This document presents the watershed analysis of the Layng Creek watershed. The interdisciplinary team followed the six-step process as presented in the document Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis (August 1995). The six steps are:

- Step 1: Characterization
- Step 2: Issues and Key Questions
- Step 3: Current Conditions
- Step 4: Reference Conditions
- Step 5: Synthesis and Interpretation
- Step 6: Recommendations

The analysis presented here concludes with recommendations, monitoring items and possible restoration projects. Any future projects in Layng Creek drainage will use this document as a guideline and will be analyzed in separate NEPA analyses.

Layng Creek Watershed Analysis Team
October, 1995

LAYNG CREEK WATERSHED ANALYSIS

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Acronyms Used

ACS	Aquatic Conservation Strategy
CCC	Civilian Conservation Corps
CHUs	Critical Habitat Units
cfs	cubic feet per second
dbh	diameter at breast height
DWD	Down Woody Debris
FLRMP	Forest Land and Resource Management Plan
FSEIS	Final Supplemental Environmenta Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl
LSOG	Late Successional Old Growth
LWM	large woody material
mmbf	million board feet
ntu/cfs	nephelomentric turbitity unit to cubic feet per second ratio
NWP	Northwest Forest Plan
NRV	natural range of variation
PACFISH	an inter-regional, inter-agency strategy to provide habitat conditions that contribute to the conservation and restoration of naturally-reproducing stocks of pacific salmon and anadromous trout
PNW-447	Old Growth; Refers to a Pacific Northwest Region Research Note (447) titled Interim Definitions for Old-Growth Douglas-fir and Mixed-Conifer Forests in the Pacific Northwest and California written by the Old-Growth Definition Task Group chaired by J.F. Franklin.
RR	Riparian Reserve lands
ROD	The Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted OwlLWD large woody debris.
UFP	Umpqua Forest Plan (see FLRMP).

EXECUTIVE SUMMARY

Introduction

Layng Creek Watershed is a fifth-field watershed designated as Matrix, Riparian Reserve and administratively withdrawn areas under the Northwest Forest Plan (NFP). The watershed covers 42,164 acres in the Coast Fork Willamette Basin, south of Eugene, Oregon and east of the small city of Cottage Grove.

Approximately 88% or 37,022 acres lie within the National Forest boundary. Layng Creek Watershed is the municipal watershed for the City of Cottage Grove.

Approximately one third of the watershed is Matrix and falls under the Umpqua Forest Plan Management Area 10, which focuses on timber production.

Another third of the watershed is within Riparian Reserves where the focus is on the health of the aquatic and riparian system and its dependent species.

The remainder of the Watershed is a combination of administratively withdrawn land, unsuitable soils, private land, owl core areas and unique and mosaic habitats.

The geology, climate, wildlife and vegetation are typical of the Western Cascade Province. Dorena Dam, built in 1940, blocks the passage of all anadromous fish to the upper Row River, which includes Layng Creek.

Process

The Revised Federal Guide for Watershed Analysis (Version 2.1) was used as a basis for this ecosystem analysis. The issues and key questions were grouped into four categories: societal, terrestrial, riparian and aquatic domains. Reference conditions were dated from 1900 to 1920. However, the natural range of variability (NRV) for 1600 to 1850 was also used to develop a context for reference conditions.

Information for analysis came from a variety of sources including field data, historical maps and photos, and personal descriptions. Habitat analysis, local databases and field guides for the area were also used to describe both current and historical conditions.

The Northwest Forest Plan, the Umpqua Forest Plan, PACFISH and the FEMAT report were used extensively as guidelines and reference documents.

Public involvement included an open house in the winter of 1995 and letters to key government agencies and local land owners describing our process. Involvement and responses have been minimal to this point except for requests to review the final document.

Key Findings and Recommendations

Time and information constraints prevented addressing and answering all questions fully or equally. Based on the current conditions, certain key questions and processes stood out as priorities for analysis. Below are key findings and recommendations from this iteration of the ecosystem analysis.

Aquatic Conditions:

- Channel and aquatic conditions are generally poor.
- Streams are low in pools per mile and channels have widened and become incised.
- More than 60% of all streams lack large woody material.

Major Recommendations:

1. Retain full buffers on all streams including Class IV streams to aid in the recovery of large woody material.
2. Institute the Standard Assessment process developed by the team for project planning to assure compliance with the Aquatic Conservation Objectives (ACS).

Terrestrial Conditions:

- There has been a transition from a moderate intensity fire regime to a high intensity fire regime.
- Wildlife habitat for late successional dependent species is below the natural range of variability and the trend is downward.
- Suitable snag habitat is at 30% but is expected to improve gradually over the next 100 years.
- Connectivity and interior habitat are critical issues. Except for the Hardesty Mountain Administratively Withdrawn Area, there are only 20 patches remaining in the watershed that have interior habitat greater than 70 acres.
- The Riparian Reserves are mainly in a pole/sapling condition with little opportunity to contribute large wood to the riparian ecosystem in the near future.
- There has been an increase in the rate of debris slides, especially on slopes greater than 60%, and the majority of these slides are in riparian zones.

Major Recommendations:

1. Maintain full Riparian Reserve widths for Class I through IV streams.
2. Increase snag and down wood requirements for Matrix lands to the average for plant associations in late successional vegetation.
3. Prioritize harvest to retain connectivity.

Standard Assessment for Project Planning

One task for the Watershed Analysis team was to provide guidelines for applying the Aquatic Conservation Strategy (ACS) at the watershed and landscape scale that could be used during project planning. To accomplish this task, the team developed a set of goals for each of the nine ACS objectives to serve as an evaluation standard.

The consensus opinion of the team is that projects and activities that meet these goals would be consistent with the ACS objectives and no further analysis would be required to show ACS objective consistency.

To assure that projects proposed within the Layng Creek watershed are consistent with the ACS objectives, a Standard Assessment will typically be completed for each subwatershed affected by the project. This methodology will provide more specific information to determine the overall condition of the subwatershed and the effect of the project on the aquatic resources. By using a standard methodology and reporting format, the data will be collected systematically, providing for direct comparison with other subwatersheds and the Layng Creek Watershed as a whole. Such comparisons are particularly helpful for a meaningful cumulative effects analysis.

Over time, as more projects are proposed, the accumulation of subwatershed assessments will provide a more complete picture of the health and condition of Layng Creek.

Restoration

The Layng Creek watershed area has received considerable management attention because of its status as a municipal watershed. Consequently, the watershed does not have a backlog of major restoration projects. However, secondary projects such as road storm proofing will be identified through the Standard Assessment process and a project priority list will be developed systematically.

Other Findings and Highlights of this Analysis

Particular findings, highlights and specific proposals that may be of interest to the reader include:

- An extensive fire history study using both scar and tree origin dates.
- Reference conditions for late seral vegetation in the range of 80 to 90 percent.
- A 95-year history of management beginning with railroad logging in 1900.
- A proposal to establish a Habitat Connectivity Zone based on aggregating remaining old growth patches, riparian reserves, unsuitable soils and other reserved lands.
- Using the Habitat Connectivity Zone as the lowest priority area for harvest, established priority areas for harvest. The development of a Standard Assessment for project planning by subwatershed to achieve ACS objectives and provide for cumulative effects analysis.
- Extensive areas of earthflow terrain with the potential for large scale impacts on water quality and quantity.
- Highest known elevation for a breeding population of red-legged frogs and the highest known elevation of an individual red-legged frog.

Chapter One

1. Characterization

The Layng Creek watershed lies on the western slope of the Cascade Range and is located in the southern region of the Willamette Province. The watershed is approximately ten miles in length and five miles in width, and encompasses a total area of 42,164 acres. Layng Creek flows in a generally western direction to its confluence with Brice Creek, jointly becoming the Row River, which flows into Dorena Lake, above the Dorena Dam. Row River enters the Coast Fork of the Willamette River below Dorena Dam, near the small community of Saginaw. The Layng Creek watershed encompasses primarily National Forest lands, with approximately 5,000 acres in private ownership.

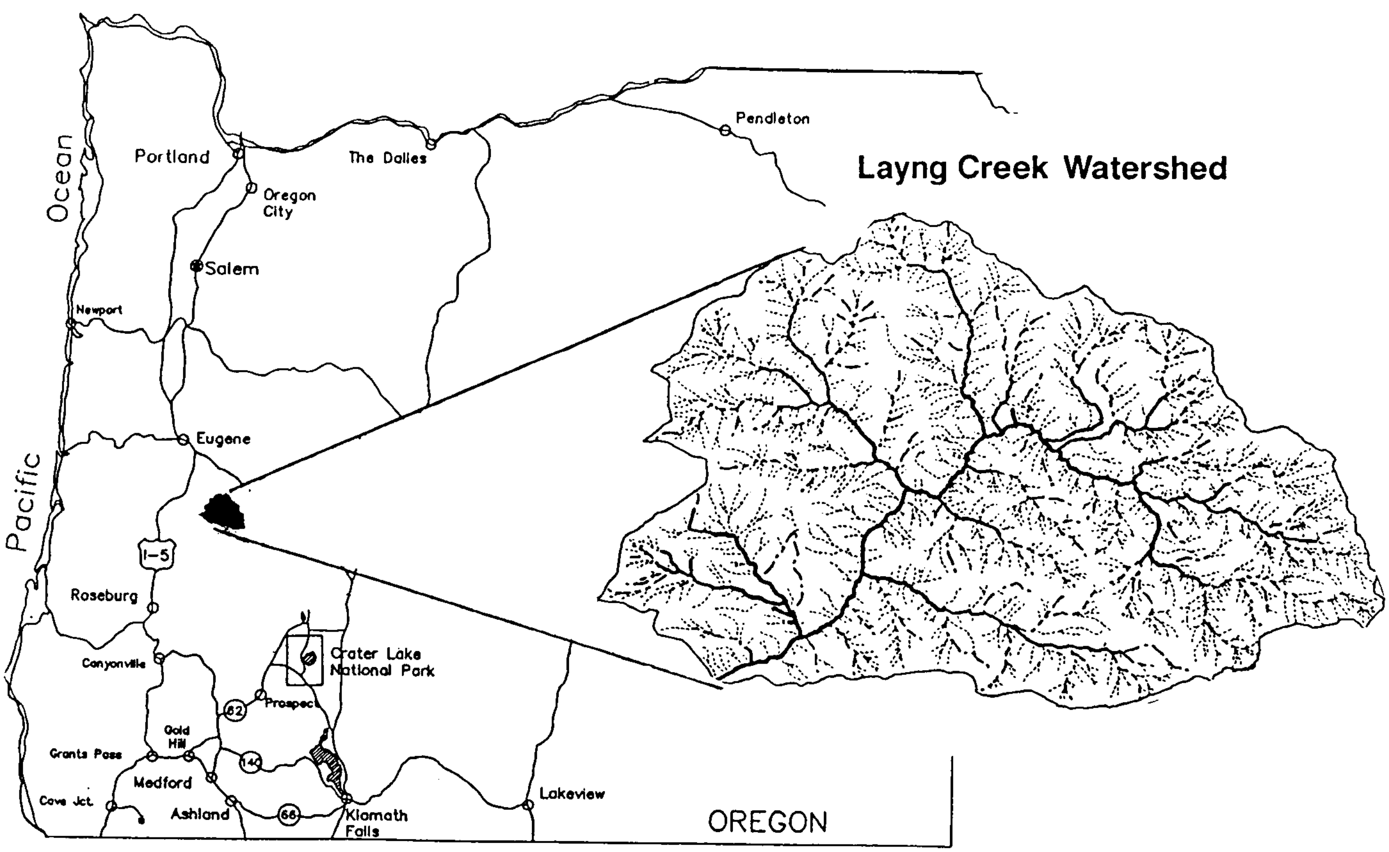


Figure 1. Layng Creek Watershed Location Map

Societal

The earliest known uses of the Layng Creek watershed by people is thought to have been limited to seasonal hunting and gathering by the Sahaptian Molalla and Kalapuyan Yoncalla tribes. Euro-American settlers started to appear in the period between 1850 and 1860. In 1863 gold was discovered in the adjacent Bohemia mining area, and in 1870 the railroad reached Cottage Grove. In 1909 the City of Cottage Grove started to use water from Layng Creek.

Two agreements with the Secretary of Agriculture for the subwatersheds of Dinner and Prather Creeks were signed in 1922 and 1924. In 1950 the City abandoned the Dinner Creek system and built the existing diversion on Layng Creek. Layng Creek was first recognized as a municipal supply in the "Watershed Management Policy Statement for Layng Creek Watershed" (1969). It is still currently the primary source of drinking water for the city of Cottage Grove.

In 1912 the railroad was extended into the Layng Creek area and about 3,200 acres were logged up until 1930. No logging took place in the 1930's but between 1941 and 1980 an additional 17,000 acres were logged. To date 62% of the watershed has been harvested.

Recreational use of the watershed has been limited due to potential conflicts with the municipal use. The watershed is open to public access but swimming and over-night camping are prohibited above the municipal intake.

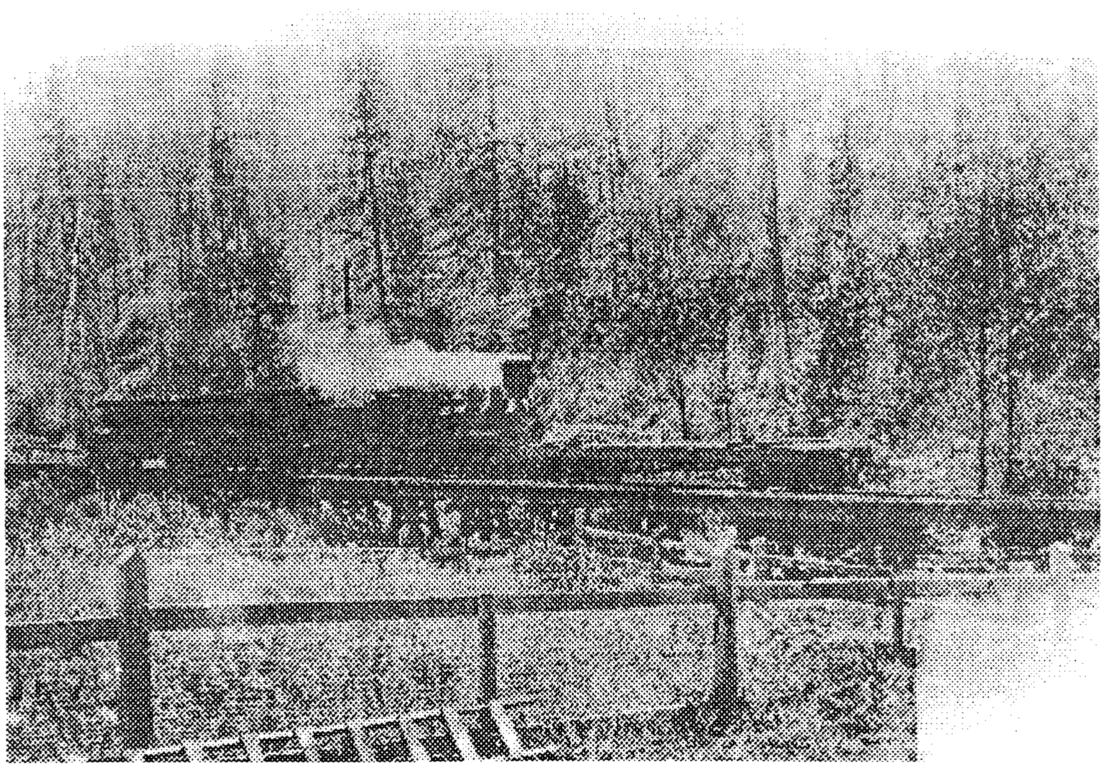


Figure 2. Railroad Logging near Rujada in 1912

Land Allocations

The Layng Creek watershed contains 18,675 acres of matrix land and 16,029 acres of Riparian Reserves (RR) under the Northwest Forest Plan (1994). The 2,298 acre administratively withdrawn area, in the vicinity of Hardesty Mt., is composed of the unroaded recreation and the ecosystem study area allocations, under the Umpqua Forest Plan (1990). To the north and east of the Layng Creek watershed lies Late-Successional Reserve (LSR) lands. To the south is the Brice Creek watershed, and to the west is private timber land.

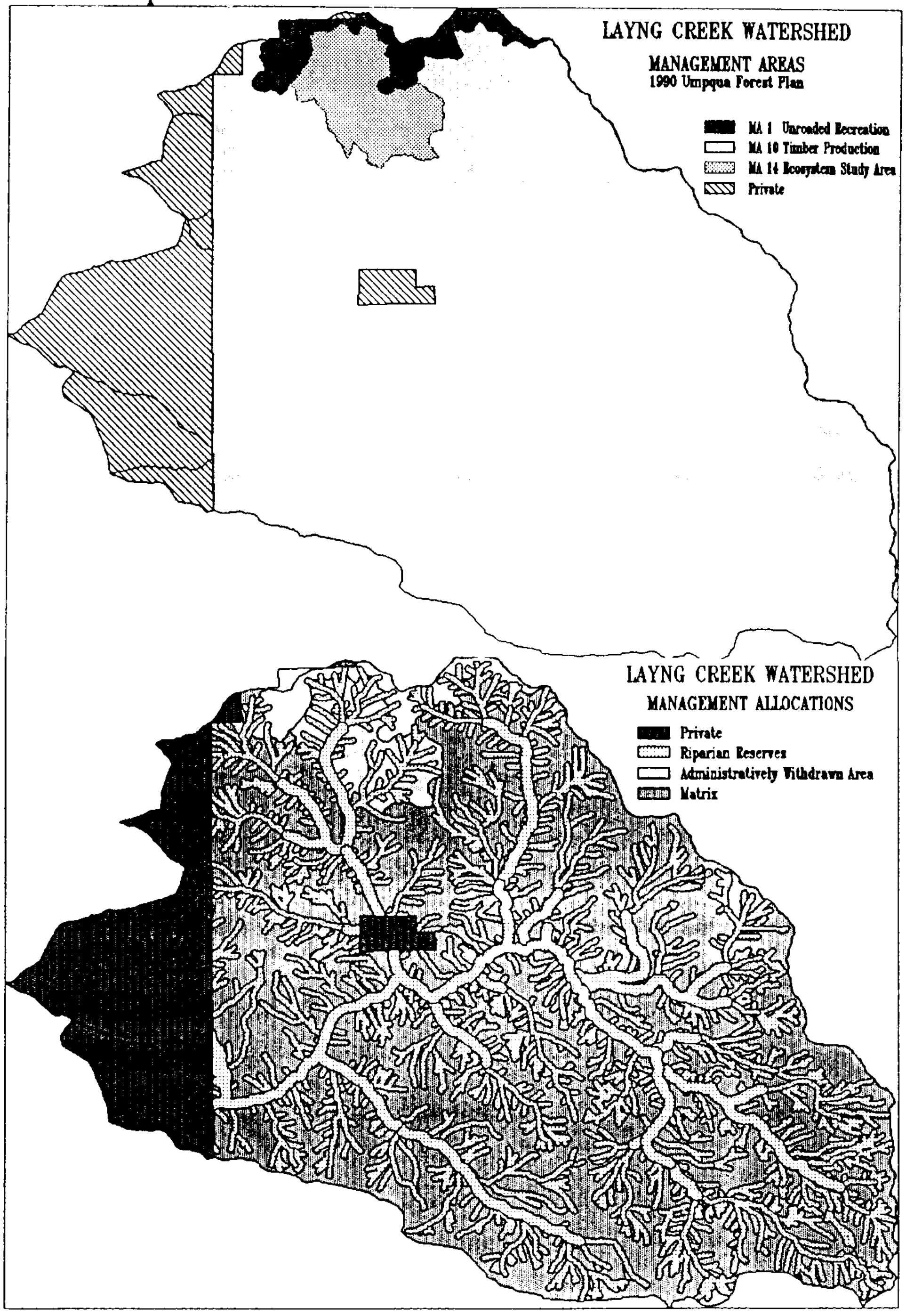


Figure 3. Management Allocations within Layng Creek Watershed as defined by both the Northwest Forest Plan and the Umpqua Land and Resource Management Plan.

Terrestrial

Climate / Physiography

The climate is temperate, with average precipitation ranging from around 53 inches near the mouth to over 70 inches in the upper reaches of the watershed. Approximately 65% of the precipitation occurs between November and March, while less than 3% occurs in July and August.

Elevations in the watershed range from about 1,120 feet at the mouth of Layng Creek to over 4,600 feet at the summit of June Mountain. Approximately 80% of the watershed lies between 2,000 and 4,000 feet, the transient snow zone.

Strong winds in the watershed are usually from the south and southwest and are generally associated with major winter storms.

Vegetation

The watershed lies predominantly in the western hemlock vegetation zone, except for occasional areas of Douglas-fir associations on lower, warmer sites, and grand fir and silver fir associations at the higher elevations. Common tree species include Douglas-fir, western hemlock, western red cedar, sugar pine, white pine, incense cedar, madrone, chinquapin and bigleaf maple.

Understory species include vine maple, rhododendron, yew, salal, Oregon-grape, ceanothus and swordfern. Fifty-seven percent of the watershed is in an early seral stage, five percent is in a mid-seral stage and the remaining thirty-two percent of the forested areas are in a late seral stage. Five percent of the watershed is non-forest.

Geology

In most respects, the geologic factors affecting water quality in Layng Creek are typical of watersheds in the Western Cascades. The watershed is characterized by several types of geomorphic terrains which have developed different flow regimes and erosional processes. The steeper, dissected terrain tends to have shallower soils and flashy streamflows. The earthflow terrain has deep, weathered soils and colluvial deposits that have a large influence on groundwater.

Riparian Interface

Like other western Oregon watersheds, the riparian zones in the Layng Creek watershed are a critical component of the landscape ecosystem. The Layng Creek stream system contains about 425 miles of streams with an average stream density of 6.5 miles per square mile. Of the Federal lands designated Matrix-Riparian Reserve, 43% of the land is in the Riparian Reserve category. At the present time about 65% of the vegetation within these Reserves is less than 80 years old.

Aquatic

Aquatic Life

Historic records indicate that spring Chinook salmon were native to the Coast Fork Willamette Basin. With a small run entering Layng Creek during years of high flow, salmon were able to pass over Wildwood Falls. However Dorena Dam was built in 1949, blocking all passage to the upper Row River which includes Layng Creek.

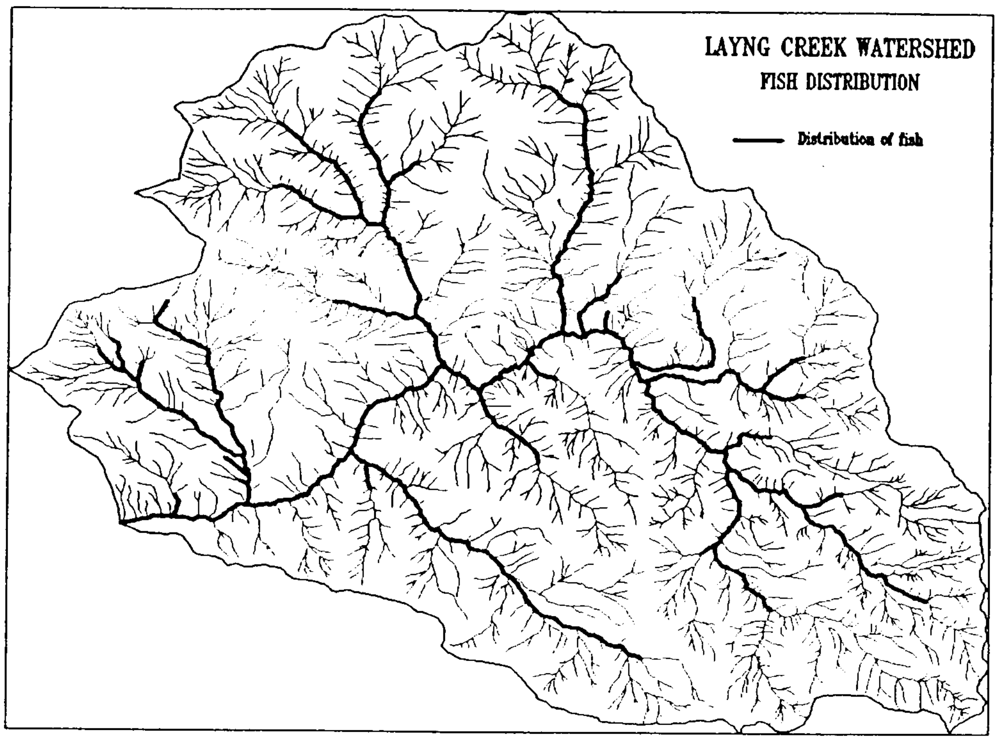


Figure 4. Fish Distribution in Layng Creek.

