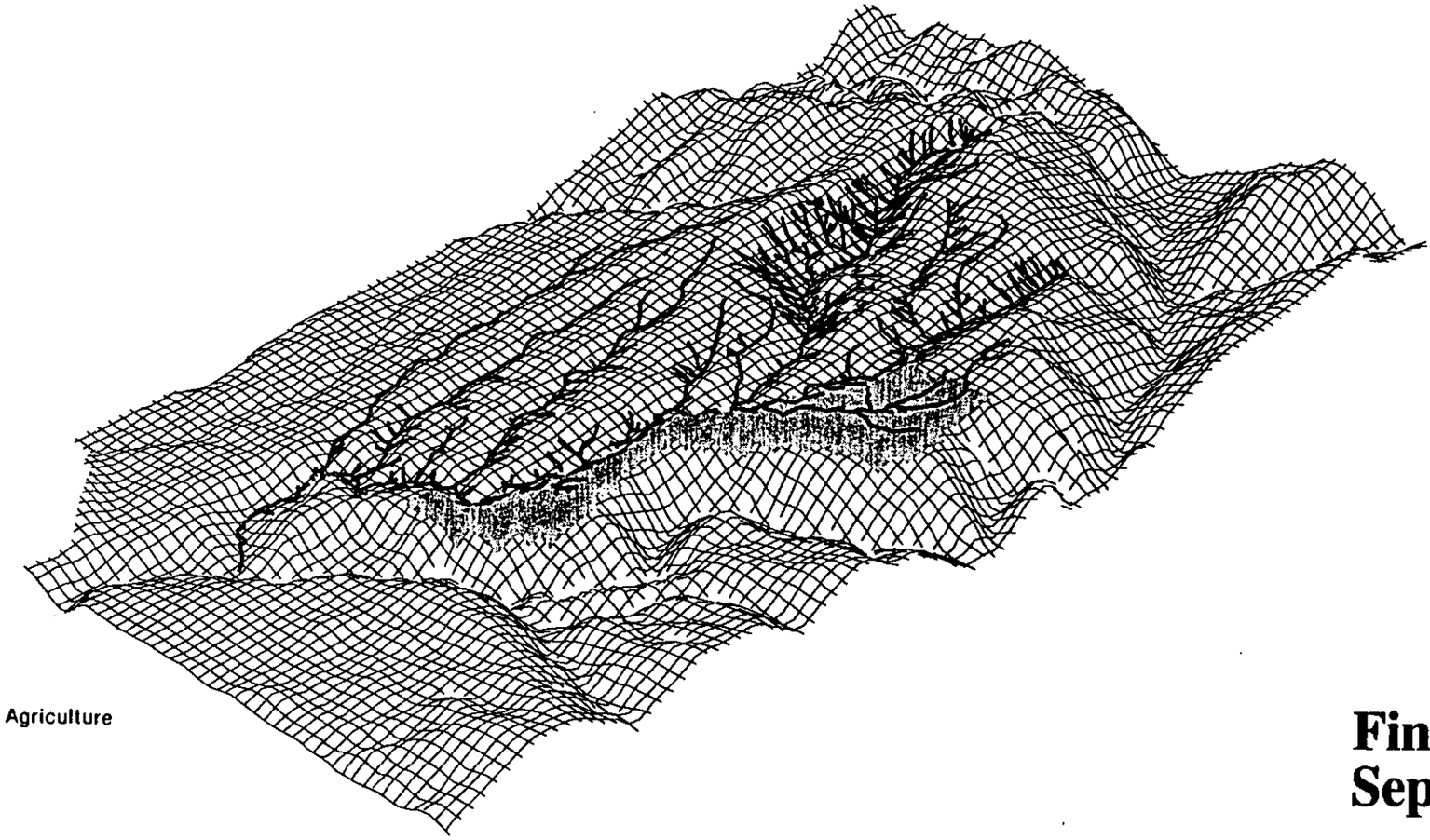
North Fork Clackamas River
WATERSHED ANALYSIS



