324		
Emile	1		
Wolf Plateau	30	?	
Cavitt Creek	0	?	1
Black Clover	168		1
Watershed	**678**	**4139**	**4**

Table 3. Percent of Forest Service Lands adequately surveyed for current listed TES species

Vicinity	Acres Surveyed	Portion Surveyed (%)
Lower Little	---	---
Mid Little River	54	0.6
Upper Little	143	1.4
Emile	0	0
Wolf Plateau	1	0
Cavitt Creek	3	0
Black Clover	169	1
Watershed	370	**0.6**

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