Fishbearing streams are displayed in Figure 4. Currently, Layng Creek supports a population of wild cutthroat trout. The Oregon Department of Fish and Wildlife's policies include managing for natural production of this wild population. To achieve this goal, the area is no longer stocked with hatchery fish. Other fish species which are native to the Coast Fork, and may be present in Layng Creek, include speckled dace, longnose dace, and a few species of sculpin.

Chapter Two

2. Issues and Key Questions

During a scoping process for issues, the Layng Creek watershed assessment team developed a list of values, uses and desired conditions. As the analysis progressed, some of these were eliminated because of insignificance or irrelevancy to the watershed. The remaining issues were prioritized based on the extent of change between current and reference conditions, management objectives in the Northwest Forest Plan (NFP) and the Umpqua Forest Plan (UFP), and the frequency with which issues were related to ecosystem processes. The twelve issues addressed in this analysis are:

Societal	**Issue 1.**	Public Use
	Issue 2.	Timber Production
	Issue 3.	Roads
Terrestrial	**Issue 4.**	Vegetation and Wildlife Habitat
	Issue 5.	Geological Processes
	Issue 6.	Natural Disturbance/Wildfire
	Issue 7.	Connectivity, Edge & Landscape Patterns
	Issue 8.	Soil Productivity
	Issue 9.	Wildlife and Plant Populations
Riparian Interface	**Issue 10.**	Riparian Reserves
Aquatic	**Issue 11.**	Water Quality
	Issue 12.	Aquatic Life

The following ecosystem elements affecting the Layng Creek watershed are the most relevant to the above issues and related key questions, and these elements are incorporated into the issues and key questions.

- *Earthflow terrain on oversteepened slopes*
- *Extensive proportions of habitat in sapling stages without snags*
- *Lack of large woody material in streams and Riparian Reserves*
- *High road densities*
- *Fragmentation of late seral vegetation.*

Societal Issues

Issue 1- Public Use

Even though recreation is not encouraged and certain activities are limited or prohibited, Layng Creek is used by the public for camping, hiking, hunting, fishing and sight seeing. Collecting mushrooms, rocks, firewood, ferns, moss and other special forest products are also common activities in the watershed.

Key Questions:

- *How should these activities be managed to meet the ACS (Aquatic Conservation Strategy) objectives ?* (pgs. 15-16, 67, 87-89, 121, 135-143)

Issue 2- Timber Production

Forest Service land use allocations for Layng Creek are primarily matrix (37%) and Riparian Reserve (46%). Private land makes up 12% of the watershed. Approximately 62% of Layng Creek, including virtually all of the private land, has been harvested. About 17% of the soils in the watershed are classified as unsuitable for sustained timber production. Layng Creek's status as the municipal watershed for the City of Cottage Grove requires certain standards and guidelines for timber harvesting and road construction. Given the high productivity of the land and the concerns described above, the following questions associated with the issue of commodities production, were formulated.

Key Questions

- *What is a sustainable yield of timber and special forest products under current management direction?* (pgs. 88-89)
- *What opportunities exist for intensive management practices of timber and special forest products?* (pgs. 15, 39-42, 88-89, 122, 126-129)
- *In the process of meeting Aquatic Conservation Objectives, are there harvest opportunities in Riparian Reserves?* (pgs. 89, 126, 146)

Issue 3- Roads

The road system significantly affects the quality of the ecosystem on a landscape scale. Specifically, the roads are conduits for activities that may be disruptive to the local ecosystem functions. The road system also reduces geographic isolation, allowing access by hunters, predators, collectors, and carriers of off-site seed including noxious weeds. Since maintained roads do not support vegetation, they reduce the land base for vegetative growth at a rate of about 5 acres per mile of road.

Roads can affect local hydrology by intercepting and redirecting both groundwater and surface runoff. This mechanism affects timing of the runoff at the local subwatershed level and also changes downslope water distribution patterns. This latter effect can result in specific areas losing or gaining water, which can directly affect a local ecosystem.

Road crossings are a particularly important component of the physical landscape because of their direct effect on the aquatic system. Culverts or bridge structures can affect channel hydraulics and affect normal channel forming processes. This could alter the meander pattern of a channel or affect the flow dynamics of a floodplain. Furthermore, a culvert can act as a barrier to fish and other aquatic organisms, restricting their longitudinal movement up and down the channel zone. This element is critical since the life cycle of some organisms may depend upon this movement.

Road crossings also increase potential for accelerated fine sediment loading to streams. A portion of the water run-off from the road prism often enters the stream. The amount of fine sediment added depends upon the condition of the roads and the amount of water draining off of the road into the stream.

Culvert failure is another potential source of sediment. If a culvert plugs or fails there is possibility of the associated road fill failing or the stream being diverted down the road to another drainage. The latter situation generally has more potential for creating additional sediment. The average life of a culvert is on the order of 50 years, and the probability of culvert failure increases with age. Debris slides associated with roads also have the potential of delivering more sediment to the stream system. Generally, the number of new slides associated with a road diminishes as the road gets older.

Road encroachment into the riparian zone can also affect the channel movement patterns as well as the flood plain characteristics. These roads can also act as barriers to terrestrial organisms as they move between the upslope areas and the channel areas.

Key Questions

- *How will the present road system be managed to meet ACS Objectives?* (pgs. 135-143)
- *What criteria will be placed on new roads to assure that they meet ACS Objectives?* (pgs. 135-143)
- *What are the contributions to water sedimentation caused by roads, and where are the high levels of road-caused sedimentation?* (pgs. 16-17, 25, 63-64, 87, 89, 90-94, 118-120)
- *What is the density, location and effect of roads in Riparian Reserves?* (pgs. 107, 109, 118, 145)
- *What are the restoration priorities for roads and road-related treatments in Layng Creek?* (pg. 145)

Terrestrial Issues

Issue 4- Vegetation and Wildlife Habitat

The vegetation in Layng Creek has been impacted by harvest activities, road building and fire suppression. The resulting loss of late successional vegetation conditions has affected the biological diversity of the area through impacts on wildlife habitat, water quality, aquatic and riparian conditions, unique habitats, individual plant species, fungi and lichens. The location, condition and types of vegetation also determine the ability to provide commodities and recreation opportunities. The following questions are associated with this issue.

Key Questions

- *What is the historic range of variability of terrestrial vegetation (including snags and large woody debris)?* (pgs. 73-80, 101-106)
- *What are the existing vegetative conditions?* (pgs. 36-38, 55, 101-102)
- *What is the condition of the existing old growth and the priorities for retention?* (pgs. 38-39, 101-104, 126-134)
- *What is the availability of snag habitat and large down woody debris habitat?* (pgs. 46-47, 60-62, 78-79, 102-104, 109)
- *What are the opportunities to enhance vegetation diversity and restore historic conditions while providing commodity production?* (pgs. 122, 126-129)

Issue 5- Wildlife and Plant Populations

Within the last century, timber production has been emphasized as a primary management objective in the Layng Creek watershed. Planning schemes designed to accommodate the high demand for wood products and a persistent emphasis on big game management has produced a fragmented landscape of managed and natural stands. Seventy percent of the watershed has had some level of timber harvest management. Current vegetation conditions and patterns, coupled with the lack of species data and trends limits the options for meeting NWP and Umpqua Forest Plan objectives. Enhancing aquatic habitat and maintaining connectivity to LSR's for late-successional species are objectives which provide options for the future and favor managing for endemic, threatened, endangered, sensitive and survey and manage species. At issue is the ability of the existing condition to provide sufficient habitat to maintain local, well-distributed populations across the landscape. The following list of questions were designed to address these issues.

Key Questions

- *What are the effects of land management activities on wildlife and plant species?* (pgs. 42-53, 56, 101-108, 110-111)
- *What is the historical and current population of wildlife and plant species and their distribution in the watershed?* (pgs. 42-53, 56, 77-82, 101-108, 110-111)
- *What wildlife and plant species are recognized as Threatened and Endangered Species?* (pgs 44, 49-53, 110-111)

- *What role does the watershed play in providing for conservation or recovery of wildlife and plant species?* (pgs. 37-40, 88-89, 101-108, 110-111, 126-143)
- *What kind of habitats are present within the watershed?* (pgs. 36-48, 77-83, 101-106, 110-111)
- *Where are the introduced wildlife and plant species located and what adverse effects may be associated with their presence?* (pgs. 42-45)
- *What management strategies and restoration opportunities exist for managing wildlife in Layng Creek watershed?* (pgs. 106-108, 110, 126-127, 130-134)

Issue 6- Connectivity, Edge and Landscape Patterns

Mature and late successional forests comprise 37% or 15,653 acres of Layng Creek. Approximately 25% of the existing late successional habitat in Layng Creek is in withdrawn, Riparian Reserves or unsuitable categories, and provides for the 15% minimum of late successional vegetation required by the ROD (the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl). At issue is the ability of the current ROD allocations and Standards and Guidelines to maintain suitable habitat for population connectivity and source areas for carryover populations for riparian associated or late-successional species. The following key questions are designed to provide an understanding of this issue.

Key Questions

- *Are there stands that are priority for retention because they are connected, late successional and have interior habitat?* (pgs. 38-39, 77, 101-107, 126-127, 130-133)
- *What is the connectivity of late-successional forests between Late Successional Reserve (LSR), Riparian Reserves and Matrix lands?* (pgs. 38-39, 56, 77, 104-107, 126-127, 132-134)
- *How should the connectivity of late-successsional forests be maintained between LSR and Matrix?* (pgs. 88-89, 106-107, 126-127, 132-134)
- *What are the historic landscape patterns?* (pg. 77)
- *What is the role of disturbance regimes (natural and introduced) on historic and existing vegetation patterns?* (pgs. 29-36, 72-81, 95-100, 123-125)
- *Are there landscape patterns that would best meet ecological and resource objectives?* (pgs. 106-107, 126-127, 130-133)

Issue 7- Geological Processes

The natural erosional processes occurring in Layng Creek have resulted in the development of aquatic communities that adjusted to natural variations in the sediment regime. Since the development and active management of the resources began in Layng Creek in the early 1900's, the rate and frequency of erosion appears to have changed significantly.

Key Questions

- *What are the physical and chemical processes and interactions that shape and control the ecological processes occurring within Layng Creek?* (pgs. 18-22, 71-72, 90-92)
- *Where are these processes occurring and what is the significance of these relationships?* (pgs. 19-29, 70-72, 90-94)

- *What geological features and geomorphic processes control the character and development of riparian areas?* (pgs. 18-23, 70-71, 90-95, 118)
- *How have these processes been affected by disturbance, including natural and imposed activities on the landscape?* (pgs. 18-29, 70-72, 90-95)
- *Are there specific areas that appear to be sensitive to disturbance processes?* (pgs. 19-22, 27-29, 70-71, 90-95)
- *What is the relationship between erosional processes and aquatic habitat, and how have these relationships been affected as a result of natural and induced disturbance?* (pgs. 18-23, 70-71, 90-95, 118)
- *Where are the high likelihood areas to prevent mass-wasting from occurring?* (pgs. 24-27, 70-71, 90-94)

Issue 8- Soil Productivity

The productivity of the soil resource is inherently connected to the productivity of the ecological unit. Soil productivity can be affected in a number of ways; the focus in this analysis will be on physical loss of soil through erosion and the detrimental disturbance of the soil as a result of physical disturbance.

Key Questions

- *What are the soil types and distributions within Layng Creek?* (pgs. 28-29)
- *What are the soil types that have a high risk of detrimental disturbance or erosion that are sensitive to land management activities?* (pgs. 28-29, 47, 95)
- *Where are high likelihood areas that detrimental disturbance may exceed Forest Plan Standards?* (pgs. 47, 95)
- *What are the high priority activities that will result in decreasing erosion or detrimental disturbance?* (pgs. 111-113, 122-123)

Issue 9- Natural Disturbances / Wildfire

Fire is the most significant natural disturbance process in Layng Creek. Historically, fire played a major role in creating, modifying or maintaining fuels conditions. The majority of Layng Creek is a moderate severity regime which is characterized by frequent partial stand replacement fires, with significant areas of high and low severity fires.

Although natural fire ignitions have been a frequent occurrence within the watershed in the last 94 years, most fires were small in size because of fire suppression. As a result, an artificial fire regime has developed which could result in stand replacement fires. Since 1900, forty-three percent of the watershed has been broadcast burned or underburned. Effects on soils range from low to severe.

Wind is another natural disturbance affecting the vegetation in Layng Creek. Leave trees and Riparian Reserves may be impacted by severe wind storms. Disturbance by insects and disease can be found throughout Layng Creek at moderate levels.

The following questions address the issues of wind, fire disturbance and fire suppression in the watershed.

Key Questions

- *What is the historic role of fire in the watershed?* (pgs. 31, 72-76, 95-98)
- *What are the existing fuel conditions?* (pgs. 29-35, 95-98)
- *Are there fire/fuels management strategies that will enhance fuels diversity, restore historic conditions and assist in silviculture and wildlife management?* (pgs. 98-99, 123-125)
- *Are there areas where wind can be expected to impact Riparian Reserves and leave trees?* (pg. 36)

Riparian Interface Issues

Issue 10- Riparian Reserves

Under previous land management policies, riparian buffers were relatively modest, or non-existent. As a result, only 32 % of the riparian habitat within Layng Creek watershed is in the late successional vegetation condition. This departure from the natural range of 45 % to 75 % represents a significant loss of ecosystem function of the riparian corridor as well as local alteration of the channel characteristics.

Because of the high stream density in Layng Creek, it is unrealistic to completely isolate the Riparian Reserves from activities in the adjacent Matrix designated lands. For example, a short temporary road across a small channel may be environmentally preferred to a longer road that fully avoids the riparian area.

Key Questions

- *How should the Riparian Reserve lands (RR) be managed to meet ACS objectives?* (pgs. 109-111, 135-144)
- *How will projects that extend into the Riparian Reserves be constrained to assure that ACS objectives are met?* (pgs. 135-143)

Aquatic Issues

Issue 11- Aquatic Life

The lack of instream large woody material (LWM) and lack of future recruitment due to removal or alteration of riparian vegetation has the largest impact to the aquatic habitat.

Management activities such as road construction and timber harvest have impacted the aquatic system. Impacts from roads are of concern due to an increase in higher flows, which cause channel instability and an increase in fine sedimentation entering the stream channel.

Species distribution has been extensively altered by migration barriers. Dorena Dam, built in 1949, blocked anadromous passage to Layng Creek. Smaller dams have been built within the watershed as part of the municipal water supply. Some road culverts and fire pump chances are a source of some concern. These barriers cause genetic isolation in fish populations by limiting upstream migration. Key questions to resolve are:

Key Questions

- *What are the current conditions of the aquatic habitat for resident cutthroat trout and other aquatic species?* (pgs. 59-63, 113-118)
- *What is the current and historic fish distribution?* (pgs. 5, 59-63, 84-85, 113-118)
- *Which subwatersheds within Layng Creek contain the best aquatic habitat?* (pgs. 113-118)
- *What are the restoration opportunities?* (pgs. 143-146)

Issue 12- Water Quality

Water quality in Layng Creek has been a primary concern since installation of the municipal water system intakes. The Forest Service works closely with the City of Cottage Grove to assure that water at the intake meets the appropriate water quality standards.

Suspended sediment/ turbidity has been a key parameter which is actively monitored to provide an annual index value of the general sediment production capability of the watershed.

Water quality of the entire aquatic system is also important. Because the riparian areas have been extensively altered, the water quality throughout the drainage is not fully consistent with that of a late successional/old growth ecosystem.

Key Questions

- *How do management activities affect water quality in Layng Creek?* (Pgs. 57-58, 63-65, 118-120)
- *How should the matrix lands be managed to assure that the ACS water quality objectives will be met?* (pgs. 109-113,118-120, 135-143, 147)

Chapter Three

3. Current Conditions

Societal

Domestic Water Supply

The City of Cottage Grove presently uses about 550 million gallons of water per year, which is about 1% of the total water yield of the watershed. A water treatment facility, located near the Rujada Campground, is used to assure that water quality standards are met. This facility is semi-automatic, requiring daily visits by City personnel.

Timber Harvest

Layng Creek watershed has been a valuable source of timber since 1900. The site productivity is primarily site class III and II. This equates to a mean annual increment (MAI) of 120 to 200 cubic feet per acre. Soils are deep and usually well drained.

An average of 286 acres per year have been harvested since 1900 in the Layng Creek watershed. Harvest rates peaked between 1950 and 1960, when over 5,000 acres were harvested. The lowest harvest levels occurred between 1930 and 1940 ,and since 1990, with less than 500 acres harvested during those time periods (see Figure 13).

A total of 14,467 acres of federal land is designated as both Matrix and suitable for timber harvest in the Layng Creek watershed. Initial estimates, based on the Northwest Forest Plan and the Umpqua Forest Plan land allocations, projected an ASQ (annual sale quantity) of 6 mmbf. This would result in 135 acres of regeneration harvest and 150 acres of commercial thinning per year and equates to a 92-year rotation.

Special forest products such as firewood, poles and Christmas trees have been a traditional commodity on the District since harvest activity began in 1913. Pacific yew and western red cedar are still valued as poles for fencing. Yew bark was harvested for use in the production of taxol, an anti-cancer pharmaceutical product, between 1990 and 1993. Yew trees were harvested for their bark on approximately 630 acres in Layng Creek during this period. Mushrooms, greenery and cones are collected in small amounts within the Watershed.

Public Use

Uses such as general recreation are not encouraged above the intakes in the Layng Creek watershed because of potential adverse effects on the water supply.

Specifically, swimming and overnight camping are prohibited activities. Other recreational use in the watershed is allowed, such as fishing, hiking, recreational collecting, hunting, biking and driving. Activities allowed by permit above the intake include firewood collection and collection of other special forest products such as mushrooms and ferns.

Recreational uses below the intakes are not limited. Rujada Campground is a 12-site fee facility with an associated day use area and short loop trail. The road system in Layng Creek does provide access to the Oakridge area and it is used to a limited degree as a travel route.

Roads

There are a total of 229 miles of Forest Service-managed roads in the Layng Creek watershed, which averages 3.7 miles of road per square mile (see Table 1). An additional 20 miles of gravel and native surface roads exist on the 3,300 acres of private land in Prather and Pitcher Creeks. Road densities range from as high as 5.5 miles of road per square mile in some of the subwatersheds , to as low as 1.8 miles/square mile in others. Road closures, including seasonal winter range closures and permanent erosion closures, reduce the density of open access roads to 2.58 miles per square mile for the entire watershed.

Table 1. Roads and Acres (Forest Service Roads only)

Road Type	Length (miles)	Area (acres)	Maintenance Level
Paved	25.3	152	25.3 mi. Level 4
Gravel	147.27	515	39.5 mi. Level 3 119.7 mi Level 2
Native (Rock)	11.93	36	
Closed & Grass	44.42	111	44.42 mi Level 1
Totals	228.92	814	

There are 89 culverts crossing class 2 and 3 streams on Forest Service lands. Culverts on Saltpeter, Harvey, Curran and Layng Creek either hinder or prevent fish passage. The average distance between drainage structures on paved roads is 350 to 400 feet. On gravel surface roads, this spacing varies from 539 feet on gentle grades of 2-3 percent slope, to 336 feet on steeper road grades (5 to 8 percent slope). The average spacing on roads in the Layng Creek watershed is 413 feet between drainage structures. Table 2 shows miles of roads within 400 feet of Class 1 and 2 streams.

Table 2. Roads within 400 feet of Class 1 & 2 Streams

Type	Length in Miles	Bridges	Culverts
Paved	8.7	6	none
Gravel/Improved	9.4	4	7
Native/Grass	1.0	-	

Between 1975 and 1995, 46.55 miles of road have been constructed and 15.2 miles of that total were constructed with a native surface, then seeded, mulched and closed to vehicle traffic. A total of 15.3 miles of road have been paved during that time, along with all bridge approaches. Native surface roads have been fertilized at least twice since construction, and most existing cutslopes have been re-fertilized at least once in the past 20 years. Ditch lines are cleaned in the spring to allow grasses to germinate and grow prior to fall rains and run off. They are seeded and fertilized as soon as possible to promote rapid recovery of ground cover. Diminishing funds for road maintenance will make it impossible to continue at a level of maintenance that will prevent erosion and sediment movement to the streams. Table 3 displays the number of road crossings in relation to the total length of class 2 and 3 streams in the subwatersheds of the Layng Creek road system.

Table 3. Road Crossings per Drainage

Stream Name	Stream Length plus Forks in feet	Number of crossings	Miles per crossing
East Fork Prather	11000	6	0.35
Junetta Creek	59000	10	1.12
Curran Creek	12500	4	.59
Herman Creek	27700	1	5.25
Harvey	12000	9	0.25
Patterson Creek	12500	4	0.59
Saltpeter	21000	6	0.66
Alex	17600	2	1.67
Silverstairs	14300	3	0.90
Doris	14800	3	0.93
Dinner Creek	47300	6	1.49
Layng Creek	121000	11	2.08
Pitcher Creek	11000	10	0.21
Prather Creek	28600	12	0.45

Since most of the road system has been in place for more than 20 years, it has had time to "season" and many of the high risks have been mitigated. However, maintenance of the road system is going to become increasingly critical in the future as the culverts fail and need to be replaced.

The Layng Creek watershed is essentially roaded and a need for further extensive roading is not anticipated. However, since most of the watershed has a Matrix allocation there will be some emphasis placed on timber sale activity and short spur roads may occasionally be required to provide the most ecologically sound access route.

Terrestrial

Geology

The geology of Layng Creek is associated with rock units of the Western Cascades, generally consisting of a complex mixture of volcanic and sedimentary units. Individual units range from isolated deposits to large continuous expanses.

Following the deposition of these rock units, the Western Cascades were severely eroded and, on the eastern end of the drainage and at higher elevations, glacial features are observed. Recent alluvial, colluvial and landslide deposits are found throughout the basin in localized areas.

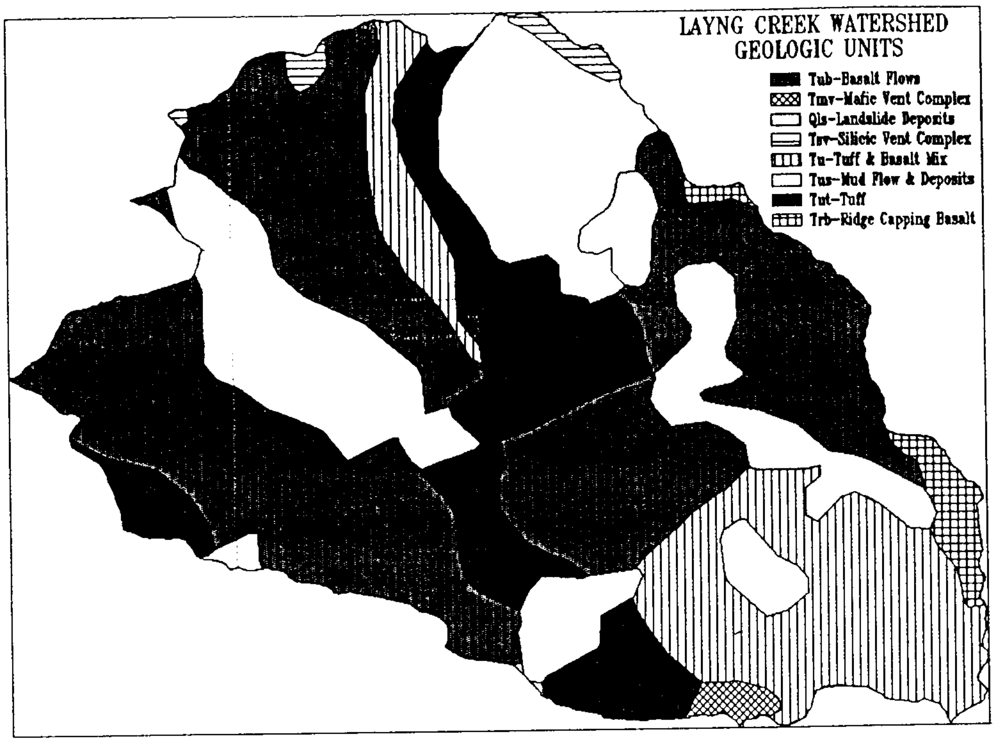


Figure 5. Geologic Units in Layng Creek

Basalt *(40%)* Layng Creek watershed contains a wide variety of rock units, which have contributed to the diverse landforms and geomorphic terrains in evidence today. By far the most predominant rock unit mapped in the basin is basalt. Basaltic rocks in Layng Creek are identified in two distinct areas in the Tub mapping unit and total 40% of the total rock mass in the basin. The largest concentrations are identified on the south side of Dinner Creek, Junneta Creek and upper Layng Creek. The basalts in these areas are considered part of the Little Butte Group and are identified as Tub in the geologic mapping. In addition, another unit of basalt (Trb) is associated with the upper elevations of Layng Creek. This basalt is considered to be part of the Ridge-Capping Basalt that is significantly younger than those associated with the Western Cascades rock unit (Sherrod, 1986). It has been dated in several areas as 3-8 million years old, while the rest of the Western Cascades is dated between 35 and 17 million years old. These Ridge-Capping Basalts tend to be very homogeneous and very resistant to erosive forces, which, combined with their relatively young age, result in prominent peaks and bluffs. These rocky features provide a number of unique habitats as discussed in terrestrial sections of the document.