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Pacific Northwest Region

Mt. Hood National Forest

BLM

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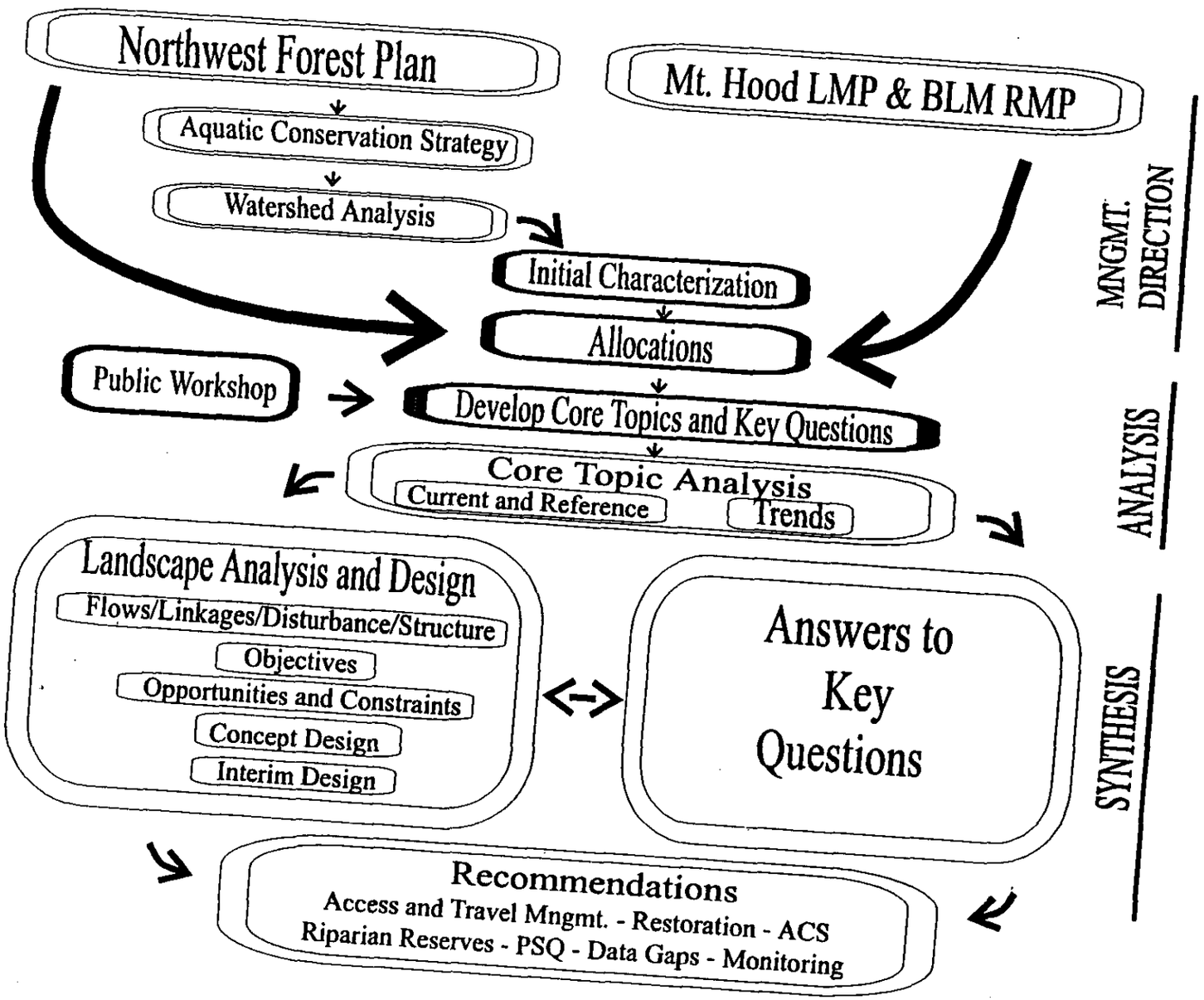
Chapter 1
Introduction



INTRODUCTION

Overview of Watershed Analysis

Watershed analysis is a procedure used to characterize the human, aquatic, riparian, and terrestrial features; and conditions, processes, and interactions within a watershed. It provides a systematic way to understand and organize ecosystem information. In so doing, watershed analysis enhances our ability to estimate direct, indirect, and cumulative effects of our past management activities and guide the general type, location, and sequence of appropriate future management activities within a watershed.

"Watershed analysis is not a decision making process. Rather it is a stage setting process."

Watershed analysis is essentially ***ecosystem analysis at the watershed scale***. As one of the principal analyses for implementing the Aquatic Conservation Strategy (ACS) set forth in the Northwest Forest Plan (Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl, USDA, USDI, 1994) it provides the watershed context for fishery protection, restoration, and enhancement efforts. The understanding gained through watershed analysis is critical to sustaining the health and productivity of natural resources. Healthy ecological functions are essential to maintain and create current and future social and economic opportunities.

Federal agencies are conducting watershed analyses to shift their focus from species and sites to the ecosystems that support them in order to understand the consequences of management actions before implementation. The watershed scale was selected because every watershed is a well defined land area having a set of unique features, a system of recurring processes, and a collection of dependent plants and animals.

Watershed analysis is not a decision making process. Rather it is a stage setting process. The results of watershed analysis establish the context for subsequent decision making processes, including planning, project development, and regulatory compliance.

The results of watershed analysis can be used to:

* Assist in developing ecologically sustainable programs to produce water, timber, recreation and other commodities.

* Facilitate program and budget development by identifying and setting priorities for social, economic, and ecological needs within and among watersheds.

* Establish a consistent, watershed-wide context for project level National Environmental Policy Act (NEPA) analyses.

* Establish a watershed context for evaluating management activity and project consistency given existing plan objectives.

* Establish a consistent, watershed-wide context for implementing the Endangered Species Act and the Federal Clean Water Act.

Process and Document Organization

The process that was followed for the North Fork Watershed Analysis is shown in Figure 1-1. Each chapter begins with this diagram and highlights the corresponding step in the watershed analysis process. The document is organized around the four primary steps in the process: core topic analysis, landscape analysis and design, answers to key questions, and recommendations.

Chapter 2 presents the analysis of core topic areas, as identified in Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis (USDA, USDI 1995). The core topic questions focus the basic analysis of ecological conditions, processes, and interactions at work in the watershed. Current and reference conditions and future trends are examined for each core topic area. The core topics address the major ecological elements that are common to all watersheds. This is the basic analysis that is addressed in every watershed analysis document. Level of detail for each core topic is based on watershed specific issues.

Chapter 3 (Landscape Analysis and Design) and Chapter 4 (Key Questions) synthesize information gained in the core topic analysis and integrate it with management direction from the Northwest Forest Plan, Mt. Hood National Forest Land and Resource Management Plan (Mt. Hood Forest Plan), and Bureau of Land Management Resource Management Plan (RMP).

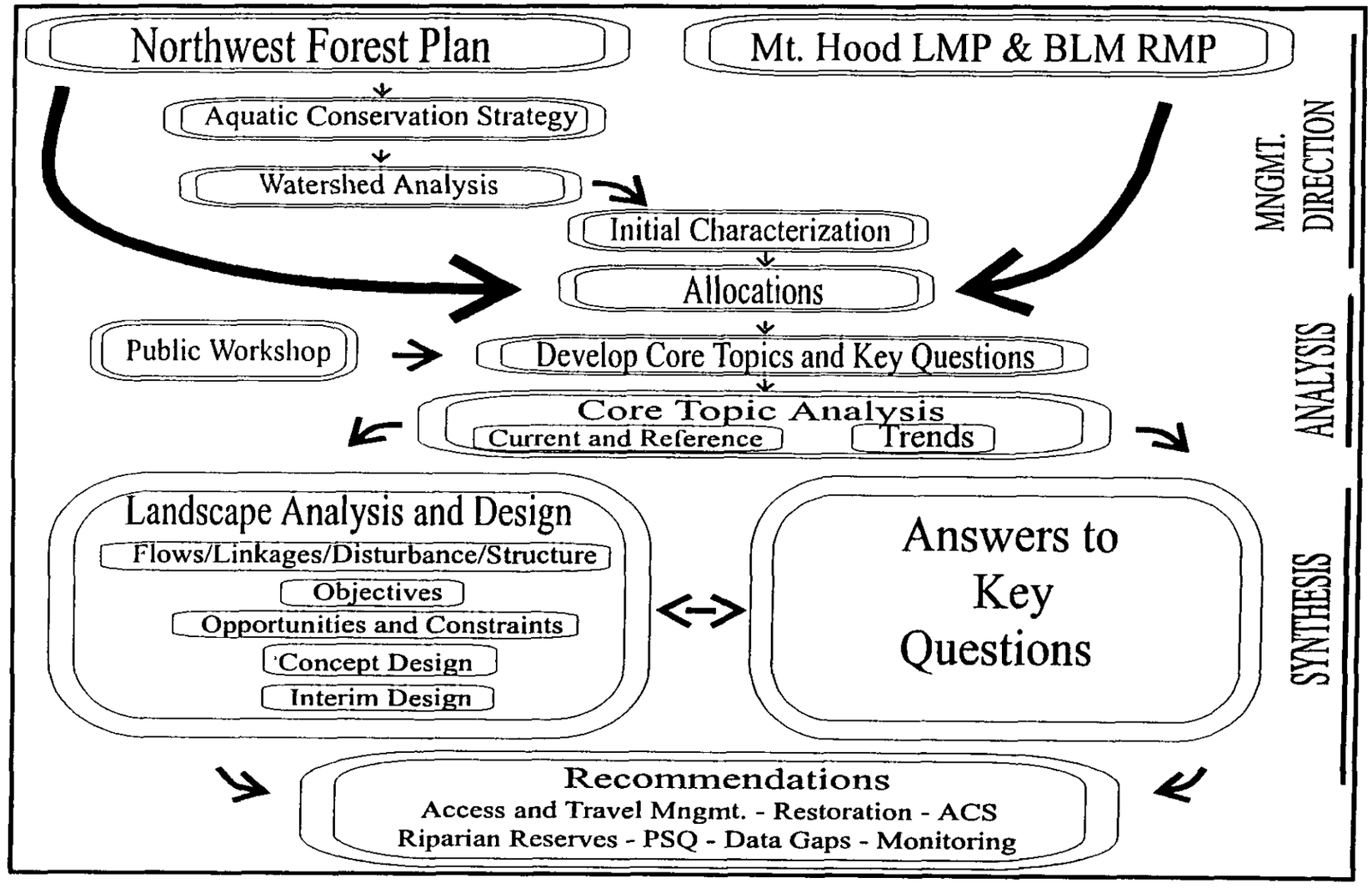
The Landscape Analysis and Design (LAD) process (Diaz and Apostol, 1992) integrates the principles of landscape ecology with forest planning through the conscious design of vegetation and infrastructure patterns based on watershed level desired future conditions, as described in the Northwest Forest Plan, Mt. Hood Forest Plan, and the BLM RMP. The results of watershed analysis are combined with management direction to give a picture of future conditions in the watershed and the ability of the watershed to meet ecological and social objectives.