Tuffaceous *(16%)* A series of tuffaceous rocks, mapped as Tut unit occupy 16% of the basin. As described in Appendix E , these rock units tend to be well cemented and resistant to weathering. Several areas of the Layng Creek watershed have distinctive topographic features as a result of the weathering processes of these hard tuffs. Specifically, the steep dissected terrain along Junetta Creek, Harvey Creek and Dinner Creek is tuffaceous in nature.

Tus / Tu *(32%)* Several other rock units in the Layng Creek watershed are identified as part of the Little Butte and Middle Miocene Volcanics. These additional units include Tus, a conglomeration of volcanics and sedimentary rocks and Tu, an ash-flow tuff deposit that occurs in a series of banded rock units which range from very soft to extremely hard. Together these units comprise 32% of the watershed. In some areas, these rock units appear to be hydrothermally altered, probably as a result of burial metamorphism. There appears to be a strong correlation between these deposits and the development of large, presently dormant, landslide complexes which developed sometime after deposition. The major channel forming events that occurred during the Pleistocene period was probably responsible for the development of a number of these complexes. The erosion of weaker rock units underlying thick accumulation of competent material destabilized large areas that moved over a long period of time. There are substantial deposits of these rock units associated with Herman Creek, Dinner Creek and the upper reaches of Layng Creek.

Other *(12%)* Several other geologic units have been identified, and although they occupy relatively little area, they play a predominant role in the landscape. Rock units Tmv and Tsv are associated with localized intrusions of granitic type material, typically placed as vents or sills. Prominent peaks such as Hardesty Mountain, Mt. June and Sugarloaf Mountain are all mapped as Tmv or Tsv. These rock complexes contain medium to coarse grained "granitic" type of material and typically erodes in a similar fashion.

Geomorphic Processes

A succession of processes and events have shaped the character of landforms and associated ecological communities in Layng Creek. The basic properties of the rock have contributed to the development of the drainage system that exist in the basin. Subsequent events associated with Plate Tectonics and changes in global climates have shaped the topographic features in evidence today.

Faults

Several large faults have been identified that appear to control the orientation of Layng Creek as well as a number of the large earthflow features. One of the faults actually parallels Layng Creek for the lower 6 miles and appears to have resulted in a significant geologic contact that is controlling the channel gradient in the vicinity of Junetta and Harvey Creeks. The Layng Creek Flats have almost certainly developed in response to this geologic control. Field investigations and observations made from topographic maps and aerial photos verify that the offset of Layng Creek in this area is related to the geologic structure in the area.

Erosional Processes

Layng Creek and other major tributaries have also been influenced over time by large scale erosional processes including the development of large earthflow complexes, some of which are still relatively active. In the past, a number of Earthflows (QEF) and Debris Slide Basins (DSB) were identified as special management areas due to concerns pertaining to irreversible soil damage and instability concerns[1]. Further evaluation during this analysis process refined these areas and appropriate recommendations are proposed in Chapter 6 of this document.

The earthflow complexes have controlled the development of the streams in a number of areas and appear to be the source of historic turbidity problems in the lower reaches of Layng Creek. Approximately 9,726 acres of earthflow terrain have been mapped in the Layng Creek watershed, with high concentrations in Saltpeter Creek and Silverstairs Creek. Several other subbasins contain substantial amounts of earthflow terrain including East Fork of Layng Creek, Dinner Creek, Alex Creek, Herman Creek and Harvey Creek. These slide complexes were identified and mapped from high elevation aerial photos and field verified, when possible.

In addition to the earthflow terrain, another geomorphic unit has been identified in Layng Creek, characterized as Debris Slide Terrain. These areas are associated with steep concave slopes and typically have shallow soils. In Layng Creek, several areas are predominantly identified as debris slide terrain, particularly the upper reaches of Junetta Creek, with smaller areas in Herman Creek, Doris and Harvey Creeks. The geomorphic mapping identified about 5,000 acres of this type of terrain in Layng Creek. Recent work by Montgomery and Buffington (1993) suggest that in this type of terrain, debris slides and debris flows are a primary factor in the development of stream channels.

These geomorphic terrains have dramatically different signatures on the landscape and provide a large amount of diversity in the physical environment. The earthflow terrain is generally characterized by gentle to moderate slopes, with areas of hummocky terrain and impoundments being relatively common. These complexes developed under Pleistocene climatic conditions as a result of large rock units overlying thin weaker units, which were eroded by downcutting streams. These rock units with over-steepened toe zones mobilized and, in a number of cases, are still approaching equilibrium. In Layng Creek a number of these earthflow deposits are still subject to secondary failures within the body of the complex, i.e. Layng Slide and 5-Point Slide.

[1] (Herman, Layng, Five-Point, Deception, Swastika, Sugarloaf, Dinner and Graben; *Layng Creek Management Plan , Appendix G, Umpqua National Forest Land and Resource Management Plan, USDA, 1990*).

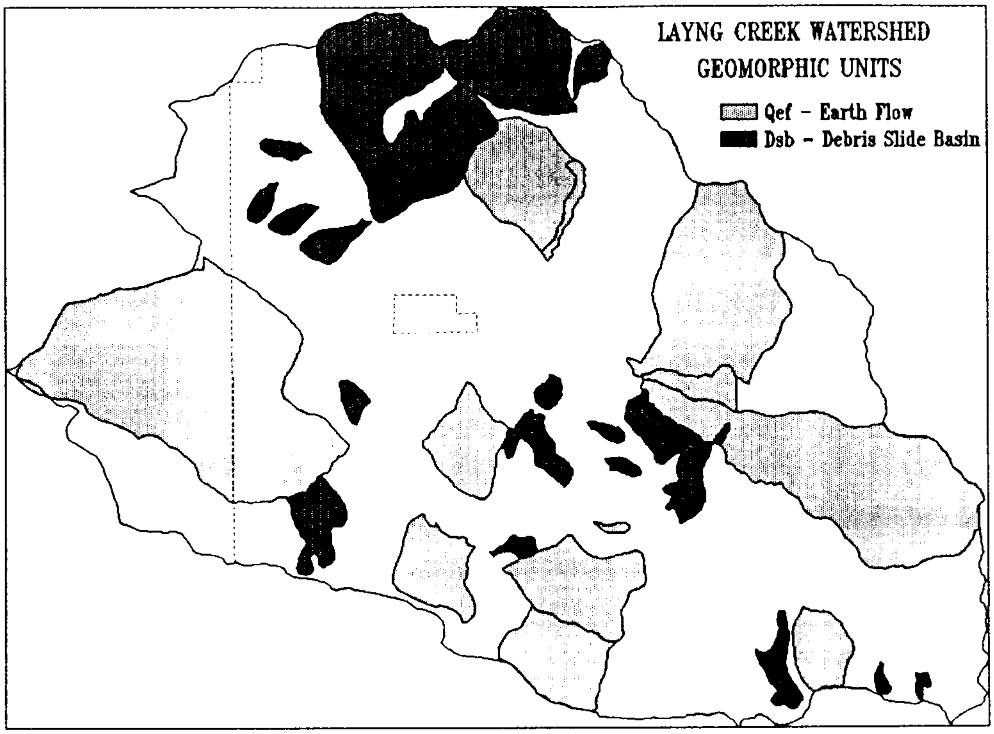


Figure 6. Geomorphic Units

Table 4. Geomorphic Terrains of Layng Creek Subwatersheds

	Miles of Stream in Earthflows (QEF) By Stream Class					Miles of Stream in Debris Slide Basin (DSB) by Stream Class					Total
Subwatershed	**1**	**2**	**3**	**4**	**All**	**1**	**2**	**3**	**4**	**All**	**Miles**
Mid Fork Junetta					0		0.11	0.78	2.3	3.19	3.19
Upper Junetta					0		1.9	2.68	7.85	12.43	12.43
E Fork Junetta					0			4.03	2.28	6.31	6.31
Upper Herman					0		0.58	4.18	7.93	12.69	12.69
Lower Herman	0.01	0.43	2.15	6.83	9.42					0	9.42
W Fork Junetta					0		0.07	1.06	0.48	1.61	1.61
E Fork Prather			2.11	0.81	2.92					0	2.92
Mid Layng W				0.11	0.11	0.1			0.75	0.85	0.96
Mid Layng E	0.31	0.02	0.01	0.14	0.48					0	0.48
Saltpeter		1.82	2.3	8.36	12.48					0	12.48
Alex	0.02	1.5	1.45	2.86	5.83					0	5.83
Silverstairs		0.66	1.96	6.22	8.84		0.05		0.22	0.27	9.11
Layng Canyon Low	1			2.08	3.08	0.43	0.02	1.32	5.12	6.89	9.97
Doris					0			1.08	1.41	2.49	2.49
Harvey		0.34	1.39	3.18	4.91		0.5	0.35	2.43	3.28	8.19
Lower Layng	0.99			2.35	3.34	0.12		2.09	2.73	4.94	8.28
Lower Dinner	0.26	0.47	1.34	3.97	6.04		0.05		1.01	1.06	7.1
Upper Dinner		1.61	3.72	8.09	13.42					0	13.42
E Fork Layng		1.7	3.36	13.17	18.23					0	18.23
Upper Layng			1.86	1.84	3.7			0.45	3.54	3.99	7.69
Totals	**2.59**	**8.55**	**21.65**	**60.01**	**92.8**	**0.65**	**3.28**	**18.02**	**38.05**	**60**	**152.8**

In addition to the contribution of sediment and associated organic material, these landslide complexes appear to be playing a unique role in the geohydrology of the landscape. These complexes tend to have deeply developed soil profiles and or regolith zones that allow for tremendous water holding capacity. The mineralogy of these features also allows for the development of subsurface flow paths, that allows for the transport of water as well sediment in what are commonly referred to as buried stream channels. In areas where the flow exceeds the capacity for whatever reason, these channels often appear as deeply incised gullies with no apparent initiation point. The influence of these complexes on both water quality and quantity could be substantial. Preliminary measurements of stream flow in other areas (Jackson Creek Watershed Analysis, Umpqua NF, 1995) suggest that as much as 10% of the summer low flow in the basin could be emerging as subsurface flow.

The relationship between earthflow terrain and channel processes is not well understood, but recent work in Jackson Creek and Little River on similar terrain suggest that these stream channels are extremely sensitive to rapid changes in the flow regime, particularly peak flows. One primary explanation of this is that these deep seated earthflows lack the complex geologic structure typically found in the geology of the Western Cascades. As a result these stream channels are dependent on external structure such as large woody material to provide complexity and stabilize the system. Approximately 21% of the identified streams in the watershed are associated with earthflow terrain. The erosional processes associated with these streams result in a high proportion of fine sediments (clay to sand size) and stream channels that have little armoring of the bed and banks. As a result they show little resistance to downcutting and bank erosion.

Debris Slides

Stream channels associated with debris slide terrain have developed with a common set of erosion and weathering processes and have a number of similarities. They tend to have higher stream densities, associated with steeper terrain and smaller source areas. In addition, the increase in bedrock exposures and skeletal soils limits the moisture holding capacity and results in flashy flows. These channels have developed under a scouring regime, with debris slides and flows influencing the amount of erosion and deposition that has occurred. The structural complexity of the channel is dependent on the diverse material normally associated with landslide deposits. This could include a wide range of rock sizes with a significant amount of organic material as well. About 36% of the streams in the drainage are associated with debris slide terrain. The erosional processes that are occurring in the these debris slide streams is often associated with large mass wasting events and periodic peak flows that mobilize the bed and maintain the complexity and armoring of the channel. Often these channels appear to be more resistant to changes in flow regimes than the earthflow streams.

The remainder of the terrain in Layng Creek, while not identified as earthflow or debris slide basins, has characteristics of a variety of geomorphic processes. The primary difference in these mountain slopes is the lack of a single overriding process that controls the development of the physical features. Analysis of the historic landslide data associated with this stratified landscape indicates that the erosional processes are not limited to one landtype.

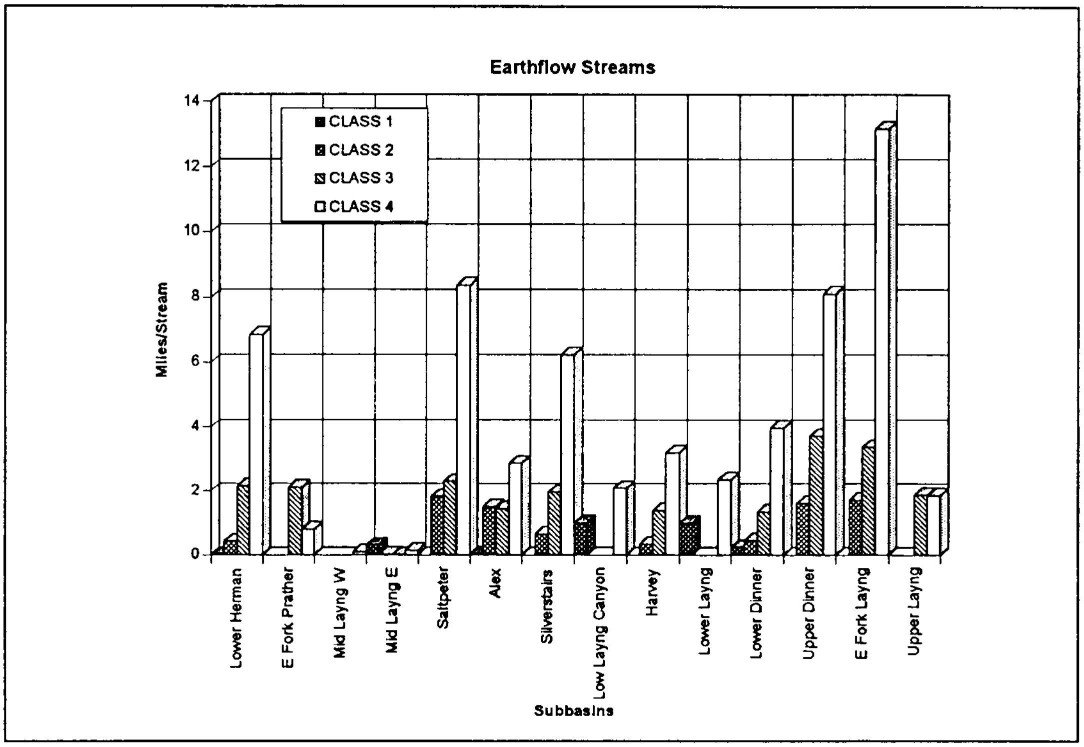


Figure 7. Streams with Earthflows

Glaciation

In general, most of the topographic features evident in Layng Creek have developed since the Ice Ages of the Pleistocene Period, about 2 million years ago. The erosive nature of the glacial episodes, particularly the channel forming processes left some oversteepened headwalls and side slopes marginally stable. These conditions allowed the development of the earthflow features still in evidence today. Several of these features dominate the landscape of Layng Creek, particularly the dormant earthflow landslide complexes discussed previously. In addition to the development of earthflow terrain, glacial features can be observed in Junetta Creek, Herman Creek and in the vicinity of Hardesty Mountain and Holland Meadows.

The Little Ice Age, which lasted from about 1350 to 1870 AD, experienced winters that were colder, summers that were cooler, and precipitation that was heavier. Ecological communities that exist now were probably heavily affected during the latest period of transition. These global climatic variations also suggest that during warm dry periods, fire played an important role in the evolution of the ecosystem, while during the cool moist periods, fire was probably less influential.

Seismic Activity

While there is little knowledge of historic seismic activity in the Layng Creek basin, the High Cascade volcanoes are still considered active. Recent seismic activity in Southern Oregon and off shore indicates that seismic activity will continue to play an active role in the development of the landscape. Erosional processes have played an important role in the development of the landforms that are found in Layng Creek, particularly those processes that post-date the last period of glaciation. The predominant processes identified in the basin are surficial erosion and mass wasting, both of which occur in a variety of situations.

Landslides

Attempts to define the causal relationship between landslide events and human activities are limited by known dates of management events. There is some indication that 30% of the mapped slides in Layng Creek occurred prior to the 1946 photos. Layng Creek is a unique watershed relative to the rest of the Umpqua National Forest, in that there was a significant amount of management activities that occurred prior to the earliest aerial photos. Prior to 1946, approximately 23% of the watershed had been subjected to timber harvest, with an estimated 25% of the existing road network in place .

Table 5. Landslide Occurrence and Timing depicting the number of landslides seen by year of aerial photograph.

	Landslides shown in 1946 Photos			Landslides shown in 1966 Photos			Landslides shown in 1988 Photos		
Subwatershed	**Not Apparent**	**Roads**	**Timber**	**Not Apparent**	**Roads**	**Timber**	**Not Apparent**	**Roads**	**Timber**
Middle Fork Junetta	3			1	5	4		2	9
Upper Junetta	5			9	2		2	3	4
E Fork Junetta	2			6	2				
Upper Herman	2			1	3		2	2	5
Patterson	2				1	1			2
Lower Herman	4	4			7	5		2	10
Lower Junetta	4	2	3		8	5		3	5
W Fork Junetta	3			2	8	2		8	10
Curran	3			1	3	9			4
Prather		4	3		4	2			
E Fork Prather		1							
Mid Layng West	2	4		3	4	7	2		3
Mid Layng East	3	5		2	10	5		3	10
Saltpeter					1			1	
Alex	7				4	4		2	1
Silverstairs	1				2	1		2	
Layng Canyon Low	4				4	1	1	3	10
Doris	3				4	1	1	4	3
Harvey	2			2	2	7	2		7
Lower Layng		1	8	2	6	1	1		3
Lower Dinner	9			4	9	8		5	6
Upper Dinner	2			4	3	8		1	15
Layng Canyon Upper	3			2	2	2	1	1	10
E Fork Layng	7				6	8		2	9
Upper Layng	10			2	2	3	13	4	5
Totals	**81**	**22**	**15**	**41**	**102**	**84**	**25**	**48**	**131**
Combined Totals			**118**			**227**			**204**

The landslides identified in this early photo series suggest that approximately 69% of the landslide features were associated with natural disturbance processes, most likely fires and floods.

The second series of photos reviewed, taken in 1966, was used to estimate the effects of the 1964 storm, the storm of record in Layng Creek. This series identified an almost complete reversal of the disturbances that resulted in landslides. About 54% of the landslide features appear to be associated with harvest units and roads, and the remainder in unmanaged areas. For reference, approximately 21% additional harvest had occurred in the period from 1950 to 1969. The amount of additional road construction was substantially higher during the period from 1946 to 1966.

The 1988 landslide layer identified an additional 204 landslide features that were not apparent on previous photos series. Of these, only 12% appeared to be unrelated to management activities and are considered natural for the purpose of this analysis. The remaining 88% have some connection with roads or timber harvest activities. (See Table 5 for a comparison of photo series).

The landslides in Layng Creek can be categorized into at least 2 distinct processes, translational debris slides and active earthflows (Bates and Jackson, 1987). The translational debris slides far outnumber the earthflows and appear to have had a large impact on soil productivity and downslope resources. Translational slides are commonly associated with shallow linear failures, and are typically found in steep, naturally thin soils under natural conditions. In the Layng Creek watershed, there is a strong association between translational slides and colluvial hollows, stream crossings and sidecast fills. These slides tend be fairly small features on the landscape, ranging from .5 to 2 acres and often revegetate within several decades.

Several active or recently active earthflows have been identified in Layng Creek, the most notable being the Layng Slide, which was active until the early 1980's when extensive stabilization measures were taken. Several other areas that have active earthflows or evidence of recent movement are located in the upper Layng Creek and East Fork of Layng Creek. At least one of these features appear to have reactivated between the 1966 and 1988 photo periods.

Geomorphic Significance of Landslides

The debris slide basins identified in the watershed were delineated with the assumption that there was a causal mechanism that was common to these areas. It seemed plausible that there would be above normal rates of debris slide occurrence in these areas. This assumption was validated; however, there were a number of areas not mapped as debris slide basins, with steep slopes and similar numbers of slides.

The erosional processes that developed in the earthflow terrain under natural conditions are isolated mass wasting along the toe and scarp zones, secondary earthflows and surficial erosion associated with hydrologic processes. Debris slides would be less likely to occur in theses areas.

Debris Flows

Soil ravel is a process that can be described as a steady downhill movement of soil and colluvial material collecting in localized concentrations in hollows, draws and streams. It occurs in localized areas throughout the basin and is associated with slope and vegetative cover. Under certain situations, as these deposits accumulate, and collect water via gravity, debris slides can result when a critical saturated thickness is reached.

The majority of stream channels (intermittent and perennial) in mountainous terrain are intermittently subjected to debris flows when channel gradients exceed about 6° (Montgomery and Buffington, 1993). Debris flows generally originate along low-order channels or in hollows steeper than 26° (Campbell, 1975). These flows typically scour high-gradient channels and aggrade the first downstream reach with a gradient low enough to allow deposition. This is a predominant process in the debris slide basins discussed previously.

While the immediate effects of the debris flow are often evident, later effects of the flow may have additional influence on channel morphology and water temperature. Debris flow scour and deposition often disturb riparian vegetation and expand the canopy openings over the channel. This has the potential to alter the riparian community, reducing the potential for the recruitment of large wood. This process can also influence channel temperature by reducing channel shading.

Dam break floods are also known to scour steep alluvial channels when organic debris dams break loose during high discharge events. Failure of these debris dams releases impounded water and sediment as a large flood wave that may proliferate through the system. In Layng Creek, a number of tributaries were subjected to debris flows, either from road related landslides or channel damming effects. In several instances the lack of large wood in the flow material appears to have greatly influenced the severity of the effect downstream. Since the woody debris is the main component in these dams under a natural setting, any increase in debris flow frequency increases the probability and impact of subsequent dam break floods (Montgomery and Buffington, 1993). This could contribute to an increase in the channel spanning debris accumulations and increase the volume of impounded sediment and water as documented by LaMarr, 1989, in the upper reaches of Jackson Creek.

As this debris flow material is transported, and temporarily accumulates in low gradient areas or nick points, younger colluvial deposits are incorporated from the upslope reaches. Water will continue to flow through and under this loose material; this is considered subsurface perennial flow, in which a stream flows year around, but only occasionally flows in an exposed channel. With continued deposition, these reaches can become saturated during storm events and remobilize to a point downstream. In many cases, this is the initiating event of debris flows and may be significant in areas where large mass wasting events are relatively scarce.

A number of tributaries appear to have been subjected to debris flows during the period of record analyzed. The majority of these were identified by the appearance of a scour line associated with a stream channel. While not conclusive, the majority of these could be followed back to an initiation point associated with a landslide feature.

It appears that there are a number of road and harvest related landslides that triggered debris flows that probably had significant impacts to the downstream resources. Additional analysis would be required to quantify this assumption.

A review of these debris flows suggest that they resulted from debris slides, plugged stream crossings, and probably from dam-break floods that resulted in scoured channels. Based on the occurrence of debris flows associated with vegetation management, it would be safe to assume that there could be a lack of large wood in the debris slides and flows that originate from road fills and harvest units. This could result in a different response in a dam break flood event.

While statistical information was not used, there appears to be a relationship between debris flow length and earth flow terrain. This relationship suggest that the debris flows tend to travel further in non-earthflow terrain. This could be a result of lower channel gradients combined with less channel roughness in earthflow terrain. Several subwatersheds have been subject to debris flows in all 3 periods reviewed, including the main stem of Layng Creek. Although this study did not attempt to quantify the relationship between disturbance factors and effects, there were some distinct instances that indicate that specific management activities were associated with debris flows, namely fill failures and stream crossings on roads.

Unstable Terrain

The presence of unstable and potentially unstable terrain in Layng Creek includes those areas currently on the Forest suitability layer, and several recent earthflow features identified on the landslide layer. These are large earthflow features that show abundant evidence of localized instability in the life of the existing vegetation (FEMAT, 1994). There are two areas in Layng Creek that have been active in the recent past and should be considered subject to additional movement. One is known as Layng Slide; the other, identified through aerial photo interpretation, is adjacent to the East Fork of Layng Creek. Both of these areas have had timber harvest and road construction activities occur within the unstable terrain and it appears that localized movement has increased. This is particularly evident near the stream channels and along the toe of the slide. These areas should be considered as part of the Riparian Reserve system.

Prior to the development of the 1990 Forest Plan, soil scientists identified a number of other areas of concern. A review of these areas through geomorphic mapping identified similar units that showed evidence of unstable terrain. Landslide mapping, in addition to some field verification led to refinement of these areas, based on available information. Further refinement should occur during future analysis efforts.

In a review of the existing information, it was apparent that a number of timber harvest projects had occurred throughout Layng Creek prior to the development of the unsuitable soils criteria. TRI information indicated that approximately 7% of the total acres harvested in Layng Creek were on terrain later identified as unstable.

Although unstable terrain is commonly regarded as an unfavorable condition, there are some benefits of unstable terrain in ecological terms. Debris filled hollows and draws can provide moisture sinks that serve as microsites for certain biota such as mountain beavers and amphibians. Talus slopes and debris slide scarps are capable of providing habitat that offers a variety of temperature and moisture condition.

Earthflows and rotational slumps often produce sag ponds or collection basins that develop riparian habitat, not necessarily connected to surface flow patterns. This terrain type also produces abundant amounts of large woody debris that is incorporated into both aquatic as well as terrestrial habitat units. Debris slides act as supply mechanisms for a wide array of particle sizes as well as organic material. These types of unstable terrain play an important role in the development and maintenance of the Unique Habitats found in the Layng Creek watershed.

Soils in the Layng basin, like the landscape itself, are highly diverse. A simpler stratification approach was adopted to delineate soil related concerns. The predominant features in Layng Creek have been divided into three broad geomorphic units, which include:

- landscapes originating from ancient earthflows
- debris slide basins
- landscapes associated with younger, volcanic materials more resistant to weathering

Earthflow Terrain

The earthflow landscapes are generally made up of fine textured soils, characterized by deeply weathered profiles with heavy clay contents. The relationship of earthflows and soft pyroclastic rocks suggest that while the topography tends towards gentle to moderate slopes, the fine textured soils can have unstable tendencies.

This weathering-to-clay process results in the presence of bentonite and smectite (Purchall, 1994). Studies of these clays show they can expand up to 8 times their volume when saturated, and subsequently shrink as much when dry. This tends to dislodge rock and soil fragments and may affect structures that are placed on them, such as roads.

Another concern of these fine textured soils is erosion, particularly in association with stream channels. A number of stream channels in the earthflow terrain exhibit active erosion, in the stream bed as well as the stream bank. Streams such as Saltpeter, Herman, East Fork of Layng and Dinner Creeks are actively downcutting through some reaches and have the potential to contribute large amounts of fine sediment to the system. Even in low flow periods, these streams can continue to erode in the absence of large woody material.

The fine textured soils that are predominant in the earthflow terrain are also susceptible to detrimental disturbance (Umpqua NF, 1990), particularly where high clay content is evident. Clay particle size by definition allows for a large amount of surface area in a given volume. This surface area and accompanying number of unattached chemical bonds allows easy access to elements needed by plants, and under undisturbed conditions, can provide excellent growing sites.

Soil Compaction and Disturbance

Under certain kinds of disturbances, particularly compaction, the small particle size and charged nature results in the loss of macro-pore space and the creation of a semi-solid mass. Although recent studies suggest that certain techniques are effective in reducing compacted surfaces (Hogenvorst, 1995 unpublished) long term side effects of these techniques are uncertain.

The 1990 Umpqua Forest Plan contains Standard and Guidelines for Soil Productivity associated with detrimental disturbances such as compaction and puddling. Detrimental disturbance should not exceed 20% within an activity area. In particular, all roads and landings are considered to be in detrimental condition unless rehabilitated to natural conditions. In Layng Creek watershed, it has been estimated that about 814 acres of roads and landings are associated with compacted surface and of this about 111 acres are native surface (Kimberling, 1995).

An analysis of harvest data and earthflow terrain available for Layng Creek suggests that overall, 12% of the entire drainage has been harvested on landscapes where compaction could be a concern. There are at least 7 subwatersheds - Lower Herman, East Fork Prather, Saltpeter, Silverstairs, Harvey, Lower Layng, and East Fork Layng - where more than 20% of the total area was harvested on earthflow terrain where concern for detrimental disturbance is high. In several subwatersheds the area harvested exceeded 50%. East fork of Prather Creek has had 96% of the subbasin harvested on terrain entirely on earthflow landscapes. Orton, 1991, presented information that similar soils on the forest have been severely disturbed in association with tractor yarding practices, in several areas over 60%.

Disturbance

Wildfire Occurrence - Human and Lightning

In the early 1900's fire appeared to be a regular occurrence. In his field notes, District Ranger Carl Henry Young recounts views of a "dense black cloud of smoke hang[ing] over the whole reserve"; of "immense clouds of smoke rising"; of "several columns at some distance apart...rising". Though written records of fire history weren't kept prior to 1930, Young's notes, early photographs, and fire scar studies done in the watershed give us clues as to what the District may have experienced in terms of fire.

On August 14, 1904, prior to the railroad logging in Layng Creek, Young had found a fire in Layng Creek. Young wrote of their efforts to "keep it down" and of "turning it from crossing" various ridges, and of backfiring "the whole lower part to save green timber". Within ten days the fire was out. This fire was on the lower north slopes below Rujada Point, adjacent to the present day Layng Creek Work Center. Given railroad logging hadn't yet begun in the area, we assume this fire was started either by lightning or someone passing through the area. It appears to have exhibited the characteristics of a partial stand replacing fire, burning through the ground fuels and occasionally making runs upslope and towards the adjacent timber. They used backfiring techniques, suggesting that intensities were such that some stand replacement may have been imminent.

Apparently the area had burned before; Young writes that there was "no damage to green timber - fire only in old burn." As he had contained his fire within the confines of the "old burn," we can assume this earlier fire was stand replacing.

Sixty five years of recent lightning and human caused fire occurrence (1930-1994) were analyzed to determine fire frequency, intensity, and extent. Over the last 65 years, 68 lightning fires have occurred in the Layng Creek Watershed. These fires represent 41% of all the lightning fires that have occurred on the Ranger District. The average lightning occurrence for the Watershed is 1.05 fires per year. The majority of these fires (94%) were size class A (1/4 acre in size or less), due to either the fuel conditions or suppression activities. (The Forest Service began suppressing fires in the early 1900's.)

Human caused fire occurrence was analyzed for the same time period. Prior to 1930, little is known about human caused fire in the Layng Creek watershed. In the last 65 years, the watershed has experienced 26 human caused fires. Of these 26 fires, 54% (14 fires) were caused by debris burning; another 8% (2 fires) were caused by lumbering (logging activities); 8% (2 fires) were caused by equipment use. Another 11% (3) were smoker fires; 11% (3) were of miscellaneous causes. One campfire and one hunter warming fire made up the remaining 8%. The most prominent fire is a 647 acre fire that started in the 1950's in the NW corner of T21S, R1E section 16. It spread up canyon/upslope and burned the equivalent of a section.

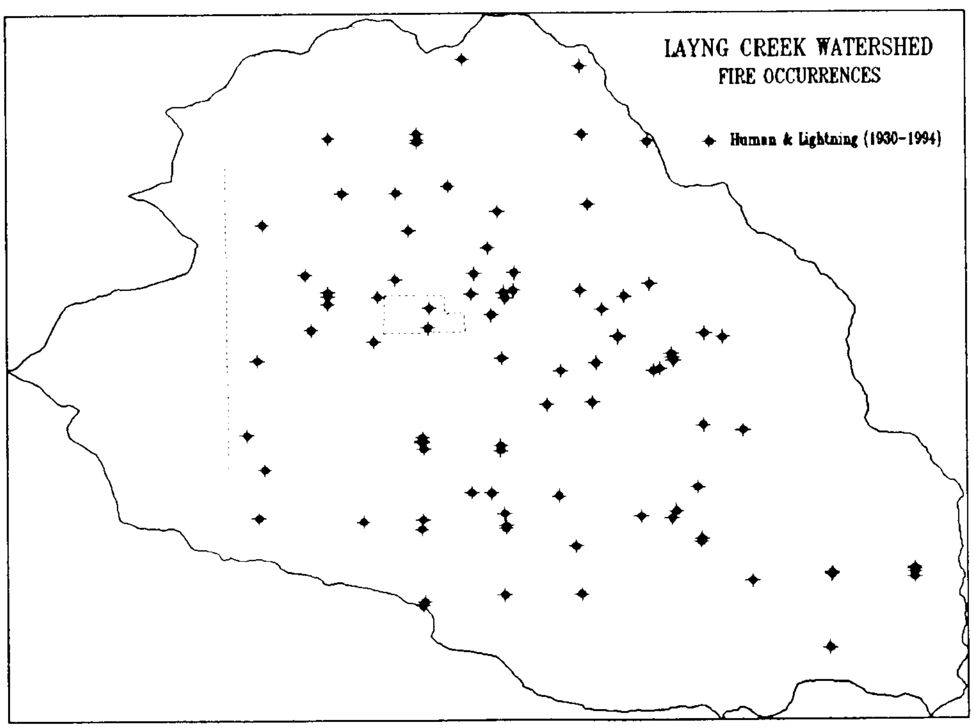


Figure 8. Fire occurrences in Layng Creek 1930-1994

Fire Regimes and Range of Variability

The Layng Creek watershed is primarily a western hemlock (Tsuga heterophylla) forest. It is adjacent to a variety of other Pacific Northwest forest types (Agee 1993). Over the western hemlock zone, there is considerable variability in the age of stands that burn, as well as in fire frequency, intensity, and extent, which creates a variety of post-fire effects.

Recent work suggests a natural fire rotation of 95-145 years over the last five centuries in the drier western hemlock forests of the Oregon Cascades. Working in the H.J. Andrews area, Teensma (1987) calculated a mean fire return interval for stand replacement fires of 130-150 years. In this regime, fires occur in areas with typically long summer dry periods and fires that will last weeks to months. Periods of intense fire behavior are mixed with periods of moderate and low intensity fire behavior; and variable weather is associated with variable fire effects. The overall effect is a patchiness over the landscape as a whole, and individual stands will often consist of two or more age classes (Agee 1990).

Fires appear to have been a frequent occurrence within the watershed in the last 94 years, although most were small in size. Whenever fires grew in size, overall intensities tended to be moderate. Had suppression policies not been in place, it is very likely the fires would have become larger, with higher intensities. The advent of fire suppression has gradually set up an artificial regime which is characterized by infrequent, high intensity, stand replacing fires.

Fuels Treatments

It is known that the Forest Service started burning for hazard reduction as early as 1904, specifically in areas that had been harvested. Consequently, we can assume that the railroad logged areas in the Layng Creek watershed were burned after harvest. Figure 9 displays areas of fuels activity and the numbers of acres treated by either broadcast burn or under burn, per decade, and the percent of the watershed they represent. Piling and burning was not evaluated because this treatment method does not usually consume enough fuels to change the fuel model or create significant fire behavior.

Significant Effects of Fire/Fuels Activities on Watershed Structure and Processes

Slash burning has had an important effect on the watershed since 1900. At least 18,153 acres have been broadcast or under burned, representing 43% of the watershed area. Early slash burns were done at various times of the year, and had a wide variety of effects. Burns occasionally exceeded cutting unit boundaries, stressing or killing nearby live trees. For the most part, this occurred within a limited distance of the unit's edge, with at least one major exception. The 1950's escaped fire in lower Junetta Creek burned up-canyon and upslope, eventually burning 647 acres. It's likely this was a moderate to high intensity, stand replacing fire which consumed large amounts of larger coarse woody debris on the ground, particularly where concentrations of fuel occurred.

Decade	Acres Treated	%
1900-13	N/A	
1913-30	3200	8
1930-39	72	<1
1940-49	1152	3
1950-59	4932	12
1960-69	3600	8
1970-79	2516	6
1980-89	2352	5
1990-95	329	1
Total Acres:	**18,153** *(43%)*	

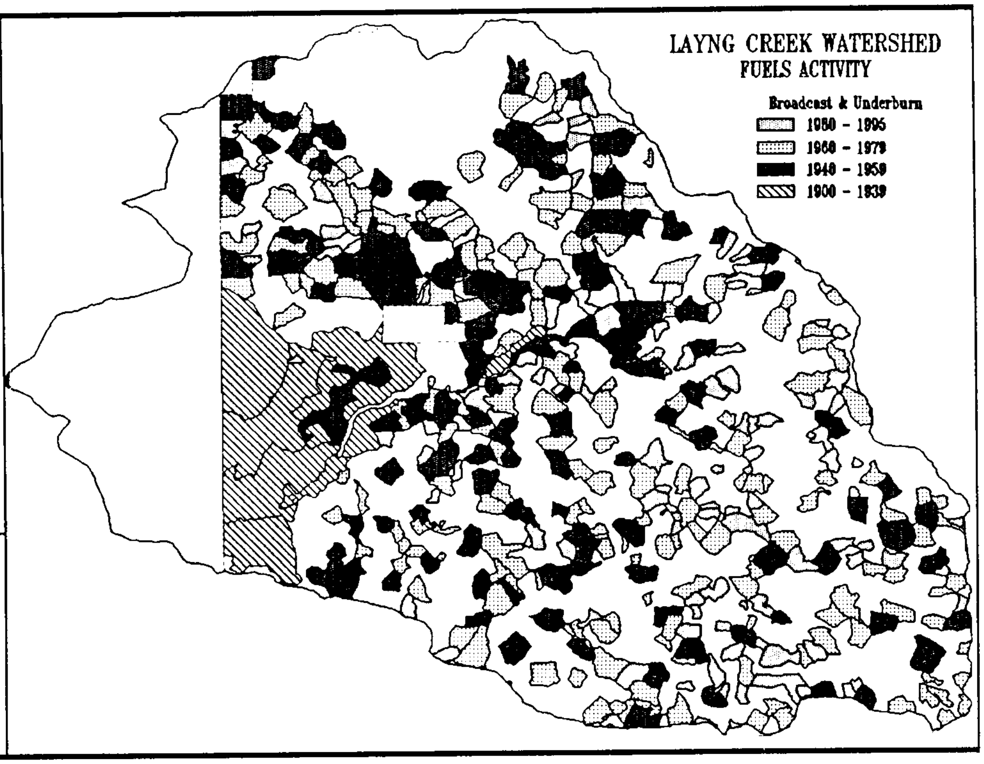


Figure 9. Fuels Activities in Layng Creek by Decade

To some extent, the earlier slash burns were of greater intensities than the watershed would have experienced in this era of fire suppression.. Effects on soils ranged from light to severe. Topography, weather, and fuel availability were factors in burn intensities and duration. In the last 15 years or so, burns have been carried out under spring burning conditions. Under these conditions, results have more closely resembled the moderate to light burn intensities typical of fires in the watershed in this century.

Early in this century, a fire near the present day Layng Creek Work Center occurred within an already burned over area. This second fire displayed moderate intensities, and probably consumed most of the fuels under eight inches, except where concentrations of heavier fuels existed. This fire had the potential to exhibit partial stand replacement characteristics, had suppression not taken place. Given the topography of the area, it could have continued burning upslope for some distance, consuming both ground fuels and occasionally patches of trees. The result may have been a mosaic burn of varying intensities.

Of the lightning caused fires, four could be characterized as partial stand replacement fires, or more severe surface fires with occasional torching. Effects of these fires were not significant to the watershed's structure or processes, but had the potential to become so. Had fire suppression efforts not been successful, these fires may have continued to grow in size and intensity. They were all within the thermal belt area, where intensities tend to be greater, due to warmer, drier site conditions. The remaining small (class A) fires had minimal effects on the watershed.

Fire Intensity Levels

Fire intensity data was incomplete for 1930-1969; fire intensity levels (FIL) for 1970-1994 showed majority of fires to be FIL 2 or less. We assumed fires in 1930-1969 would have displayed similar FIL's, and used fire size classes of known FIL's to assign FIL's to the earlier fires.

Air Quality

"Air, with the passage of the 1977 Amendments to the Clean Air Act (CAA), attained the status of a natural resource that must be guarded and used with an eye for the future. As such, the Congress, through the Environmental Protection Agency (EPA), has set minimum standards and goals for improving the nation's air quality." (Deeming 1989)

"Another provision of the Clean Air Act is the Prevention of Significant Deterioration (PSD). The premise behind the PSD provisions is to prevent areas that currently have very clean air from being polluted up to the maximum point established in the standards. Three air quality classes were established, Class I, Class II, and Class III. Class I areas are subject to the tightest restrictions on how much additional pollution can be added to the air. National parks and wildernesses fall into this category. All other Forest Service lands are Class II." (Peterson 1993)

Adjacent to the Umpqua National Forest, the Crater Lake National Park and the Diamond Peak Wilderness are Class I areas. The remaining areas, including the wildernesses within the Forest, are Class II areas. The Class I areas nearest the watershed are 20 or more miles away and include the Diamond Peak Wilderness to the southeast, and the Three Sisters Wilderness to the northeast.

The Umpqua National Forest is required to comply with the Oregon State Smoke Management Plan. One objective is to prevent smoke from being carried to or accumulating in designated areas or other areas sensitive to smoke. The western boundary of the Layng Creek Watershed is approximately 11 miles east of the southern-most edge of the Willamette Valley Designated Area (DA), which includes the town of Cottage Grove and the Dorena Reservoir area. Just over the ridge to the east and north of the watershed is the Oakridge Special Protection Zone (SPZ). This zone requires us to adhere to possible additional restrictions to prescribed burning between November 15th and February.

Within the Oregon State Implementation Plan for Visibility Protection (SIP), a general prohibition on prescribed burning applies to Lane County during the July 1st to September 15th period of each year. The goal of this strategy is to reduce substantially impaired visibility within select Class I lands.

Prescribed natural and management ignited fire techniques are not currently being implemented within the Layng Creek watershed.

Role of Fire on the Existing Fuel Condition

The primary role of fire since the early 1900's has been that of a management tool to reduce the fuels hazard and associated risk of fire starts. The fuel conditions under which the burns were carried out were unnatural (extensive clearcutting), but the resulting mosaic of various burn intensities may in some way mimic the overall effects of fires that occurred in reference times. Fire is currently used for site preparation and hazard reduction following harvest activities within the watershed. Outside of these human caused fires, the role of fire has been minimal. Regardless of ignition source, partial stand replacement fires have been a rare occurrence in the watershed since 1900. Of the small fires, the vast majority have burned only small concentrations of fuels, occasional snag patches, or individual snags or trees.

Existing Fuel Models

The watershed is currently comprised of five primary fire behavior (FBO) fuel models. The FBO fuel models consider primarily the 0-3 inch size classes, and are the standard models used to estimate fire behavior.

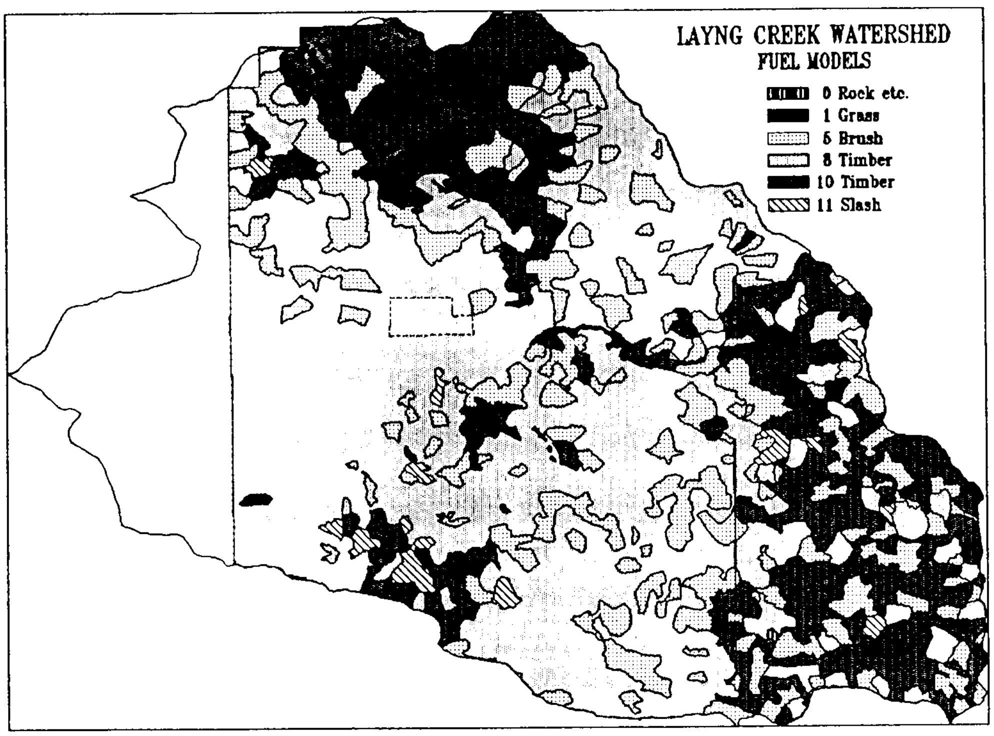


Figure 10. Fuel Model Distribution in Layng Creek Watershed

Fuel Model 1: The meadow areas within the watershed are represented by Fuel Model One. In this grass fuel model, fire spread is governed by the fine, very porous, and continuous herbaceous fuels that have cured or are nearly cured. Fires are surface fires that move rapidly through the cured grass and associated material. Very little shrub or timber is present, generally less than one third of the area.

Fuel Model 5: Young reproduction, prior to canopy closure, is fairly well represented by Fuel Model Five. Fire is generally carried in the surface fuels that are made up of litter cast by the shrubs and the grasses or forbs in the understory. The fires are generally not very intense because surface fuel loads are light, the shrubs are young with little dead material, and the foliage contains little volatile material. Usually shrubs are short and almost totally cover the area.

Fuel Model 8: Portions of the timbered areas are represented by Fuel Model Eight, and the remainder by Fuel Model Ten. In Fuel Model Eight, slow burning ground fires with low flame lengths are generally the case, although the fire may encounter an occasional heavy fuel concentration that can flare up. Only under severe weather conditions involving high temperatures, low humidities, and high winds do the fuels pose high fire hazards.

Fuel Model 10: Fires burn in the surface and ground fuels with greater fire intensity in Fuel Model Ten than in fuel model eight. Dead down fuels include greater quantities of 3 inch or larger limb wood resulting from over-maturity or natural events that create a large load of dead material on the forest floor.

Fuel Model 11: This is a slash model. This model would represent some thinning areas and clearcuts less than five years old. Fires are fairly active in the slash and herbaceous material intermixed with the slash. The spacing of the slash, shading from overstory, or the aging of the fine fuels can contribute to limiting the fire potential.

Disturbance - Insect and Disease

Insects and disease pathogens have caused scattered mortality of individual trees and groups of trees throughout the Layng Creek Watershed. However, current watershed-wide mortality levels are low.

Phellinus weirii is the most significant root rot in the watershed. Small pockets are present in both natural stands and plantations where it can remain viable for decades. Douglas-fir is very susceptible to laminated root rot. In stands where there are few low or intermediate susceptible species such as hemlock or western red cedar, mortality could be extensive. To date, only minor mortality has occurred throughout the watershed. Douglas-fir bark beetle is associated with laminated root rot pockets and can be found in scattered clumps throughout the watershed.

Black stain and Armillaria root diseases are primarily affecting sapling and pole-sized Douglas-fir stands in the watershed. Once these stands reach 30 years in age, the disease risk decreases, except in stands with extensive compacted soils and areas with high road densities.

Hemlock mistletoe is present throughout the watershed and typically has been dealt with through individual prescriptions by removing infected hemlock. Phellinus pini or red ring rot, is a stem decay present in older trees. It is widespread in the natural stands in Layng Creek, especially where some salvage activity has occurred.

Blister rust is extant and has killed a majority of the white and sugar pine in Layng Creek watershed. Planting of rust resistant pine has helped maintain sugar and white pine stocking levels in plantations. Also, in the Holland Meadows area, there are scattered groups of true firs with mistletoe that are infected with Cytospora canker.

The above insect and disease pathogens play an important role in creating snags and down woody debris if they are present at endemic levels. Compaction, extensive blowdown, monocultures and severe weather conditions can lead to situations where epidemics can cause widespread mortality.

Wind

The entire Layng Creek drainage has moderate to high susceptibility to wind damage. Mature timber on ridges or saddles that have been exposed through timber harvest have received the most frequent incidents of blowdown. Repeated incidents of blowdown have occurred at saddles and ridgelines in the Willamette/Umpqua Divide, Dinner Ridge, and Swastika Ridge areas. Figure 11 shows area with high wind risk.