LAD (Chapter 3) gives a graphic depiction of the vegetation patterns over the next 20 years (Interim Design) and conceptually over the long term (Concept Design) given current conditions, coupled with management direction. Future projects can be evaluated against the Concept Design to see if they help achieve the desired future conditions of the watershed given in the various land management planning documents. Chapter 3 also contains the Access and Travel Management Plan (ATM), depicting the long term road infrastructure system in the watershed.

Chapter 4, Key Questions, presents the answers to the Key Questions. These questions were developed around the key issues for the watershed. They are the issues that are of primary concern and are unique to the North Fork watershed. The answers to the Key Questions synthesize and examine interrelationships between the information presented by core topic area in Chapter 2 and LAD (Chapter 3). Recommendations are made to address problems identified in the Key Questions.

Chapter 5, Recommendations, summarizes recommendations derived from the Key Questions and LAD. The recommended Riparian Reserve system, restoration projects, compliance with the Aquatic Conservation Strategy (ACS), data gaps, and monitoring are all presented in this chapter. There is also an analysis of Probable Sale Quantity (PSQ), examining the amount of timber volume that can be produced in the North Fork watershed.

Figure 1-1
Process Diagram



INITIAL CHARACTERIZATION

North Fork Clackamas River watershed lies in western Oregon on the west slope of the Cascade Range and is a one hour drive from the Portland Metropolitan area in Clackamas County.(Map 1-1) There is a mix of ownership in the watershed (Map 1-3) with approximately two thirds of the watershed administered by the Mt. Hood National Forest (Clackamas River Ranger Districts) and one section administered by the Bureau of Land Management. An estimated one quarter is owned by Longview Fiber Corporation and a short section of Boyer Creek is owned by Portland General Electric.

"In general, landforms are stable and the watershed experienced only minor damage from the 1996 flood."

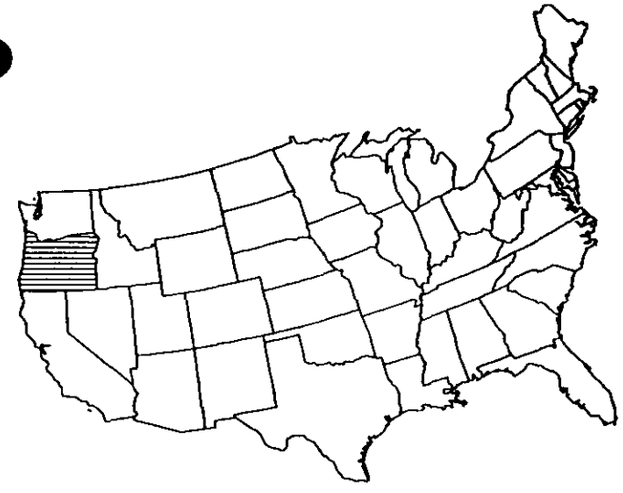
The watershed is approximately 30,000 acres in size and is bisected by the North Fork River which flows westward to the Clackamas River. (Map 1-2) Elevations range from 4,770 feet at Squaw Mountain on the eastern perimeter of the watershed to 660 feet at the confluence of the North Fork River with the slackwater of the North Fork Reservoir. The terrain ranges from steeply incised valley walls in the western third of the watershed to less incised, moderate to gently sloping ridges and drainages in the eastern two-thirds of the watershed. In general, landforms are stable and the watershed experienced only minor damage from the 1996 flood. The most notable landform in the watershed is Ladee Flats, a flat topped ridge formed when lava flows filled an old valley. The old valley walls have since been removed by fluvial erosion, leaving the resistant lava flows on the present day ridgetop. The river valley of the North Fork is narrow and steep and a waterfall two and a half miles from the confluence limits the passage of anadromous fish. Anadromous fish are confined to BLM and private lands. Below the falls, the river is home to native winter steelhead, spring chinook, coho salmon, summer steelhead and hatchery stocked rainbow trout. Above the falls, the river and tributaries are habitat for native rainbow and cutthroat trout. The North Fork River is eligible for designation as a Wild and Scenic River because of its free-flowing nature and the presence of late winter run coho salmon.