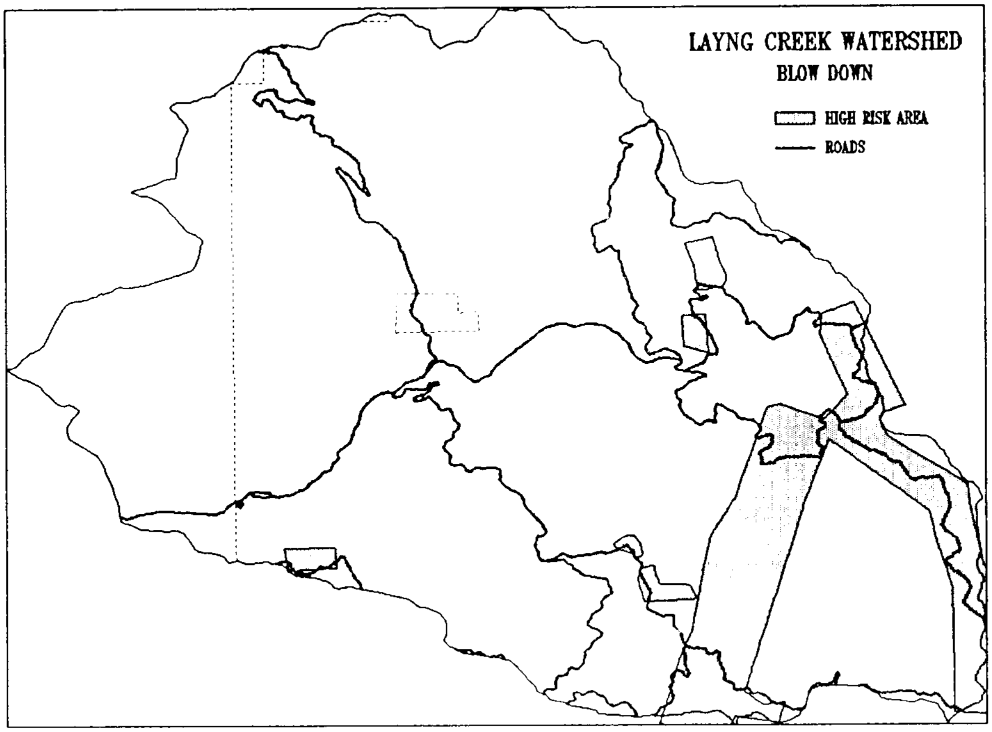


Figure 11. High wind risk areas in Layng Creek Watershed

Vegetation and Wildlife Habitat

The vegetation in Layng Creek is typical of the Western Cascade geological province, ranging in elevation from 1,000 to 5,000 feet. At least 90% of the land is in western hemlock potential vegetation series. Above 4,000 feet, grand fir and silver fir associations can be found, and below 2,000 feet on south slopes, the Douglas-fir series occurs occasionally. Typical conifer species include Douglas-fir, western hemlock, western red cedar, incense cedar, Pacific silver fir, sugar pine, western white pine, grand fir and yew. Hardwoods include bigleaf maple, red alder, madrone and golden chinquapin. Shrub species such as rhododendron, dwarf Oregon grape, manzanita, vine maple, elderberry, dogwood and salal are common.

As a result of limited data on species or their populations in the Watershed, vegetation conditions and patterns are used to evaluate species occurrence. Presence of special habitats such as wetlands, meadows, caves, cliffs and talus are discussed to illustrate their value and note the need for further evaluation of conditions.

All forested series in this watershed are used by wildlife species including those species considered rare, unique, threatened, endangered or sensitive. Since the majority (90%) of the Layng Creek watershed is in the hemlock series, wildlife descriptions will focus on species associated with the hemlock zone and the unique habitats (5%) in the watershed. (See Figure 12 and Table 6 for plant associations).

Table 6. Most common plant associations in Layng Creek, and characteristics of each. This information was derived from the Willamette Plant Association Guide, Southwest Oregon ecology plot data, and District stand exams.

Association	Temperature Regime	Time to old growth Characteristics	Snags per Acre
Western hemlock/Pacific rhododendron-dwarf Oregon grape	moderate	200-250 years	11.3
Western hemlock/dwarf Oregon grape/Oregon oxalis	moist	150-200 years	14.2
Western hemlock/dwarf Oregon grape	mod to dry	200-250 years	6
Western hemlock/Oregon oxalis	moist	150-175 years	9
Western hemlock/salal/swordfern	mod to moist	150-200 years	7
Western hemlock/salal-Pacific rhododendron	moderate	200-2-50 years	10
Western hemlock/Pacific rhododendron-salal	mod-dry	200-250 years	7
Western hemlock/Pacific rhododendron-dwarf mistletoe	moderate	200-250 years	11
Western hemlock-Western red cedar/Pacific rhododendron	mod-moist	200-250 years	7
Western hemlock/vine maple-salal	mod-dry	200-250 years	7
Western hemlock/vine maple-Pacific rhododendron	cool-mod	200-250 years	7

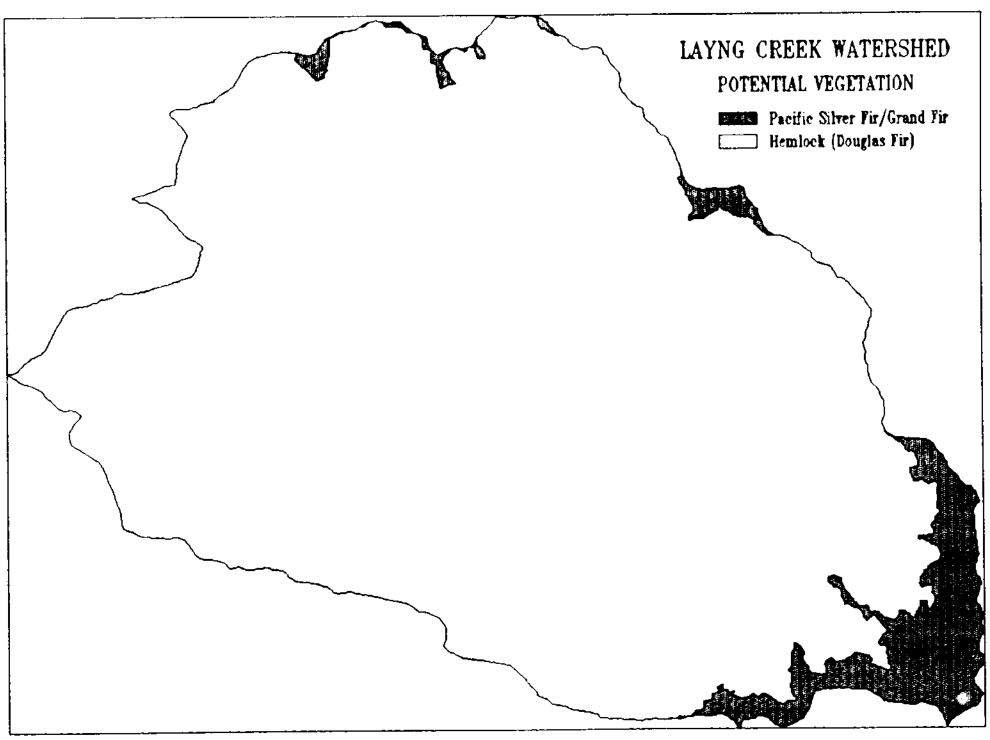
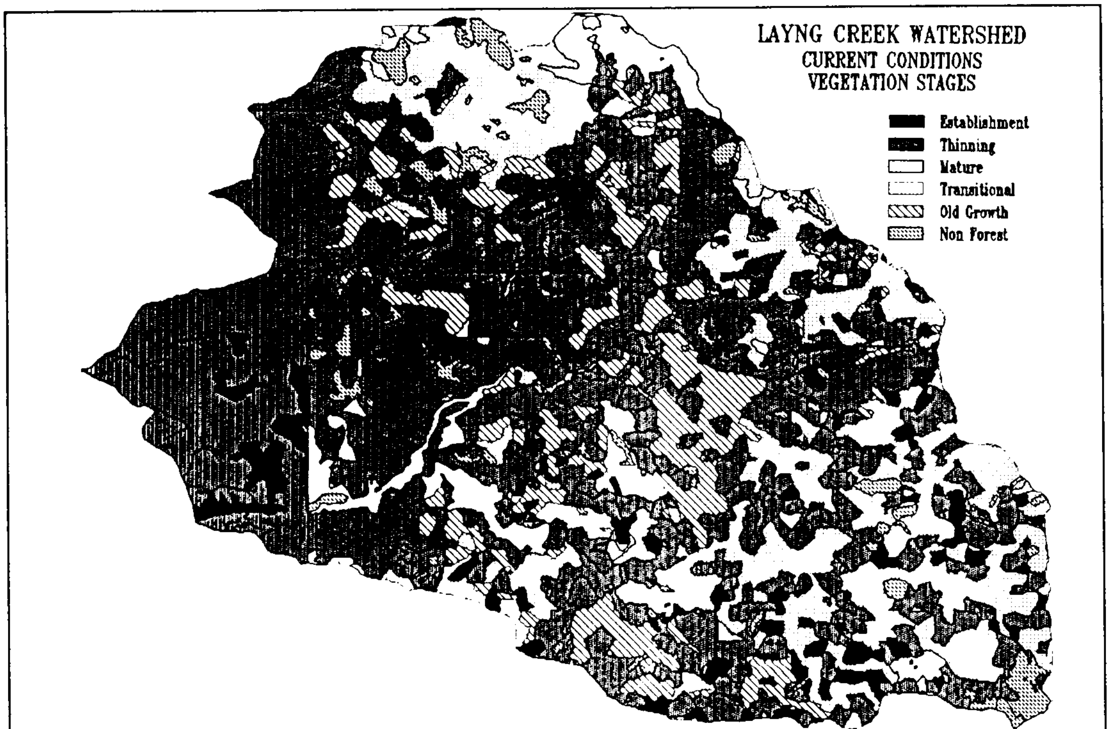


Figure 12. Potential Vegetation (Plant Association Series)

Snags and large woody material (LWM) are an indicator of overall biological health in forested landscapes because these elements are considered to provide key habitat for many species. Discussion in this section centers on the presence and distribution of this habitat in matrix and Riparian Reserves. Landscape patterns and trends are equally important in the analysis of wildlife habitat. The amount of interior habitat, edge habitat and patterns of connectivity help determine species viability, dispersal patterns and population trends.

Five stages were used to describe the current vegetation in Layng Creek: The term "late successional vegetation" is interchangeable with the stage transitional and old growth vegetation. The majority of the vegetation in Layng Creek is in a thinning stage. For the most part, the stands in mature, transitional and old growth stages have not been harvested whereas the stands in establishment and thinning stages are the result of harvest (See Figure 13).



Stage	Acres	Age	Description	Condition
Establishment	3,192	0-10 years	grass, forbs, shrubs, seedlings	Early
Thinning	20,029	11-79 years	closed and open saplings	Early
Mature	2,301	80 to 149	understory reinitiation of trees, shrubs	Mid
Transitional	9,724	150+	late successional vegetation	Late
Old Growth	4,018	200+	old trees, snags, multiple storied, down logs	Late
Nonforest	2,000	--	water, talus slopes, meadows, etc.	

Figure 13. Descriptions, ages, and acres of vegetation seral stages.

There are 15,873 acres of forest land remaining in Layng Creek that have not had major harvest activity. To distinguish these from plantations, they are being called "natural stands" in this document. Varying in ages from 80 to 500 years in age, these stands are the remaining patches of forest in what was once a continuous forest with patches of mid and early seral vegetation (See Figure 14).

The majority of these natural stands occur in the western hemlock potential vegetation series. Generally speaking, the stands are multistoried, between 150 and 300 years of age, and are stocked predominantly by Douglas-fir, western red cedar, and western hemlock, with sugar pine, white pine, grand fir and Pacific silver fir which occurs less frequently. Some of the understory species are vine maple, rhododendron, yew, salal, dwarf Oregon grape and twinflower. There are 62 miles of roads intersecting these stands, and roadside salvage has usually occurred along these roads. Also, many of these roaded areas have been impacted by cedar pole harvesting or pre-logging.

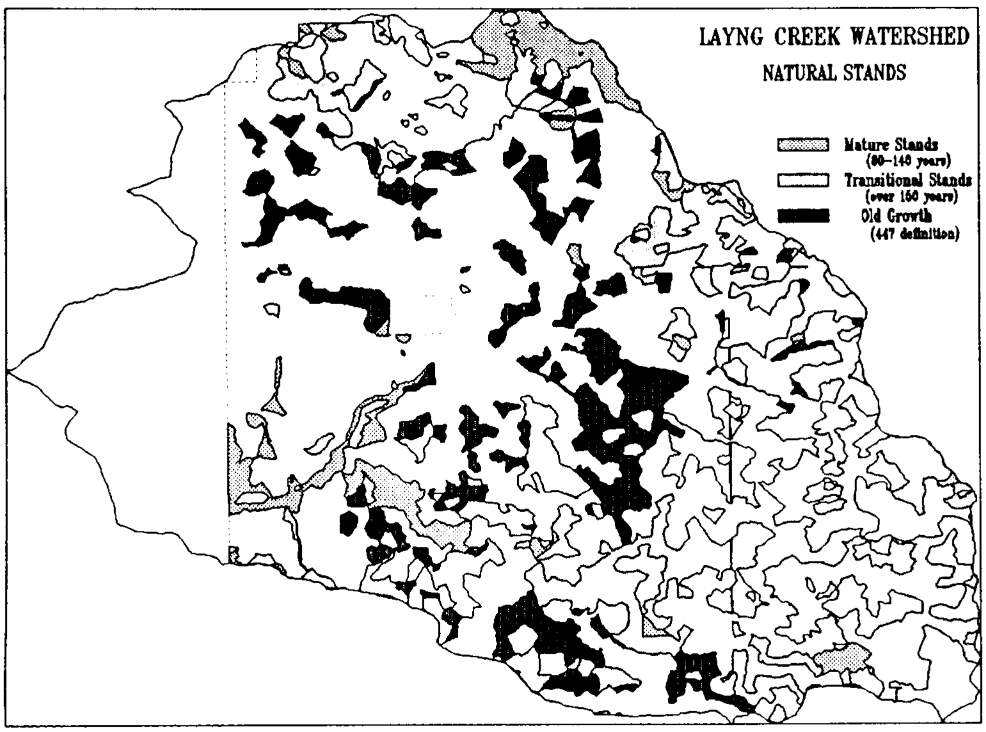


Figure 14. Locations of mature, transitional and PNW-447 old growth.

Species Diversity

In general, tree species diversity is present in all vegetation stages. Douglas-fir, hemlock, incense cedar, western red cedar, sugar pine, grand fir, chinquapin, elderberry and madrone are just a few of the species that can be found in the majority of plantations. However, during pre-commercial thinning operations, stocking levels of shade tolerant conifers and hardwoods were routinely reduced in plantations during the period between 1965 and 1985.

Table 7. The occurrence of common tree species by percentage and constancy. The data was taken from 15 stand exams in natural stands in the Dinner Creek area and from information included in the Willamette Plant Association Guide.

Species	Average %	Range %	Constancy %
Douglas-fir	57	32 - 74	99
Western red cedar	25	6 - 27	55
Western hemlock	18	10 - 43	88
Yew	2	2 - 6	30
Sugar pine	3	1 - 7	10
White pine	2	2 - 7	5
Incense cedar	3	2 - 5	11
Pacific silver fir	3	1 - 7	5
Grand fir	3	2 - 8	20
Bigleaf maple	8	3 - 13	40

Harvest History

The first harvest activity in Layng Creek watershed was by railroad logging in Prather Creek on private land in 1900. Railroad logging began on Forest Service land in 1913. Including the private lands, 25,801 acres (61% of the land base) has been harvested. Virtually all stands on private lands are less than 80 years of age.

In the 40 years between 1950 and 1989, 15,000 acres, or 41% of the Layng Creek watershed was harvested on Forest Service lands. The adjacent chart shows the rate of harvest on FS lands.

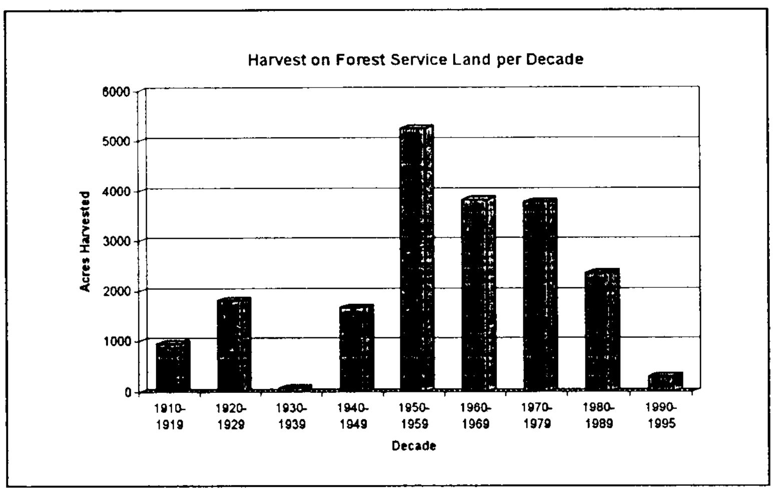


Figure 15. Harvest Acres by Decade.

Various harvest systems, reforestation practices and stand culturing techniques were used in Layng Creek over the past 95 years. Some of the differences are explained below.

1900-1935 3,000 acres harvested Current age: 65- 70

History: Between 1900 and 1935, railroad logging operations began in Prather Creek and progressed east and north. Seed trees were usually left to provide a seed source for natural regeneration of the cut-over area, and later salvaged. Streambeds were used as skid trails to move logs to landing areas. Low grade and cull logs, and inaccessible logs, were left in the woods. When logging was completed, residual fuels were often disposed of by broadcast burning.

Current Status: The majority of these stands are between 60 and 70 years in age. Most were commercially thinned between 1975 and 1990 to varying densities and have been fertilized with 200 pounds/acre of urea. They will be ready for a second thinning or final harvest in 15 to 20 years. Approximately 1200 acres are in Riparian Reserves.

1936-1965 8,000 acres harvested Current age: 30 - 60

History: Timber harvesting was accomplished with highlead and tractors, then hauled by truck. Partial cut, seed tree harvest and clearcuts were used, and often salvaged later. Harvest units were usually broadcast burned in the fall, generating a hot burn. Natural seeding and planting were common reforestation techniques, and some aerial seeding of units occurred. Large cull material was usually left on the ground. All snags were felled to reduce the fire hazard associated with lightning strikes. Some precommercial thinning and pruning was done.

Current Status: The majority of these stands are in the closed sapling or pole stage. Commercial thinning either has been prescribed for most of these stands, or will be in the immediate future. Approximately 3400 acres are in Riparian Reserves.

1966-1985 8500 acres harvested Current age: 10 - 30

History: This period was a time of intensive forestry practices. Most of the steeper ground was logged with some kind of cable system, and ground-based systems were generally used on the gentler slopes. Some balloon and helicopter systems were used in Dinner Creek. All log haul was done by truck. Most cull material was yarded and burned, or removed as firewood. Streams were cleared of logs. Snags that were within several hundred feet of roads or harvest unit edges were felled to mitigate fire and safety hazards. Salvage activity was widespread. Planting harvest units with Douglas-fir seedlings grown from collected seed became standard procedure. Precommercial thinning, aerial fertilization, and manual brush release were common practices. Herbicides were used on a limited basis. Many units were broadcast burned in the fall, resulting in a hot burn that encouraged the establishment of brush such as ceanothus and diminished the duff layer in some areas.

Current Status: About 2200 acres of this group of plantations will need precommercial thinning. Some of the older stands in this group were originally thinned to relatively close spacing, and now need a second thinning. Most of the older stands have been fertilized. Approximately 3600 acres are in Riparian Reserves.

1986-1995 1500 acres harvested Age: 2 - 15

History: In this period, standards and guidelines provided for leaving large woody material (LWM), usually cull material, in units. Fuels management and site preparation tended to take the form of cool spring burns. Planting of genetically improved stock, and use of species other than Douglas-fir became more commonplace. Timber stand improvement practices were prescribed extensively and included wider precommercial thinning spacing, cultivation of other species besides Douglas-fir, and retention of hardwoods. A limited amount of conifer pruning was done. Aerial fertilization became common during this period, but the use of herbicides came to an end.

Current Status: Most units have been or will be ready for precommercial thinning. If funding is available, pruning and fertilization will be applied. Approximately 600 acres of this age class are in Riparian Reserves.

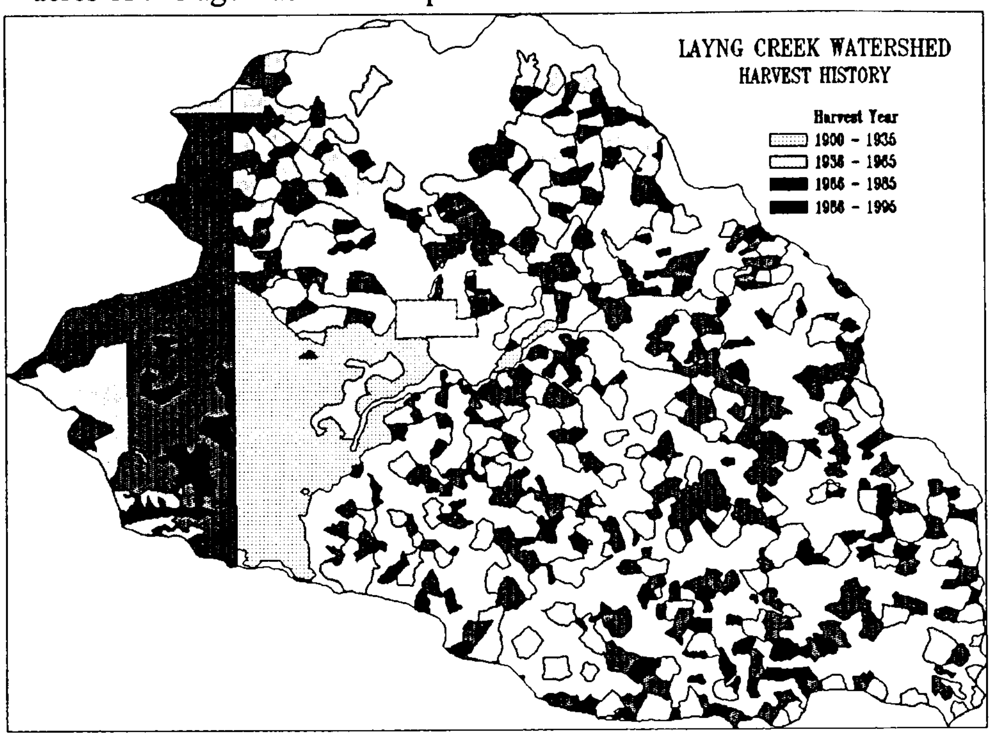


Figure 16. Harvest history showing period of harvest from 1900-1995.

Special Habitats

Special habitats are non-forested, unique habitats that make up less than 5% of the Layng Creek watershed. In the Region, meadows, rock outcrops, talus slopes, shrublands, caves, ponds and wetlands, though uncommon, account for 85% of the plant species diversity in forested landscapes (Hickman 1968). The unique habitat areas in the Layng Creek Watershed are mapped and categorized by type. However, there is no comprehensive survey data on the condition or number of species present in these habitats.

Timber harvest, roads, fire suppression and introduced species are the most serious impacts on the areas that have been surveyed. A few surveys of upland grasslands were conducted in 1993. The primary objective of the surveys, conducted by Mary Ann Weber, was to determine the relative abundance of native grasses and introduced species in these areas. Other objectives were to identify areas which could be used for native seed collection and for potential restoration and monitoring projects. Following is a partial list of these areas.

Dinner Creek Grassland *(Unique Area 042183)*

This area has several introduced grasses: *Cynosurus sp.* (dog's tail), *Panicum sp., Agrostis exerota* and cheatgrass, tall Fescue, hairgrass, and *Bromus sp.* but it does contain native species also (*Deschampsia cespitosa, Danthonia californica, Poa sp.*, and *Festuca idahoensis*). The introduced species are mainly in barren areas where no native forbs can persist and were probably introduced from nearby clearcuts. Klamath weed is established across the entire prairie. There are small western red cedar and Douglas-fir seedlings encroaching, which threaten the integrity of the meadow and could be eliminated by prescribed burning.

Harvey Creek Meadow Complex *(Unique Area 042124*

This area has at least three meadows in it, two of which have been examined carefully. The largest meadow is on the northern end of the complex . It contains many introduced species: *Cynosurus sp., Aira elegans, Festuca arundinacea, Hypericum perforatum* in the middle, and two varieties of *Senecio jacobeae* (tansy ragwort) throughout the meadow. One native fescue was too withered to identify at the time the meadow was studied. In addition, the native grass *Danthonia californica* was found to occur here, and seed was collected in 1994. The meadow will be more difficult to restore to a native condition than the others that were surveyed. The populations of tansy and Klamath weed are small enough, however, to be manually removed. In addition, the Douglas-fir is encroaching on the oaks (*Quercus garryana*) which border the meadow. The next meadow is in good native condition and retains small, pure stands of *Danthonia californica* and *Deschampsia cespitosa*. Western buttercup and a *Sidalcea* species are also found here. *Sidalcea* is often browsed by big game and there was evidence of elk use in this meadow.