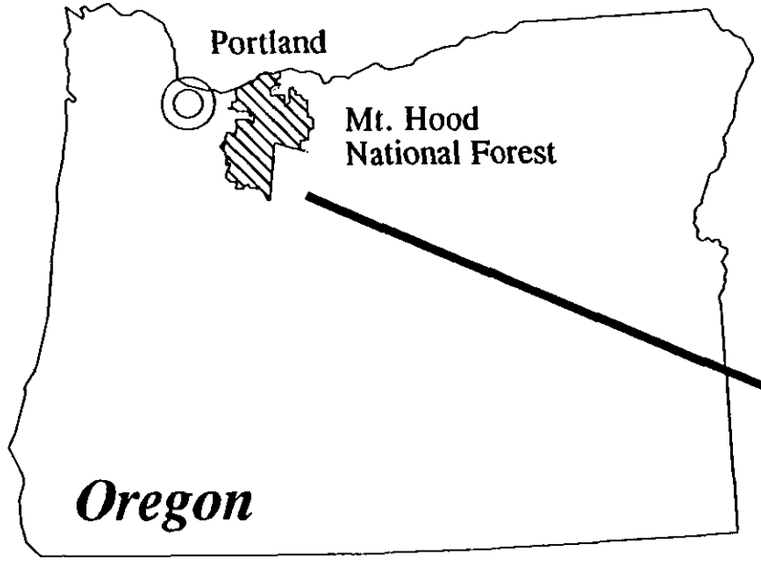
The watershed is dominated by mid seral forests of Douglas-fir and western hemlock in the western half, Pacific silver fir forests in the eastern half, and a minor amount of mountain hemlock on the eastern border. The area is relatively unfragmented mid seral forest with less than 15% of the watershed's forest in late seral condition. Elk and deer herds occupy the watershed as well as one known resident single northern spotted owl. Few special habitats like wetlands, meadows, lakes, cliffs, or rock/talus areas exist in the watershed compared to the rest of the Clackamas River drainage. Mid seral forests are also dominant within the riparian areas of the watershed which has resulted in a lack of late seral structure, such as large woody debris, important to aquatic habitat.

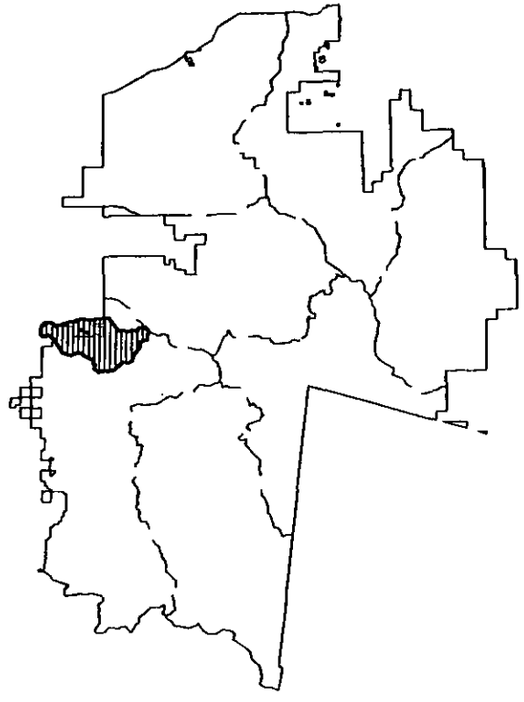
The predominant quantity of mid seral forest in the watershed is evidence of the history and continuing human use of the landscape. Although the forested landscape visible today is less than a century old, human use of the watershed precedes the comparatively recent Euroamerican settlement. Aboriginal use in the North Fork watershed probably followed the pattern of use in the Clackamas River drainage and was of a seasonal and short term nature. Human occupancy of the Western Cascades dates back as far as approximately 9,000 years ago and this environment still provides habitat for game, fish, and plant foods and the ridges and river valley still serve as primary travel routes. Several small scattered archaeological sites and one major site near Lookout Springs are a testament to the watershed's long human history.