Rujada Meadow / Layng Creek Work Center *(Unique Area 042248)*

Approximately 90% of the species in this area are introduced. The only suggestion made for this grassland was mowing during the late summer so that if western pond turtles are present in Layng Creek they would be more likely to use the area as a nesting site.

Hardesty Meadow / Sawtooth Meadow *(Unique Area 012145*)

This area contains mainly *Festuca idahoensis*, with some dog's tail and tall fescue along the trail. There is also a small population of tansy ragwort on the southern edge of the meadow. The Sawtooth meadow, unique area 012212, is almost pure *Festuca* *idahoensis*. A few introduced grasses (hairgrass, dog's tail, tall Fescue) are present in small amounts, mostly along the trail.

Holland Meadows

This area is a meadow mosaic which consists of dry rock garden, moist, mesic and dry meadows and shrublands. The majority is in moist meadow. The area has been impacted by harvest, road building, noxious weeds, and fire suppression.

Threatened, Endangered and Sensitive Plant Species

Many botanical issues are related to management practices. In general, threatened, endangered, and sensitive (TES) species do not respond well to management activities, but some forms of management are necessary and can be beneficial. Additionally, natural disturbance creates opportunities for non-native species to invade habitat of TES species. Also, there is a dearth of information on the survey management species listed in the Northwest Forest Plan, since appropriate surveys have not been conducted.

One sensitive plant species, Thompson's mistmaiden *(Romanzoffia thompsonii)* occurs in four locations in the Layng Creek watershed. This species is found in seasonally wet, rocky shallow-soiled openings where mosses and forbs predominate. Locations are mapped in the District's geographic information system (GIS). The populations and associated subpopulations of Romanzoffia located in the watershed occupy approximately 2.2 acres. To date, other TES species have only been surveyed in relation to proposed activities, usually logging, and results have been negative.

Another species, Branching Montia ***(Montia diffusa)*** was previously listed as a TES species but was removed from that list in 1991. There are four populations and two subpopulations of this species located on the Cottage Grove Ranger District, all of which are in the Layng Creek Watershed.

At least six species listed in the Record of Decision as a survey management species are found on the District. Candy stick *(Allotropa virgata)* has been reported, but none of the known locations are in the Layng Creek watershed. Five fungi species listed as survey management species were also reported during TES surveys in proposed timber sale units: *Ramaria araispora, Ramaria botrytis, Cantharellus cibarius, Cantharellus subalbidus*, and *Sparassis crispa*. *Ramaria araispora* and *Sparassis crispa* were reported at only one location while the other three were reported in two locations, all within the Layng Creek Watershed Analysis Area. These species and the others species of Concern (fungi, lichens, bryophytes, and vascular plants) have not been the focus of any surveys on the Cottage Grove Ranger District. (See Table 8)

Table 8. Plant Management Species In Layng Creek

Actual or Potential Threatened, Endangered or Sensitive Plant Species

Species	Acres	Species	Acres
Allium campanulatum	0	*Hieracium bolanderi*	917
Asarum wagneri	0	*Iliamna latibracteata*	1751
Asplenium septentrionale	434	*Isopyrum stipitatum*	0
Astragalus umbraticus	2353	*Lewisia columbiana*	112
Botrychium minganense	0	*Mimulus douglasii*	471
Campanula scabrella	0	*Mimulus kelloggii*	341
Cimicifuga elata	0	*Oxypolis occidentalis*	0
Cypripedium fasciculatum	0	*Pellaea andromedaefolia*	0
Frasera umpquaensis	0	*Polystichum californicum*	67
Gentiana newberryi	0	*Romanzoffia thompsonii*	486
Hazardia whitneyi ssp. Discoidea	0	*Wolffia columbiana*	0

Survey Management Species

Species	Acres	Species	Acres
Allotropa virgata	0	*Coptis aspenifolia*	+
Arceuthobium tsugense	0	*Coptis trifolia*	0
Aster vialis	3643	*Cypripedium montanum*	0
Botrychium montanum	0		0

Noxious Weeds

Several noxious weed species are found in the Layng Creek watershed. These species are mostly associated with disturbance such as roads, logging, and fires. They are usually difficult to eradicate, especially once they become established, and they tend to spread rapidly. They do compete successfully with native vegetation. Scotch broom , tansy ragwort and Canada thistle are widespread. Other known species include St. Johnswort (Klamath weed) and Bull thistle. In 1991, Tansy flea beetles were released at several locations in the watershed to help control tansy ragwort. Flea beetles and cinnabar moth larvae were also released in the early 1980's.

Many of the district roads (45% of the total road miles and 49% of the roadside acres in Layng Creek Watershed) were surveyed in 1991 for noxious weeds by Glenn Miller, of the Oregon Department of Agriculture. Only two roads out of eighteen (11%) surveyed had no weeds reported, but there are historical reports for weeds along these two roads. Biological control agents had been released along those two roads in 1982, but it is doubtful that this completely eliminated the tansy populations. Several of the spur roads associated with these two roads also had noxious weeds. Considering the fact that these surveys were conducted four years ago by driving, and subsequent reports of the presence of noxious weeds by district employees, it is highly probable that 100% of the roads in the watershed have populations of noxious weeds present. It should also be noted that English ivy, although not listed as a noxious weed, is present in the watershed. It is located within one mile of the district boundary along Layng Creek Road on private land (see Table 9).

Table 9. List of noxious weed plant species found in the watershed or suspected but not documented.

Species	Acres	Species	Acres
Carthamus lanatus	0	*Cytisus monspessulanus*	656
Centaurea diffusa	606	*Cytisus scoparius*	606
Centaurea maculosa	606	*Euphorbia esula*	0
Centaurea pratensis	606	*Hypericum perforatum*	0
Centaurea solstitialis	606	*Linaria dalmatica*	0
Centaurea virgata ssp. squarrosa	0	*Linaria vulgaris*	0
Chondrilla juncea	0	*Lythrum salicaria*	0
Cirsium arvense	260	*Senecio jacobaea*	606
Cirsium vulgare	744	*Ule Europaeus*	0
Cynoglossum officianale	606		

Snags and Large Woody Material

The current condition of snags and large woody material (LWM) in Layng Creek watershed is a function of the harvest history in the drainage. The distribution, quantity and condition of snags and large woody material in Layng Creek is critical to the maintenance of viable populations of desired species while managing for commodity production. LWM plays a crucial role in the maintenance of Riparian Reserves, aquatic habitat, water quality and soil productivity.

The 15,653 acres of natural stands in the watershed provide the majority of the remaining snag habitat within the drainage. Since salvage logging occurred on 200 feet of each side of the 62 miles of roads within the natural stands, approximately 3,000 acres within these natural stands are without snags. This results in 12,653 acres or 30 percent of the watershed currently with suitable snag habitat.

Coarse woody material

Coarse woody material is defined as any standing or down woody material debris greater than 2.5 cm in diameter (Harmon et al, 1986). District records from 1985 to 1991 reveal that 51 tons/acre of 1" to 20" material were left on the ground after clearcut harvest.

Table 10. Fuel Loading in Layng Creek

Fuel Size Class (inches)	Average tons/acre
1-20	29
9-20	22
20 +	19

Before 1985, levels of coarse woody debris in harvest units can only be estimated from harvest history. Information on fuel loading and large woody material (>20 inches) from the Cottage Grove District Fuel Loading Monitoring Report reveal an average of 19 tons per acre remaining after harvest from 1985 to 1993. (See Table 10).

Large woody material is distributed unevenly across the drainage. More recent harvests (1985 to 1991) have less tons/acre than older harvest units. Natural stands are assumed to have the highest amounts of LWM.

Soils

Earthflow terrain in Layng Creek is associated with deep, fine textured soils. Soil compaction hazard is high on fine-textured soils, particularly under moist conditions. At least 12% of the entire drainage has been harvested on landscapes where compaction is a concern. In addition to the following list of units logged by tractor, numerous skid trails exist in salvage areas, prelogged stands and portions of harvest units that were highlead or skyline logged.

Table 11. Units Logged by Tractor in Layng Creek

Unit Name	Acres	Unit Name	Acres
West Boundary	52	Big Sky TB	27
June Down	6	Under Overstory	27
Silver Seed	60	Rujada 1	22
Rujada 3	57	Layng Creek Harvest	60
Pickup 11	14	Doris Overstory	57
Horse 4	3		

Umpqua Forest Plan standards and guidelines for soil productivity state that the combined total amount of unacceptable soil condition (detrimental compaction, displacement, puddling or severely burned) should not exceed 20 percent in an activity area (e.g., cutting unit or site preparation area). While units logged recently meet the Forest standards and guidelines, many older units clearly exceed this standard.

Connectivity, Edge & Landscape Patterns

Recent timber harvest activity has been dispersed throughout the watershed, mainly to increase edge habitat and available forage for big game. Consequently, landscape patterns in the watershed are heterogeneous because of the fragmentation caused by this dispersed arrangement of patch cuts, and the extensive roading required to access this matrix of harvest units.

The subsequent increase in early successional habitat has resulted in a decline in wildlife populations which depend on large patches of late successional vegetation. There are 591 patches of late successional vegetation of various sizes and shapes, resulting in 314 miles of edge habitat within the watershed. Table 12 shows the number, size and types of patches.

Large patches of interior habitat are especially important for the viability of species which require large home ranges and are dependent on interior habitat conditions. In Layng Creek watershed, there remains one large (1,591 acres) patch of transitional/mature habitat in the Hardesty Mt. area. This patch connects with LSR #022, to the north, and may be suitable habitat for marten or fisher.

Table 12. Patches in Layng Creek by Brown's Habitat Type.

Brown's Habitat Type	Total Acres	Number of Patches	Mean Patch Size	Patches per 100 acres
Grass/Forb	1341	138	9.72	10.29
Shrub	1968	81	24.3	4.12
Open Sapling	6609	115	57.47	1.74
Closed Sapling, Poles, Small Sawtimber	17770	92	193.15	.52
Sawtimber >21"dbh	10451	94	111.18	.9
Old Growth	4019	71	56.34	1.77

Ten patches of interior habitat which average 140 acres in size, and ten patches averaging 70 acres are dispersed throughout the watershed. These patches provide habitat for highly mobile, interior-dependent species, such as the northern spotted owl and pileated woodpecker, or species with small home ranges such as salamanders, voles and squirrels. The majority of these patches are in the south or eastern portion of the Watershed. To the west are isolated patches less than 50 acres that are connected within a matrix of closed sapling poles.

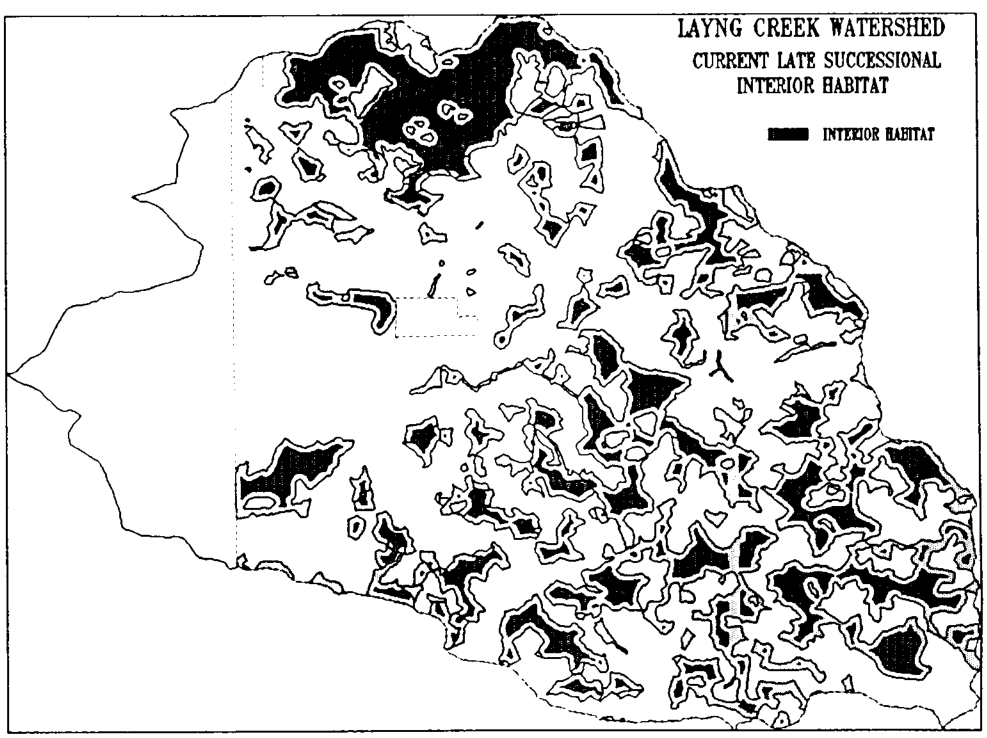


Figure 17. Interior Late Successional Habitat.

Wildlife

As a result of limited data on species or their populations in the Layng Creek watershed, much of the information presented here is based on habitat assessment, known species occurrences and existing vegetation patterns. The Jackson Creek Watershed Analysis (1995), noted that habitat analysis, without baseline inventories, may provide an inaccurate picture of species health and status, since other factors may be influencing occupancy and population dynamics.

Some of the inherent risks include:

- *Habitat patches may or may not be occupied,*
- *Populations may or may not be stable and interconnected,*
- *Vegetation information is coarse and does not necessarily give an accurate description of specific stand conditions.*

Three groups of wildlife species and their associated habitat are described for the Layng Creek watershed. Each have different habitat requirements and have been determined to be at high risk of local extirpation (Lemkuhl and Ruggerio 1991).

Some species require only terrestrial habitats and some species require only riparian habitats. However, terrestrial wildlife habitats usually function in connection with associated riparian habitats. Also, upslope habitats provide different functions for different species. For example, upslope may be the primary breeding and feeding habitat for red tree voles, but will be used by tailed frogs for foraging and as dispersal habitat to the next riparian area (South Fork Mckenzie WA, 1994).

Group 1 Species

Group 1 species are small body sized and have low vagility. Included in this group are small mammals, amphibians and reptiles which have largely unknown life histories. Fragmentation, loss of habitat and associated conditions such as changes in microclimates and large woody material (LWM) are the processes placing these species at risk. During dispersal small mammals and amphibians require connected habitats wide enough to support resident populations, since their travel distances are too small to cross entire corridor lengths (Bennett 1990). Late successional and riparian corridors are particularly valuable habitat for small, low mobility species associated with moist microclimates. Connected patches from 50 to 100 acres are the estimated size necessary for habitat suitability and genetic exchange.

Red-Legged Frog, Cascade Frog and Tailed Frog

The Cottage Grove Ranger District has conducted herpetological studies since 1990. Surveys conducted by Dr. Mark Hayes in 1992 revealed that the district has the highest known elevation for a breeding population of red-legged frogs and the highest known elevation of an individual red-legged frog.. He located red-legged frogs at eight sites, Cascade frogs at six sites plus one site very near the district boundary, and tailed frogs in nine streams.

Some informal surveys were conducted during the springs of 1993 and 1994. In 1995, Cathy Tighe and Rob Cox, district employees, conducted surveys during February and March at the sites where Dr. Hayes found red-legged frogs and a few additional sites. Five new sites were identified as having red-legged frogs present (four of these had egg masses, one had only an adult male) and two sites where Dr. Hayes reported red-legged frogs were verified in 1995. Of the other six red-legged frogs sites identified by Dr. Hayes, five produced negative results, and the other was inaccessible due to snow.

Three breeding sites resulted from management activity (road berms and blocked culverts). One site appears to be a deep wheel track made from a skidder, during logging operation through a wet meadow, and the additional sites are natural ponds or slow moving stream channels.

There appears to be a strong relationship between red-legged frog habitat and earthflow terrain. The "slumpiness" of that terrain leads to development of sag ponds and moist habitat.

Past management has allowed fish to be stocked in ponds and portions of streams that historically did not have fish. These activities are detrimental to native aquatic species that inhabit these systems, including species of frogs. The introduced species often compete directly with the native species for resources and sometimes cause predation.

Northwestern Pond Turtle

Habitat for the Northwestern Pond Turtle consists of marshes, sloughs, ponds and slow-moving sections of streams and rivers (usually below 2,500 feet). They also require basking sites such as floating logs, branches and other vegetation, rocks, and mud banks. Nesting occurs in early summer. The female digs a hole along the waters edge or adjacent area, lays 6-7 eggs, refills the hole, and returns to the water. There is no parental care. Predation, human disturbance, and pollution prevent many hatchlings from reaching maturity.

Three pond sites in Layng creek watershed were surveyed in 1990 by Dr. Marc Hayes; none were populated or determined to be suitable habitat. The only suitable habitat for pond turtles within the watershed probably occurs in the first two miles of the lower end of Layng Creek. Western pond turtles were verified in the lower Layng Creek drainage in 1993.

Currently there is a major forest road (Rd.17) that runs along the first two miles of the lower end of Layng Creek. Other developments in the area include the district work center, a year round residence, the intake for City of Cottage Grove water supply and the water treatment plant, a full-service campground and a local swimming hole. These circumstances result in a high level of disturbance and risk to local turtle populations.

Western red-backed vole

The Western red-backed vole is associated with upslope, late successional forest. Primary habitat occurs at distances greater than 650 feet from second and third order streams (McComb et al 1993). The western red-backed vole is important prey for the northern spotted owl and other wildlife species. This species plays an important functional role in the spread of forest plants and nutrient cycling by eating lichens and fungi.

As noted in Jackson Creek Watershed Analysis (1995) this species is more abundant on the Rogue and Umpqua National Forest than in the northern Cascades forests (Gilbert and Allwine 1991). Linkages of mature and late successional forest away from riparian habitat are currently limited in Layng Creek, placing this species at risk of isolation now and in the future.

Red Tree Vole

The following description of the red tree vole is a summary of the information presented in the Jackson Creek Watershed Analysis (1995). The red-tree vole is a member of the late succession forest arboreal rodent community. Nothing is known about species occurrence, distribution and abundance in Layng Creek. Brian Bisswell, in preliminary observations from his master's thesis in the Rock Creek drainage near Mary's Peak in the Oregon coast range (December 1994) suggest this species is presently very rare and has a clumpy distribution. He also suggested the Umpqua National Forest may have some of the best contiguous habitat remaining in the species range.

Of the arboreal rodents, the red tree vole is most vulnerable to local extirpations resulting from loss of fragmentation of old-growth Douglas-fir forests (Huff et. al., 1992) The species has been classified as a survey and manage species (ROD table C-3), requiring additional protection with the addition of patches of late successional reserves when local populations are found (ROD Standards and Guidelines, Section C). This species is a habitat specialist, disperses poorly and has a limited geographic range (western Oregon and northwestern California).

Red tree voles are found exclusively in forests having Douglas-fir in the canopy. They are believed to be associated with low elevations forests (<4000 feet). Red tree voles prefer upslope mesic forest (coast range) near ridge tops. Douglas-fir needles are the primary food of red tree voles. Douglas-fir trees are also selected for nesting, especially Douglas-fir trees with large branches and deep crowns.

Gillesberg and Carey (1991) found that average diameter of trees with nests versus trees without nests were 39 inches and 171 feet height and 31 inches and 144 feet height respectively. Huff et. Al. (1992) stated that red-tree voles were more likely to be found in stands with numerous large Douglas-fir (15/acre) than in stands with few large Douglas-fir (4/acre).

Group 2 Species

Group 2 species are small to medium body sized and moderately to highly mobile. Included in this group are fisher, pine marten, goshawk, pileated woodpecker and the northern spotted owl. Since this group has greater mobility and a larger home range size than Group 1 species, it requires larger patches.

Northern Spotted Owl

There are 18 known pair of spotted owl within the watershed. Based on the 1990 Biological Opinion, 12 pairs have been defined as in a "Take " situation because of lack of suitable habitat within their home range. Suitable habitat does not have to be "old-growth forest" or continuous. However, it must have large woody debris (snags and down wood) for associated prey and nest sites, and the habitat must be at a density adequate to provide resources for viability of offspring and adults.

The February 4, 1994 Biological Opinion for the preferred alternative (Alternative 9) of the FSEIS (Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl), issued by the US Fish and Wildlife Service states that the adoption of Alternative 9, as modified, is not likely to jeopardize the continued existence of any listed species, or result in the destruction or adverse modification of any modification of any designated critical habitat for those listed species.

Alternative 9 allocated blocks of federal land to accomplish different resource objectives. One of those allocations was described as Matrix land, where most timber harvest and other silvicultural activities would be conducted within suitable forest lands, according to standards and guidelines from the ROD and Umpqua FLMP (Forest Land Management Plan). The Layng Creek watershed is within Matrix lands. The Draft Recovery Plan for the Northern spotted owl designated 8,960 acre of the Layng Creek watershed as Critical Habitat Unit # RO-20. The Opinion concludes that Alternative 9 will accomplish or exceed the standards expected for Federal contribution to recovery of the Northern spotted owl and assurance of adequate habitat for its reproduction and dispersal. Overall, the Late-Successional Reserves (LSR's) and Managed Late-Successional Areas (MLSAs) and Matrix prescriptions and other prescriptions in Alternative 9, should enable critical habitat to perform the biological function for which it was designated. Currently 60% of the land managed by the USDA Forest Service within the watershed (22,037 acres) can be characterized as dispersal habitat.

Northern Bald Eagle

The goals of the recovery plan for this species are nearly attained within the state. The Layng Creek watershed has no known nest sites within it boundaries. However, eagles have been observed in the watershed foraging on winter kill deer and roosting on trees. There is a resident pair down stream at Dorena Lake and water quality from the watershed will contribute to the success of this pair. The Dorena Dam has had the greatest impact to eagles that may have been associated with the watershed by blocking the passage of salmon and steelhead to the Layng Creek system, which historically may have been a foraging area. Other pairs are known to reside at Lookout Point reservoir, north of the watershed, and at Cottage Grove Lake to the south.

Peregrine Falcon

Although habitat for the Peregrine Falcon exists in the Mount June and Sawtooth areas, there are no known nest sites within the watershed. Habitat inventories have been conducted on a limited basis, and recent inventory of cliff sites (Lybarger 1995) revealed three potential nest sites.

Northern Goshawk

Northern goshawks are found in a wide variety of forest types within their range. Habitat may vary from dense old-growth Douglas-fir stands to open pine forest. Nest sites in Western Oregon are usually found in mature or old-growth forests, with a preference for moist areas on north slopes, often near water. The nest tree is usually the largest in the stand and a limb is used as a platform for nest construction.

Monitoring conducted in July 1995 detected two goshawks near Junetta Creek in the Mount June/Sawtooth Rock area. Both birds responded verbally and one was visually identified as a juvenile (believed to be dispersing).

Townsend's Big-Eared Bat

The big-eared bat is a possible inhabitant of the analysis area. These bats form nursery colonies and hibernate in open caves, adits, bridges, large cavities or buildings, and prefer structures with two openings for ventilation. The big-eared bat is very sensitive to human disturbance.

Roost sites are a critical resource for bats and their availability may play a major role in determining population size (Kunz, 1982). Existing information indicates that old-growth forests provide higher quality roost sites. Structural characteristics of older trees and large snags with cracks, peeling bark, and hollow cavities provide ideal sites for roost and maternity colonies.

Group 3 Species

Group 3 species are large body sized and have high vagility. Species in this group are large predators and ungulates. They are at risk in Layng Creek Watershed because of limited resources available in small patches. However, adjacent Late Successional Reserves (LSR's) were designed to function as required habitat for large and medium body species with medium to high vagility (as well as for small body size, low vagility species).

Habitat Connectivity

Species such as spotted owl, marten, fisher, goshawk and pileated woodpecker will require connecting corridors throughout the Matrix to LSR's of 360 to 500 meters wide. The intent is not to maintain viable populations of these species within Matrix lands, but to allow some interaction with other species within Matrix.

Primary and Secondary Excavators

Primary and secondary excavators are of particular interest in the Layng Creek watershed because of their relatively specialized snag use patterns. Primary excavators are species such as woodpeckers and nuthatches that are capable of excavating holes in the boles of trees.

Secondary excavators use cavities created by primary excavators and natural processes. Included in this group are the endangered spotted owl, the sensitive pine martin, many tropical migrant birds, resident birds, bats and numerous other large and small vertebrate.

The limited availability of suitable snag habitat (30%) in the watershed is the most critical condition affecting this groups of species. Fragmentation of late successional vegetation is another important impact affecting primary and secondary excavators.