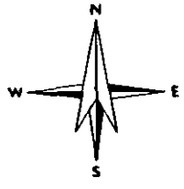
Settlement of the Clackamas drainage was limited by

VICINITY MAP







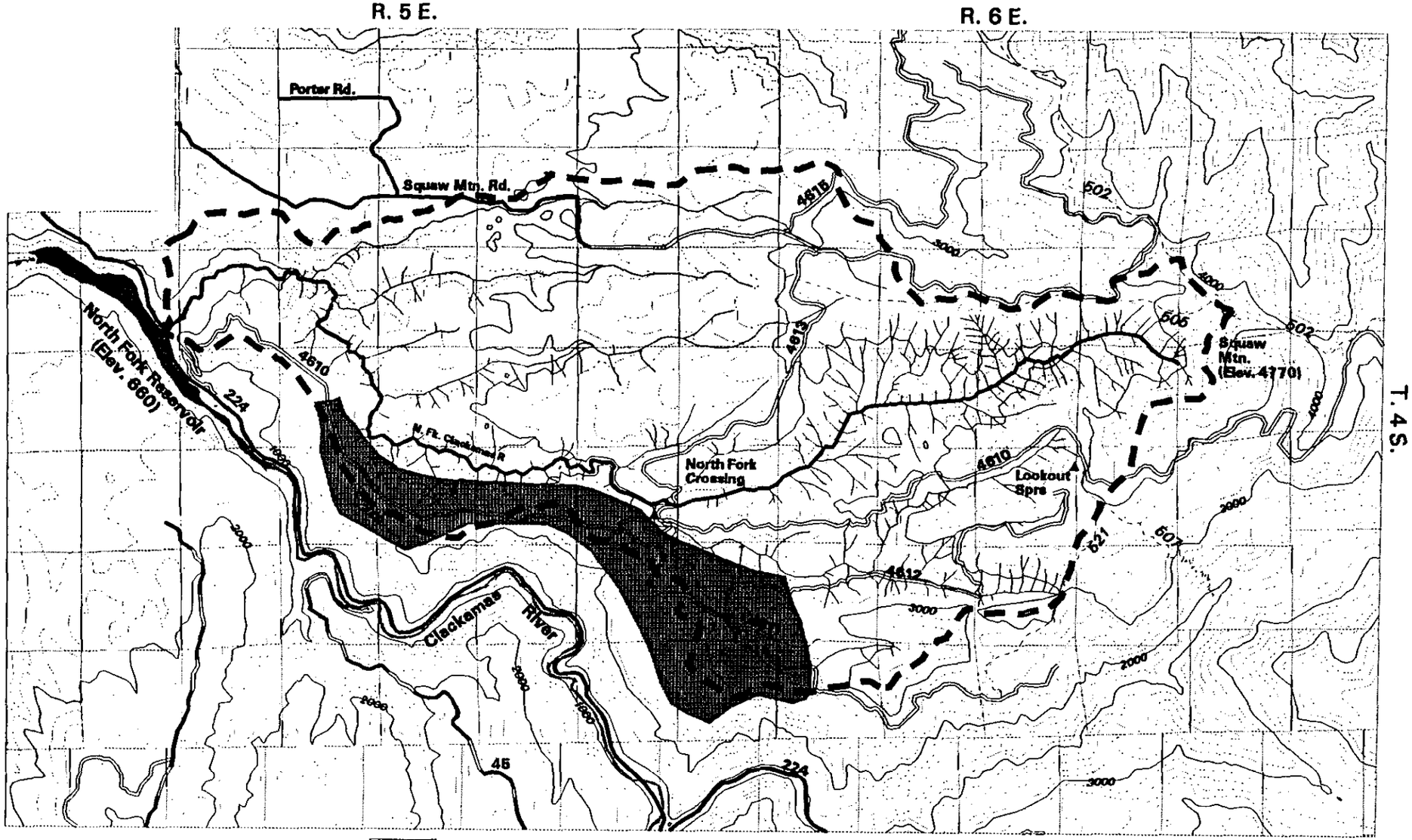


Legend

North Fork
Clackamas River

MAP 1-1

North Fork Clackamas River Watershed



Private Land Ownership

Single Lane Paved

Gravel, Suitable For Passenger

Double Lane Paved

Dispersed Camping Area

Trail

La Dee Flat

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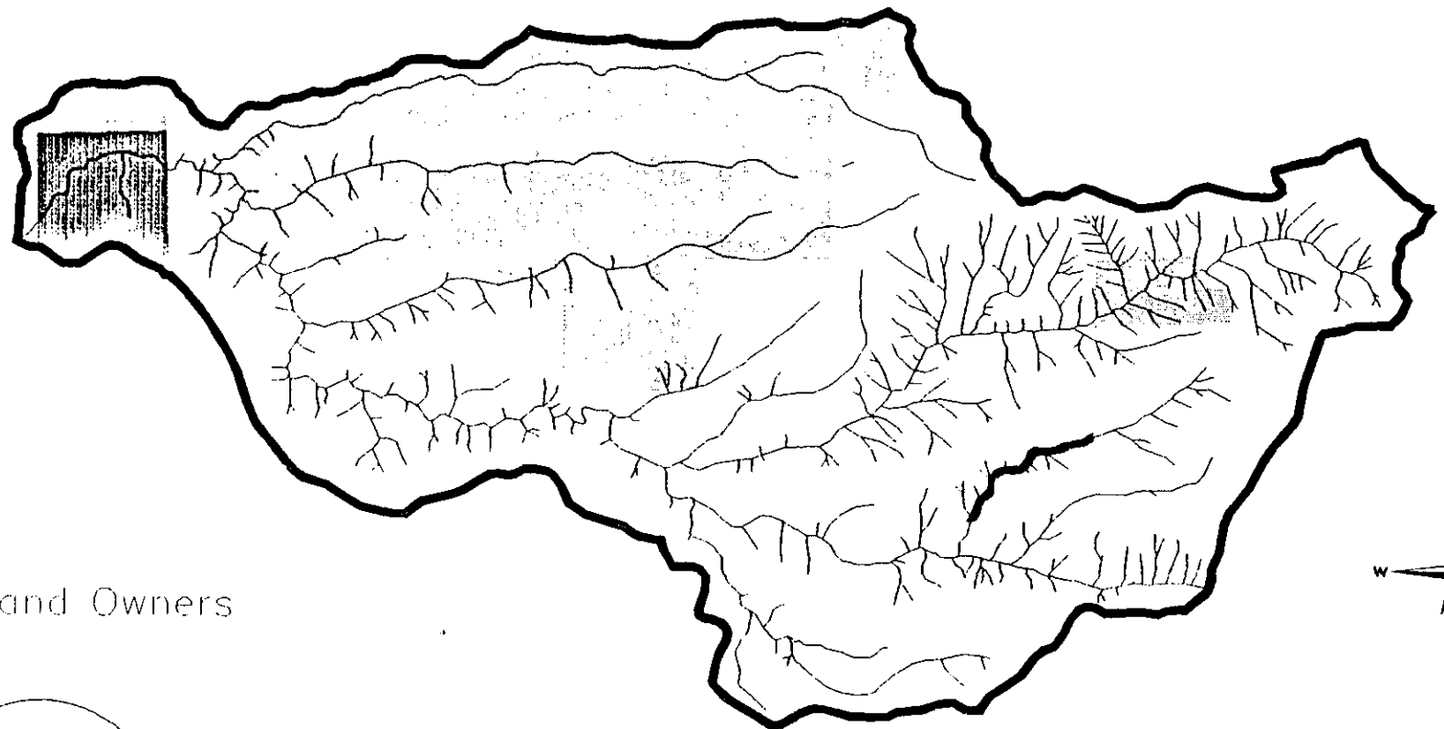
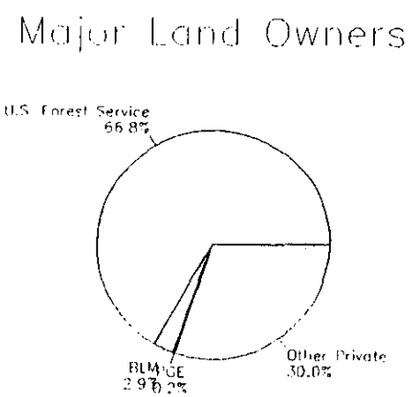
MAP 1-2

North Fork Clackamas River Watershed
Major Land Ownership





BLM
U.S. Forest Service
Other Private
PGE

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MILES

MAP 1-3

steep terrain until the 1890's but the North Fork watershed was one of the earliest settled due to the watershed's accessibility, proximity to the foothill settlements, and low elevation. At the turn of the 19th century, North Fork watershed had several homesteads, trails and wagon roads, and was used for sheep and cattle grazing. Grazing began to disappear from the drainage in the 1930's when prime pasture land became overgrown but the last range allotment in North Fork watershed ended in 1986. Today there are still remanent wire fence lines, corrals, and livestock chutes in the watershed.