Neotropical Migratory Birds

Neotropical migrant birds are a group of species which are highly mobile between seasons, but typically have high site tenacity and small total acreage requirements. Neotropical migrant birds are at particular risk from fragmentation due to their nesting, feeding and reproductive strategies (Whitcomb et al., 1981). This group includes the Sharp-shinned hawk, northern goshawk, dark-eye junco, solitary vireo, vaux's swift, and many more.

The impact of nest predation and parasitism is thought to be largely responsible for the decline of neotropical migrants in some areas (Wilcox 1985). The research of Whitcomb et al., (1981) indicated that the number of neotropical migrant bird species found in habitat fragments declined in areas even as large as several hundred hectares.

Riparian interface

The NWP provides a method for defining Riparian Reserves, which is a land allocation for federal lands that includes specific objectives and restrictions. Stream class and site potential values are used to determine reserve area boundaries. That is, the larger the stream and the more productive the site, the larger the reserve. Although the reserves are land allocations, they essentially describe a riparian "zone", or area of riparian influence. If one were to apply this definition to all of the streams in the watershed, including those on private land, a total of 19,210 acres or 45% of the watershed could be defined as riparian zone. The actual allocation of Riparian Reserves on federal lands in the watershed is 16,014 acres. Tables 13 and 14 indicates the current condition of the riparian areas in terms of vegetation and road miles.

Table 13. Riparian Reserve Acres by Stream Class

	Stream Class						All Streams	
	I-II		III		IV		Total	
Riparian Reserve Acres	4,180	22%	3,834	20%	11,196	58%	19,210	100%
Road Acres in Reserves	26	4%	17	2%	68	2%	111	2.8%
Miles of Stream by Class	47	11%	89	21%	289	68%	425	100%

Table 14. Riparian Vegetation Condition by Age Class and Stream Class

	Stream Class						All Streams	
	I-II		III		IV		Total	
Age Class	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Grass Forbes	120	3%	101	2.6%	349	3%	570	3%
0-15 Years	126	3%	134	3.4%	436	4%	696	3.6%
15-20 Years	765	18%	438	11%	2,224	20%	3,427	18%
20-80 Years	1,760	42%	1708	45%	5052	45%	8520	44%
80-200 Years	840	20%	1064	28%	2271	20%	4175	22%
200-+ Years	569	14%	389	10%	864	8%	1822	9.4%
Totals→	4,180	100%	3,834	100 %	11,196A	100%	19,210	100 %

Management Status

Over the past 75 years the riparian zones in the Layng Creek watershed have experienced considerable impacts from management activities. In the 1920's, extensive railroad logging activities in the lower end of the watershed heavily impacted the riparian zone. Streams were not buffered, and the channel themselves were used as travel routes by the steam donkeys which were winched up to the log staging areas. However, during this period many cull logs were left in the channels which continue to contribute structure today. This area has recovered well and the average age of most of the dominant trees in the associated riparian zone exceeds 60 years.

Between the railroad logging era and the mid 1980's, the rest of the watershed experienced extensive clear-cut harvest, with more than 16,000 acres harvested on federal lands. Small stream buffers, averaging 100' in width, were typically applied to the Class I & II streams. Class III streams either had small stream buffers (average 50') or no buffers at all. These buffers had a tendency to deteriorate, as a result of blow down, salvage, and fire damage associated with slash burning. Ordinarily, no buffers were retained on the Class IV streams. Slash burning and extensive yarding of unutilized materials (YUM) left little large woody debris in the Riparian Reserves. Many of the Class IV channels were routinely seeded with an erosion control mix and planted with alder after slash burning. In an effort to preserve water quality, provide channel stability and allow fish passage, large wood was actively removed from the stream channels. The net result is a severe deficiency of large wood within the riparian areas compared with conditions before the advent of modern management practices.

The cumulative effects on the Riparian zones in the Layng Creek watershed is that 13,212 acres (69%) appear to lack sufficient quantities of the large down woody material and snags which are critical for wildlife habitat. Within the riparian zones, 1,830 acres (9.5%) of late successional old-growth habitat remains .

Currently, 111 miles (48 %) of the roads in the watershed are in the Riparian Reserve area. There are 10 bridges, 245 stream culverts associated with road crossings and about 3,000 relief culverts in the watershed.

In recent times, there have been numerous restoration activities within the municipal watershed. Stabilization of the Layng slide eliminated a major source of turbidity for Layng Creek. Paving of the main roads and an active program of cut bank and ditch management has kept road related sediment to a minimum. An aggressive road maintenance and culvert management program which includes storm patrol minimizes road and culvert related failures.

Riparian Vegetation

Approximately 31% of the riparian vegetation in the Laying Creek watershed is in a late seral condition. Except for a small portion in grass/forbs (3%), the remaining vegetation is in an open or closed sapling/pole stage (10 to 80 years). About 3% of the riparian vegetation has been displaced by roads.

Layng Creek, Junetta, Harvey and Dinner Creek have extensive areas of hardwoods. Layng Creek and Junetta Creek both have flood plain development which may have contributed, along with disturbance, to the development of hardwood stands. The lower reaches of Harvey Creek, where timber harvest occurred in the early 1980's, have extensive areas of hardwood development that include a substantial conifer component in the understory.

Disturbed areas, such as debris slides, landslides and roads in riparian areas are typical sites for hardwood establishment. Depending on the site characteristics, conifer replacement can take from 50 to 150 years to emerge. On sites after a stand replacement disturbance, where no mineral seed bed is created, conifers will reestablish and dominate the site in 20 to 30 years. (C. McCain, SFMcK WA).

Wildlife

The Riparian Reserves are designed to help provide connectivity between LSR's for late successional dependent species. LSR #022 is located to the north and east on the Willamette National Forest and in Brice Creek Watershed. Matrix lands are to the south and private lands are to the west.

The high level of fragmentation of the Riparian Reserves, which is described earlier in this chapter, is a critical factor because of the number of species dependent on Riparian Reserves for habitat and dispersal. Of all the mammals that occur in Western Oregon, 89% utilize the riparian zone or wetlands. Riparian habitats are utilized by 72% of the raptor species in Western Oregon for their primary foraging and nesting sites.

Within the Riparian Reserves, 2.8 percent or 539 acres are permanently in roads. As noted earlier, because of roads and fragmentation caused by harvest activity, only 30% of the Riparian Reserve remains in late successional habitat.

Wildfire

Fire activity tends to be less frequent and less severe in the Riparian Reserves since these areas tend to be less exposed to wind, and have more dense canopies, which provide more shade and higher fuel moistures. Historically , these areas were capable of producing large trees to the extent that appropriate growing sites were available.

In 1983, a slash burn reburned in the lower reaches of Harvey Creek area, resulting in the disturbance of 3000 ft of riparian zone along the main stem of Layng Creek. It is estimated that over 50% of the watershed's Riparian Reserve has burned in the past 300 years.

Hydrology

On the average, the annual output of water from Layng Creek would cover the entire watershed to a uniform depth of 38 inches. The instantaneous flow ranges from a low of about 5 cfs (cubic feet per second) in the late summer months to as much as 9,000 cfs for a 100-year storm event.

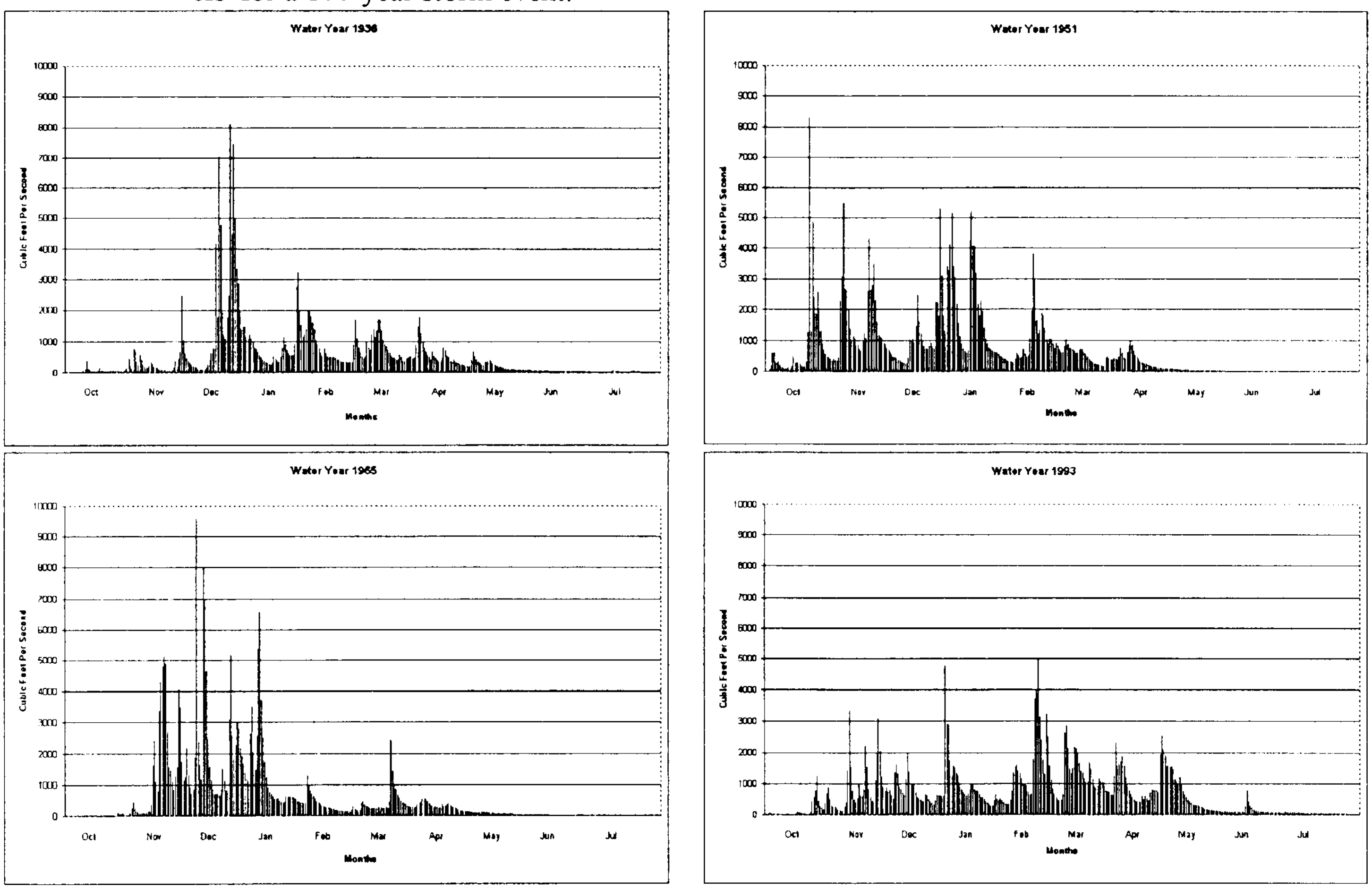


Figure 18. Mean Daily Flows of Row River in 1936, 1951, 1965, and 1993.

Figure 18 shows the mean daily flow values for several years of record. This data was collected at the Row River gauging station downstream from Layng Creek. The contributed flow from Layng Creek is estimated to be about 31% of the total amount shown.

Stream flooding can affect the riparian zone condition. Since a large storm can wash out much of the riparian vegetation, the age of the trees within the flood plain are directly related to flood history. The largest flood event in the 60 year record is the 1964 flood which is considered to be a 100 year event. The age class of much of the inner riparian vegetation in the Layng Creek watershed is consistent with this date. In 1981, there was an 18 year flood event which produced a younger age class of flood plain vegetation.

During flooding, fresh channel scour and deposition takes place and debris becomes mobilized. Subsequently, this mobilized debris is either removed or redistributed in tangled clumps. Signs of these effects are still apparent for the '64 and '81 events. Of course, on a seasonal basis, there is annual scour and deposition from normal winter storms, but the scale of these effects is much smaller than the '64 and '81 events.

Debris torrents are often associated with the larger events. They can move a large mass of rock, wood and water downstream, effectively scouring out the channel and then depositing the material abruptly at some point downstream.

Aquatic

Aquatic life

Fish Species

Cutthroat trout, at least two species of sculpin, longnose dace and/or speckled dace are the only known native fish species observed within the Layng Creek watershed. However, other native fish, such as whitefish and course scale suckers may also be present in the watershed. Eastern brook trout, an introduced species, have been caught by anglers in upper mainstem Layng Creek, between Saltpeter Creek and Silverstairs Creek. Crayfish and mollusks are also found throughout Layng Creek and several of the tributaries. Of the 425 stream miles within the watershed 47.2 are fish bearing (see Figure 4).

Aquatic Habitat

For purposes of analysis, the subwatersheds were grouped, with subwatersheds of the same tributary lumped together (see figure 19). One exception is the Layng Corridor group which is not made up of true subwatersheds. Also, the Lower Layng group was separated out due to the difference in management objectives on private land.

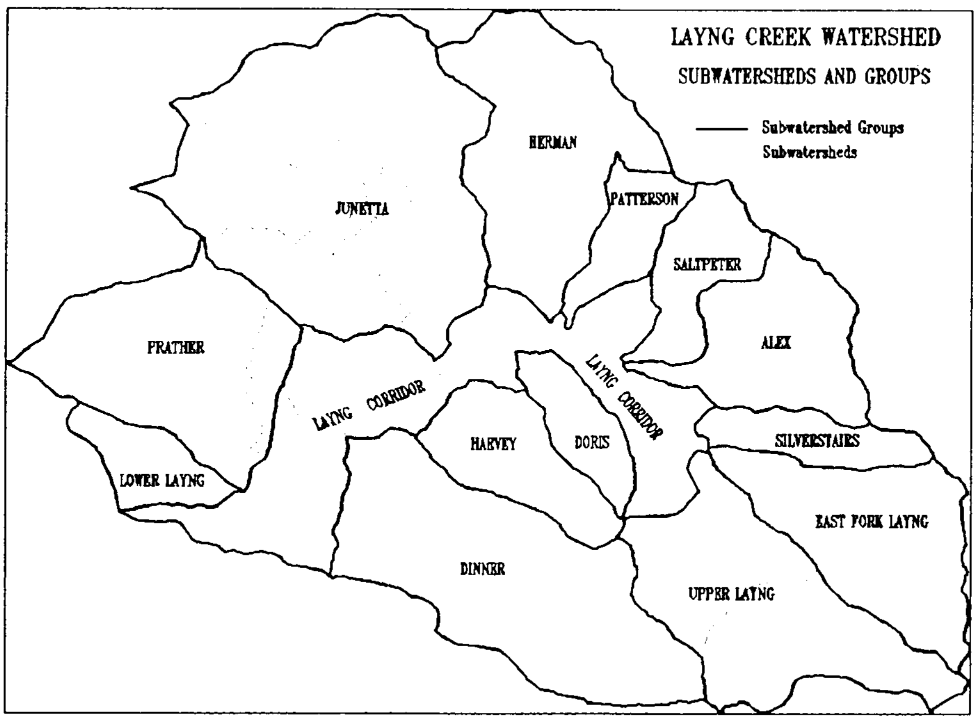


Figure 19. Stream subgrouping used in stream assessments.

Riparian seral condition was looked at for each of these groups along fish bearing, perennial non-fishbearing and intermittent streams. The analysis indicated that the majority of the riparian condition has been altered so that large conifers are no longer the dominant vegetation.

Stream inventories were conducted to assess existing aquatic conditions. Inventories are limited within the Layng Creek Watershed. Surveys were done on Layng Creek in 1992, and on Harvey Creek, Dinner Creek and Junetta Creek in 1994 (see Figure 20).

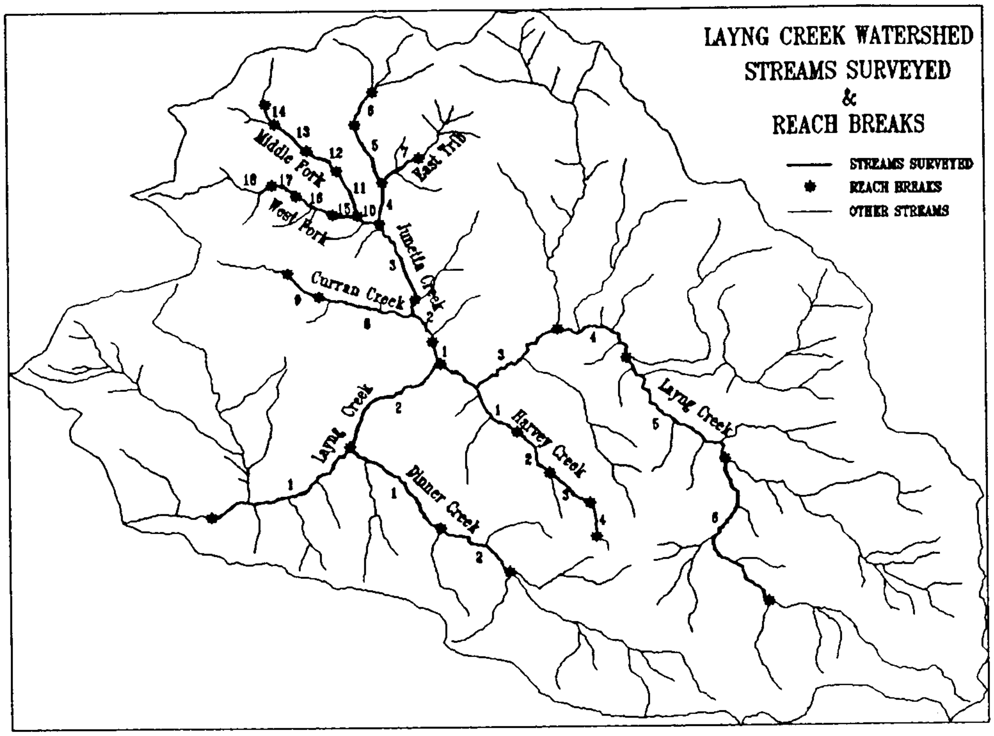


Figure 20. Map of Streams Surveyed and Reach Breaks

Site specific analysis of current conditions for the streams surveyed

Layng Creek

Six reaches were surveyed on the mainstem of Layng Creek, extending from the Forest boundary to the West Fork of Layng Creek, approximately 11 miles. All reaches were low in channel width pools per mile. Instream large woody material was also low for the first four reaches and fair for the upper two. Riparian condition was recorded for a 100-foot width, limiting the seral condition to a hardwood zone. True riparian seral stages varied, with small trees throughout most of the reaches, and with some mature trees, particularly in the upper two reaches (5 and 6).

Fish surveys indicated freshwater mollusks to be found in reaches 1 through 2, sculpin to be found in reaches 1 through 3, and dace in reaches 1 through 5. Cutthroat trout were found in reaches 1 through 6. Of the trout, all age classes were found in reaches 1 through 4, with few adults in reach 3 and an abundance of young in reach 4. Reach 5 had many young, few juvenile and no adult trout. Reach 6 had few young, limited juvenile and no adult trout.

The valley becomes more confined and the channel gradient steepens at Reach 5. Habitat parameters such as large woody material and riparian vegetation are good.

Harvey Creek

Reach 1 is from the mouth up to where the 1746.824 road crosses the stream, approximately 0.9 miles. A slash burn reburned in 1983, impacting the mouth of the stream. Much of the riparian area is in hardwoods, leaving little chance of future recruitment of large wood to enter the channel. A low level of large woody material (6.1 pieces/mile) is found within the stream channel. This has resulted in few channel width pools (29 pools/mile). Much of the riffle habitat has been scoured to bedrock, with a few pocket pools. Biologic sampling was conducted to estimate relative abundance by age class. The data revealed few trout, particularly few fry and no adults. No sculpin or dace were present.

Reach 2 is from river mile 0.9 to 1.7. Habitat improves in this reach, with more large woody material (46.7 pieces/mile), more channel width pools (63 pools/mile) and better riparian condition. Large amounts of smaller wood (12-24 inch diameter and 25-50 feet long) are found with an estimate of 139 pieces per mile, also contributing to pool and cover habitat. Riparian vegetation consists of large conifer trees. This higher quality habitat is reflected in the increase of trout found in this reach, particularly lots of fry. No sculpin or dace were observed. Salamanders and crayfish were found throughout the reach. A pump chance is located at the beginning of the reach, just above the culvert. These structures impede upstream migration. Resident cutthroat trout were observed more than a mile above the culvert.

No physical habitat survey was conducted on Reach 3, but biological sampling indicated fry and juvenile cutthroat above the 20' falls.

Dinner Creek

Aquatic habitat conditions are similar for Reaches 1 and 2. The geomorphology is also similar, a steeply incised valley, but Reach 2 has a steeper channel gradient. Reach 2 ends at a 25 foot falls at river mile 1.9. Large woody material (>24 inch diameter and >50 feet long) averages 23 pieces per mile, and smaller pieces (12-24 inch and 25-50 feet) are abundant (76 per mile for Reach 1 and 113 per mile for reach 2). The large woody material creates some good habitat in Dinner Creek. Channel width pools are approximately 50 pools per mile, which is low for this narrow 10 foot wide summer low flow channel. However, much of the habitat is characterized as a boulder cascade stair-step type. The actual pool frequency may be underrated, since inventory procedures preclude taking into account many of the smaller pools, that are no longer than they are wide. Smaller pocket pool type of habitat is available. In addition, side channel habitat is common in both reaches. Riparian vegetation appears to be primarily hardwoods adjacent to the stream, with small conifers further out. Biologic sampling in both reaches resulted in many fish of all age classes, including many fry and several adults. Few sculpin were found in Reach 1, none in Reach 2. No dace were observed.

A manmade dam was built some time around 1930. The structure is a 10-foot drop and is a migration barrier, genetically isolating the upstream fish populations. The structure, which was originally built for purposes of domestic intake, has not been used for many years, and is now completely filled with sediment. Removal of this barrier would allow fish from Layng Creek to freely move upstream and use the quality spawning and rearing habitat available in Dinner Creek.

Junetta Creek and tributaries

Junetta Creek, Curran Creek, West Fork Junetta Creek, Middle Fork Junetta Creek and East Fork Junetta Creek were all surveyed in 1994.

Two large falls (10-feet and 15-feet high) exist near the mouth of Junetta Creek. These falls are natural migration barriers to upstream migration for trout and other species within Layng Creek. However, populations do exist above these barriers. Relative abundance and age class distribution for the cutthroat trout within Junetta Creek was estimated. Spawning appears to be occurring in the first two reaches of Junetta Creek along with the lower parts of Curran and East Fork Junetta tributaries. Some fry were present wherever fish were present except for Reach 13, which is the upper reach of Middle Fork Junetta. Adult fish are found throughout most of the system, but they tend to be absent in the upper reaches, where the stream becomes shallow and narrow. Some large (9-12") cutthroat were found in Reaches 2 and 4 of Junetta Creek and Reach 15 of West Fork Junetta Creek. Sculpin were found up to reach 4 in Junetta Creek; two species were observed, one believed to be torrent, the other is unknown. No sculpin were found in Curran Creek, Middle Fork or West Fork Junetta Creeks. Overall relative abundance was low.

Junetta Creek

Six reaches were surveyed on Junetta Creek. Extremely low quantities of large woody material (0 to 6.3 pieces per mile) were found in these reaches. Channel width pool frequencies are also low, ranging from 21 to 35 pools per mile. Riparian vegetation for the first four reaches consists of hardwoods shifting to small conifers on the east bank, and large conifers on the west bank for the last two reaches. Reach 2 is predominantly within private land, and riparian management objectives can be assumed to differ from that on land administered by the Forest Service.

The lower end of the subwatershed was roaded and harvested in the 1920's. It was the first tributary of Layng Creek to be disturbed. Roads are adjacent to much of the stream within the Riparian Reserve, at times causing erosion and channel constriction.

East Fork Junetta Creek

One reach was surveyed, until the stream was dry in 0.4 miles. Hardwoods adjacent to an old clearcut unit dominated the riparian vegetation for the lower part of the reach, changing to larger trees at the top of the reach. Large woody material is fair with 42 pieces per mile. Channel width pools are low (34 per mile). Good spawning habitat was noted and fry were present throughout the reach.

Curran Creek

The creek was surveyed to the 1721 road, and separated into two reaches. The first reach starts out on private land. Pieces of large woody material (24 per mile) and channel width pools (58 per mile) are low to moderate and bank cutting and erosion are relatively common. Abundant fry were observed in this reach, suggesting Curran

Creek is an important spawning area. Riparian vegetation is limited to second growth, limiting recruitment of large wood to the stream channel. The second reach begins as the valley constricts and the stream channel increases. Pieces of large wood increase to 83 per mile, but channel width pools are low (30 per mile). This is probably due to the steep gradient and therefore more pocket pools and less of the channel width pools that need to be longer than wide. Riparian vegetation consists of mature trees on one side and second growth on the other. Some future recruitment of large wood is available. No fish were observed in this reach.

Middle Fork Junetta Creek

Four reaches were surveyed, all fish bearing. All but the uppermost reach were limited in large woody material (3 to 8 pieces per mile). The upper reach had 64 pieces per mile with lots of smaller pieces of wood. Riparian vegetation was also different in this reach. Though all the other reaches surveyed were in a second growth seral stage, one side of this reach consisted of large trees. This probably influenced the increased amount of down wood found in this reach. Channel width pools were similar in the first two reaches at 47 and 40 pools per mile, respectively. The last two reaches were also similar at 60 and 69 pools per mile. Again the increased amount of wood in the last reach did not influence the pools per mile because of the steep gradient and, therefore, a lack of pools that were longer than wide. Bank cutting and erosion in the lower reaches appear to be associated with the road above the stream channel. Juvenile (5-7") cutthroat trout were found throughout the survey area. A few larger trout (9-12") were found in the first reach and few fry were found in the first three reaches. This may indicate poor spawning and fair adult holding habitat.

West Fork Junetta Creek

Three reaches were surveyed, with fish populations diminishing approaching the end of the second reach. Large woody material was fairly abundant for the first two reaches (65 and 59 pieces per mile, respectfully), decreasing to 17 pieces per mile for the upper reach. This correlates with riparian vegetation conditions; mature trees in the first two reaches and a regeneration harvest unit in an early successional stage in the upper reach. Channel width pools per mile are fair (52 to 69 per mile) for all reaches. Adult fish and a few fry were found in the first reach; no sampling for fish was done in the second reach, though a few fry were observed during the time of the survey. The fairly intact riparian condition and instream large woody material for the first two reaches provides good habitat within the Junetta Creek watershed.

Water Quality

In the 1970's, turbidity in Layng Creek was a particularly critical issue. Water treatment for the City consisted of a simple filtration and chlorination system; consequently, the City was not meeting state standards for drinking water turbidity. During winter storms, city residents would frequently get brown water from their tap. A new treatment plant was needed and funding was a very troublesome public issue. Anecdotal reports from long term residents suggested that water quality was becoming worse, but there was no data available to evaluate that contention. In 1976, the Forest Service responded by initiating a turbidity monitoring program in Layng Creek and by increasing the harvest rotation period from 80 to 160 years which effectively reduced the mean annual timber harvest by 50%.

It should be noted that during the early 1970's a large earth flow, referred to as the "Layng Slide" was actively moving into Layng Creek. The point of entry was about 5 miles above the municipal intake. The source area of the slide was roughly 80 acres and the width of the slide at the mouth was about 200 feet. Anecdotal reports stated that the slide moved as much as 40 feet per year. In the late '70s, the Layng Creek stream channel was artificially shifted to stabilize the toe of the earthflow and reduce sedimentation in the system. The slide then proceeded to flow into and fill the abandoned channel This stabilization effort has allowed the development of a buttress along the toe of the earthflow, and appears to be in a state of remission. During the '80s the slide stopped and slowly formed its internal drainage system. Today the slide has revegetated and has the appearance of a typical landform. Analysis of the monitoring data suggests that this stabilization project resulted in a very significant reduction in the turbidity production of Layng Creek.

Other water quality parameters

Besides turbidity, the City monitors several other water quality parameters. Figures 21 and 22 show samples of this data. The Forest Service also routinely monitors stream temperature.

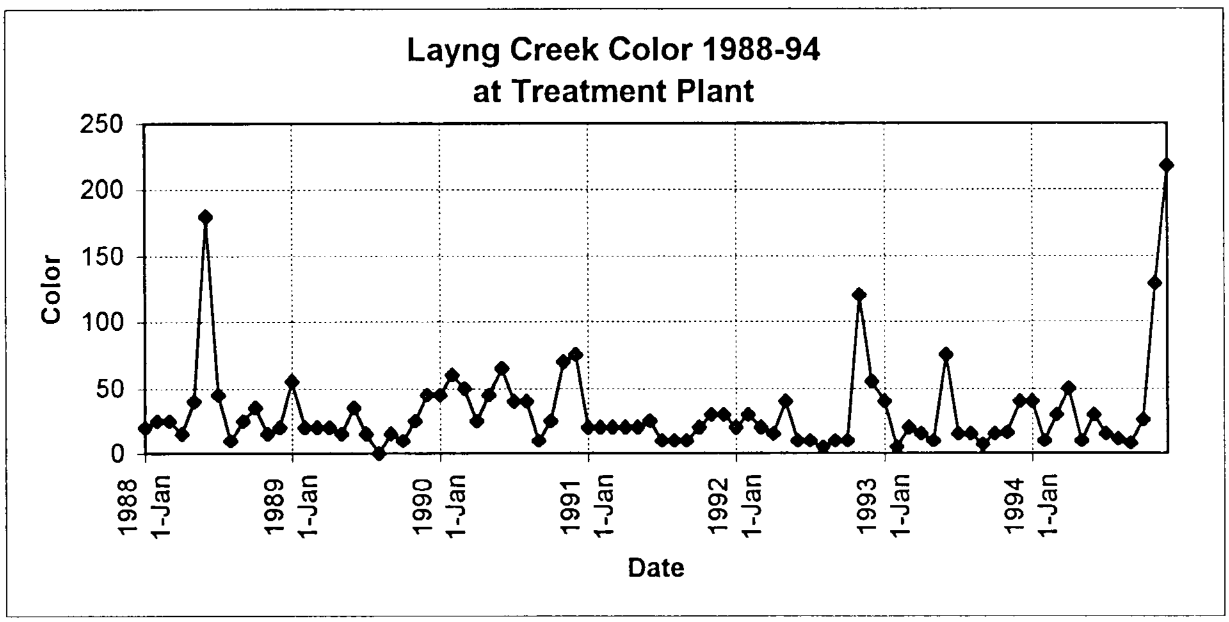


Figure 21. Turbitity of Layng Creek 1988-1994

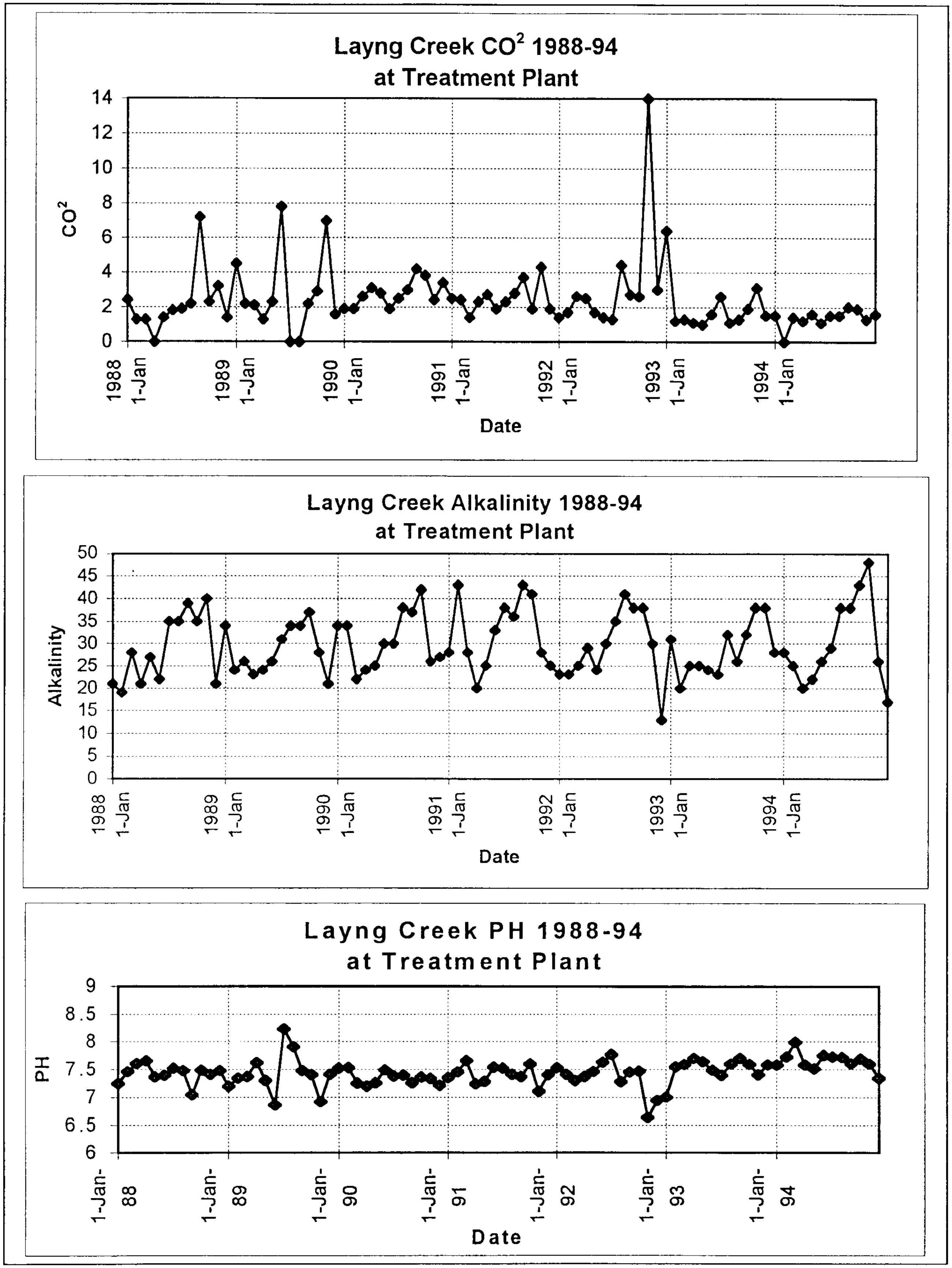


Figure 22. Water quality monitoring results from Layng Creek 1988-1994

Chapter Four

4. Reference Conditions

Societal

Human Use and Occupancy

The date of the earliest human occupancy of the Layng Creek watershed is unknown. Use of the area is thought to have been limited to seasonal hunting and gathering by the Sahaptian Molalla and Kalapuyan Yoncalla tribes. Euro-American settlers started to appear in the period between 1850 and 1860. In 1863 gold was discovered in the adjacent Bohemia mining area, and in 1870 the railroad reached Cottage Grove. In 1909, the City of Cottage Grove started to use Layng Creek as a source of drinking water.

The lower 12% of Layng Creek (starting in the vicinity of Prather Creek) is relatively flat and probably had more early use. The Prather Creek area was used as a logging camp. In the 1930's this camp became a CCC (Civilian Conservation Corps) camp, and was converted into the Bohemia Ranger Station and the Rujada Campground. The private ranch land in the lower end of the watershed has probably been settled since the late 1800s.

Figure 23.Bohemia Ranger Station and CCC camp, May, 1936. This is the current location of the Layng Creek Work Center. Two of the original buildings still remain.

Two agreements with the Secretary of Agriculture for the subwatersheds of Dinner and Prather Creeks were signed in 1922 and 1924. In 1950 the City abandoned the Dinner Creek system and built the existing diversion on Layng Creek. Layng Creek was first recognized as a municipal supply in the "Watershed Management Policy Statement for Layng Creek Watershed" (1969). In 1985 a water treatment plant was constructed near the Rujada Campground.

In 1913 the railroad was extended into the Layng Creek area and about 3,200 acres were logged up until 1930. No logging took place in the 1930's but between 1941 and 1980 an additional 17,000 acres were logged.

Timber Harvest

There is no available history or records regarding harvest activity prior to 1900. Harvest practices from 1900 to the present were described in Chapter 3.

Roads and Railroads

Plans for railroad logging in the Layng Creek watershed began in 1909, when a group of Cottage Grove investors bid for 175 mmbf of timber. Logging operations began in 1913. In 1914, the company built a spur track which ran 1/4 of a mile along Prather Creek past the City of Cottage Grove intake, then turned east to the logging area towards Mount June and the upper slopes of Junetta Creek.

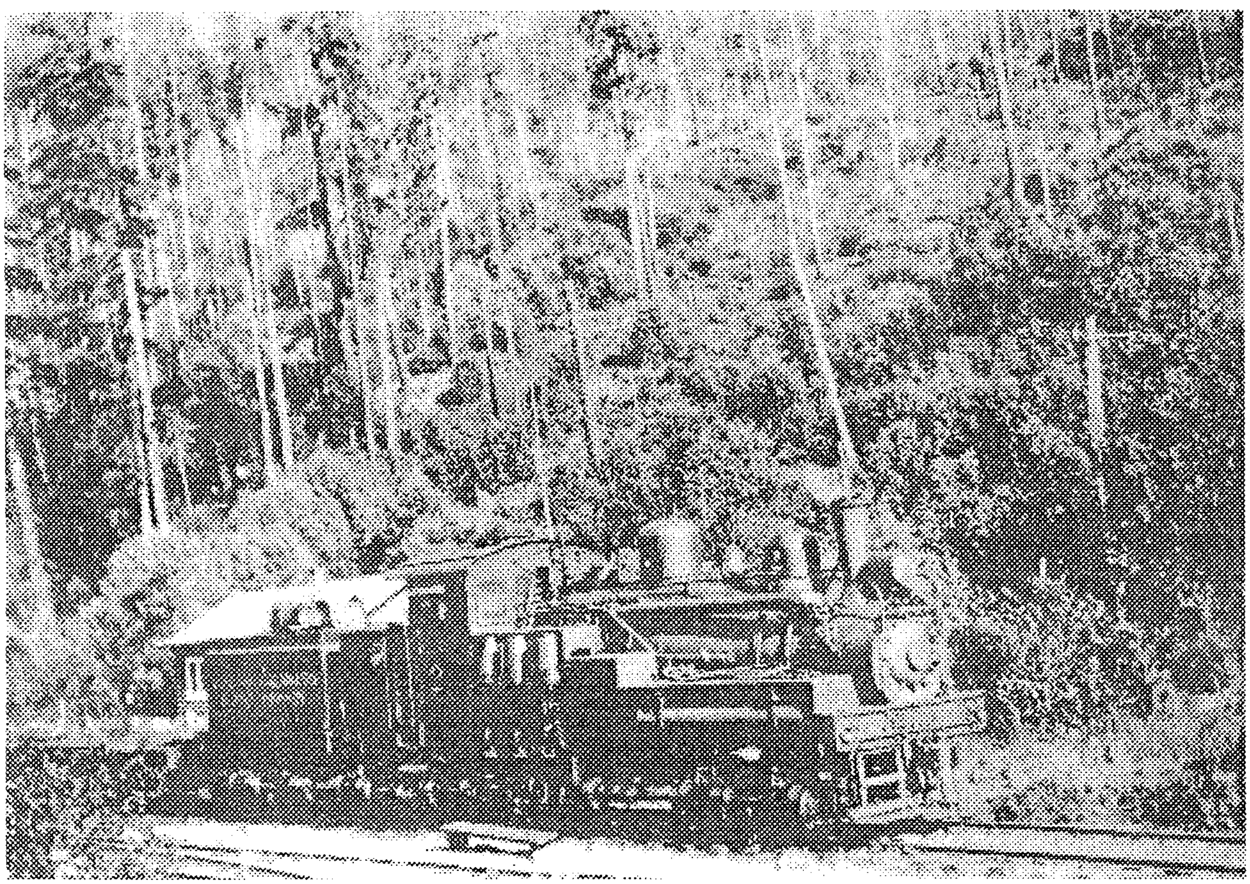


Figure 24. The Anderson and Middleton Lumber Company steam engine "Two Spot" near Rujada on the Bohemia Ranger District (present day Cottage Grove Ranger District) on May 17, 1924.

In 1924,the Anderson and Middleton Lumber Co. made a successful bid for 375 mmbf of timber in the Herman Creek watershed. A logging railroad was built in the area before the company went out of business in 1934. The railroad grade is in the location of the Layng Creek Road #1700.

By 1939, a number of significant changes had occurred in the logging industry. The invention of the bull dozer made it possible to build plank roads constructed of rough-cut four by fours and mills began using trucks to haul the logs out of the woods. A few years later gasoline powered chain saws enabled trees to be cut at a much faster rate. Getting a greater number of logs out of the woods on the old roads became such a problem that mill workers were forced to build new roads on their own time to insure that an adequate supply of logs reached the mills. This was when road construction began in the Layng Creek watershed.

By 1950, roads covered much of the Layng Creek watershed. The Prather Creek drainage had been logged and some logging had occurred in the Herman Creek, Harvey Creek, and Dinner Creek subwatersheds. Roads were constructed in all of these subwatersheds.

Approximately 51 miles of system roads were constructed that are still in use today. There were many miles of spur roads and railroad grades constructed prior to 1950 that were allowed to degrade and eventually become re-forested. Through out the '50's and '60's, roads were constructed in the Layng Creek watershed. By 1970, most of the area had been roaded. All of the District's current arterial and collector roads were in place.

Between 1974 and 1980, the District identified all roads that could be driven and had a tread width of over 40 inches. This effort was called the "ED 10 Study," and included roads constructed during both the railroad logging era and the modern periods. After the roads had been identified, they were placed on the system and numbered. In the late '70's and early '80's, many of these roads were scarified, water-barred, seeded and closed to public use. Many past erosion problems were corrected or mitigated as a result of this effort.

In 1978, 4.5 miles of Layng Creek Road (1700) was paved. In 1980, 6.3 miles of Road 1746 was paved. Another 5.5 mile segment of Road 1700 was paved in 1982. These roads were paved to prevent erosion and reduce sediment from entering Layng Creek. Corrective actions began in the middle and late 70's and continue today.

Terrestrial

Geology and Soils

Landslides and Debris Flows

Prior to the 1900's, sedimentation was associated with natural disturbances. In this natural landscape, which characterizes reference conditions for Layng Creek watershed, fire and precipitation were the primary factors that controlled the sediment regime. Information provided elsewhere in this document suggests that there was a wide range of fire frequency and intensity throughout Layng Creek. The occurrence of fire, particularly stand replacing events that covered large areas, can be correlated to the loss of organic material on the surface and loss of root strength for a period of years. These factors, singularly or combined with other environmental contributors, had the potential to expose the soil mantle and allow saturation to occur. Under certain conditions saturated surface materials, particularly on slopes over 60% were subject to translational slides, typically debris slides that often developed into debris flows in the stream channels.

An analysis of the naturally occurring landslides in the watershed identified that between 1946 and 1988 there were 2 natural landslides per square mile (see Table 15). A number of subwatersheds had substantially higher frequencies, including Junetta Creek, the Layng Creek corridor, and Lower Dinner Creek. The common denominator for these areas is the relationship of the natural slides to steep convergent slopes and/or riparian areas commonly found along inner gorges.

Table 15. Natural slides per mile of subwatersheds in Layng Creek.

Subwatershed	Acres	Sq mile	Slides 1946-88	Slides / Mile	Subwatershed	Acres	Sq mile	Slides 1946-88	Slides / Mile
Pitcher/Gleason	892	1.4	0	0.00	Mid Layng East	1587	2.5	5	2.02
Mid Fork Junetta	1515	2.4	4	1.70	Saltpeter	1306	2.0	0	0.00
Upper Junetta	1407	2.2	16	7.28	Alex	2318	3.6	7	1.93
East Fork Junetta	884	1.4	8	5.79	Silverstairs	940	1.5	1	0.68
Upper Herman	1570	2.5	5	2.04	Layng Canyon Low	980	1.5	5	3.27
Patterson	946	1.5	2	1.35	Doris	925	1.4	4	2.77
Lower Herman	2315	3.6	4	1.11	Harvey	1656	2.6	6	2.32
Lower Junetta	1463	2.3	4	1.75	Lower Layng	1637	2.6	3	1.17
W Fork Junetta	1344	2.1	5	2.38	Lower Dinner	2391	3.7	13	3.48
Curran	1194	1.9	4	2.16	Upper Dinner	2833	4.4	6	1.36
Prather	3307	5.2	0	0.00	Layng Canyon Up	1868	2.9	6	2.06
E Fork Prather	405	0.6	0	0.00	East Fork Layng	2980	4.7	7	1.50
Mid Layng West	1376	2.2	7	3.26	Upper Layng	2095	3.3	14	4.28

Totals: 42,134 Acres; 66 Square Miles; 136 Slides; Average 2.06 slides per Square Mile

Although the areas mentioned above had higher than average slide frequencies, a number of other subwatersheds were affected by landslides prior to the onset of land management activities around 1900. One principle conclusion can be derived from the available data; although there were periods of time prior to 1900 when disturbance processes resulted in landslide activity, these disturbances were more evenly distributed in time and space.

Since the initiation of forest and land management activities around 1900, the sediment regime associated with landslides has been altered dramatically. Landslides related to management actions account for approximately 75% of the observable features in the past 50 years. In addition to the numerical increase, slides are occurring on terrain where they would not typically be expected, therefore affecting the ecological balance. Another change from reference conditions is that a large number of road related failures do not have the character of material that would be expected to fail. In a number of instances, the associated large wood normally found in a slide deposit has been removed and is not providing the complexity of a natural failure.

The consequences of a landslide occurrence were dramatically different before the turn of the century. In a natural system, landslides tend to recover fairly rapidly, within 15-30 years where conditions are favorable. These events usually provide large wood and a wide range of colluvial material. A natural slide has the opportunity to transport the material that is above the slide plane, including any available vegetation and sediment, to a point where deposition occurs. Often times these slides were deposited in or adjacent to riparian areas and there is little evidence that debris flows commonly occurred. The exceptions are the areas in Layng Creek where the dominant channel forming processes are debris slides and debris flows. Typically this terrain is in excess of 60-70% slopes; channels have steep gradients and are controlled by the colluvial material and bedrock. Junetta Creek is a good example of this type of terrain.

Lack of large wood plays a role in management related failures and is highlighted where landslides have impacted stream channels. In an undisturbed system, it is probable that the large organic material serves as a buffering influence and minimizes the adverse impacts to the stream. The Layng Creek system has had a tremendous amount of LWM removed from the riparian zone and landslides.

Earthflows

Layng Creek has a significant amount of dormant earthflow terrain that developed during the glacial periods of the Pleistocene era. Although these features have not been active for thousands of years, the landforms contain isolated earthflows that have been subject to periodic activity during the last several hundred years. Several of these earthflows have been identified through aerial photo interpretation. Even though management activities have not occurred, they appear to be relatively active; two of them have grown in size since 1946. Under natural conditions, these features tend to be episodic in nature and are usually associated with increased moisture and or localized geologic conditions. Earthflows characteristically provide significant amounts of sediment as well as organic material and act as source areas for aquifers as well. It appears that the semi-active features in Layng Creek have contributed sediment and large wood for a long period of time, possibly several thousand years.

Soils

The reference conditions for the soil resources in Layng Creek can be discussed in terms of erosion, the amount of detrimental disturbance and, to some extent, the amount of large organic material present. It is highly probable that rates of erosion under reference conditions were similar to the present, but the amount of area that was potentially susceptible to erosion was substantially less. Under natural conditions, the number and types of areas exposed to surficial erosional processes were related to the kind and amount of disturbances mechanism that occurred on the landscape. In Layng Creek, surface erosion was likely to occur in areas where the organic material was removed from the soil horizon, typically from high intensity fire, and to a lesser extent from exposed surfaces associated with older mass wasting and stream erosion. Based on this information, it is safe to assume there was a low occurrence of surface erosion in most of the Layng Creek basin over time.

Detrimental disturbance, particularly puddling and compaction of the upper soil zones, was probably limited to the random patterns associated with big game trails and falling trees. Based on the harvest history, particularly on the earthflow terrain, it is probable that there has been a significant increase in the amount of area that's been subjected to activities known to disrupt the soil profile.

Wildfire

Historic Uses, Activities, Occupancies

Under reference conditions, native Americans used fire to set back or kill brush that impeded big game movement or reduced visibility and ease of travel, and to maintain gathering and grazing sites. Fires set for these reasons within the watershed would have been mostly low intensity (2-4 feet flame lengths), and with few exceptions would have been ground fires. If Indians maintained select areas, as has been suggested in various writings, fire was probably set every year to five years, depending on site needs.

Significant Effects of Wildfire on Watershed Structure and Processes

Fire played a major role in watershed structure and processes in reference times. As previously discussed, fire created and maintained a mosaic landscape pattern which changed through the centuries. The fire episodes indicated several areas of stand replacement, as well as significant areas of partial stand replacement. Very little of the watershed was left unburned within the 1600-1900 time period.

In those areas that had recurrent stand replacement, fires would have burned at intensities that consumed coarse woody debris (material greater than one inch in diameter) as well as some larger down logs in various stages of decay. Fire would have burned within riparian areas with relative ease, primarily those higher in elevation and somewhat exposed to prevailing winds. After these fires, fuels would slowly accumulate as fire killed trees and brush fell to the forest floor; trees and brush would eventually re-establish themselves. Eventually; after a period of time, another stand replacing fire would sweep through the area, and the process would repeat itself.