It wasn't until around 1920 that logging began as a major land use in the watershed and Ladee Flat is named after the Ladee Logging Company which began full scale logging operations at that site. Extension of a railroad line into the Clackamas drainage to serve hydroelectric development also served to transport logs from LaDee Flat to Cazadero. The railroad bed of a logging railroad which accessed the watershed from the Clackamas to the break of Roaring River is still evident along with other historic logging artifacts. Logging continued regularly on Ladee Flat until 1929 when a stand replacement fire swept through the watershed. Although salvage logging occurred after the fire, Ladee Flat was transferred to the Forest Service in 1934 in part settlement for a fire trespass. The intensity of this fire, coupled with salvage logging resulted in the existing mid seral forest present today in North Fork watershed.

"...a high incidence of illegal and/or anti-social activities like assaults, garbage dumping, underage drinking, and homeless camping is present..."

Under Forest Service administration, trails, fire lookouts at Bedford Point and Squaw Mountain, guard stations, and Lookout Springs Campground built by the Civilian Conservation Corp, were constructed in the watershed, although only traces of these developments remain. Today the watershed receives high use from the public although no developed recreation facilities currently exist and access to the river is limited by terrain. Due to the terrain, proximity, and low elevation, the area receives year round use and serves as a primary entrance to the National Forest. There are no developed facilities but dispersed camping occurs at Lookout Springs, North Fork Crossing and most roads and timbersale landings throughout the watershed. Off highway vehicle use, target shooting, hunting, fishing, hiking, equestrian use driving for pleasure, and dispersed camping are popular recreation activities. In addition a high incidence of illegal and/or anti-social activities like assaults, garbage dumping, underage drinking, and homeless camping is present due, in part, to the watershed's close proximity and easy access to the Portland urban area.

MANAGEMENT DIRECTION AND LAND ALLOCATIONS

The Mt. Hood National Forest Land and Resource Management Plan (Mt. Hood Forest Plan) of 1991 and the Bureau of Land Management (BLM) Resource Management Plan/Final Environmental Impact Statement (RMP/FEIS), both amended by the Northwest Forest Plan of 1994, provides management direction for federal lands within the North Fork Clackamas River watershed.

The Northwest Forest Plan Record of Decision (ROD, page 12) has specific direction about amending existing land management plans for both National Forests and BLM. The ROD direction supersedes Forest Plan allocations that are in conflict with, or are less restrictive than management direction in the Northwest Forest Plan.

Table 1-1 displays each of the Mt. Food Forest Plan and BLM's RMP land allocations, along with the acreage. The groups of land allocation are intended to lump similar management direction to allow comparison between the two plans (refer to Map 1-4). Overlapping land allocations are present in both plans. For instance, General Riparian and Trail Viewshed (refer to Map 2-16) overlays the Timber Emphasis allocation.

Table 1-1. North Fork Clackamas River Watershed Land Allocation Acreage from the Mt. Hood Forest Plan, BLM RMP and the Northwest Forest Plan.

Mt. Hood Forest Plan	Acres	Northwest Forest Plan	Acres
B5 - Pileated Woodpecker /Pine Marten C1 - Timber Emphasis	1148 12129	BLM Matrix Forest Service Matrix	603 13789
B7 - General Riparian A9 - Key Site Riparian	* 511	BLM Riparian Reserves FS Riparian Reserves	157 4385
B1- FS Eligible Wild & Scenic River B1- BLM Eligible Wild & Scenic River	3110 371	Designated Wild & Scenic Rivers	
Trail Viewshed	761		
		LSRs (mapped and Unmapped)	100

*B7 General Riparian is an unmapped Mt. Hood Forest Plan land allocation, and may be superseded by the Northwest Forest Plan Riparian Reserve direction. Many allocations overlap and the sum acres may be misleading.

Mt. Hood Forest Plan

C1: Timber Emphasis

Goal: Provide lumber, wood fiber, and other products on a regulated basis, based on the capability and suitability of the land. A secondary goal is to enhance other resource uses and values that are compatible with timber production such as deer and elk habitat..

B5: Pileated Woodpecker/Pine Marten Habitat Area

Goal: Provide Forestwide mature or old growth forest habitat blocks of sufficient quality, quantity, and distribution to sustain viable populations of pine marten and pileated woodpecker. A secondary goal is to maintain a healthy forest condition through a variety of timber management practices.

B7: General Riparian Area

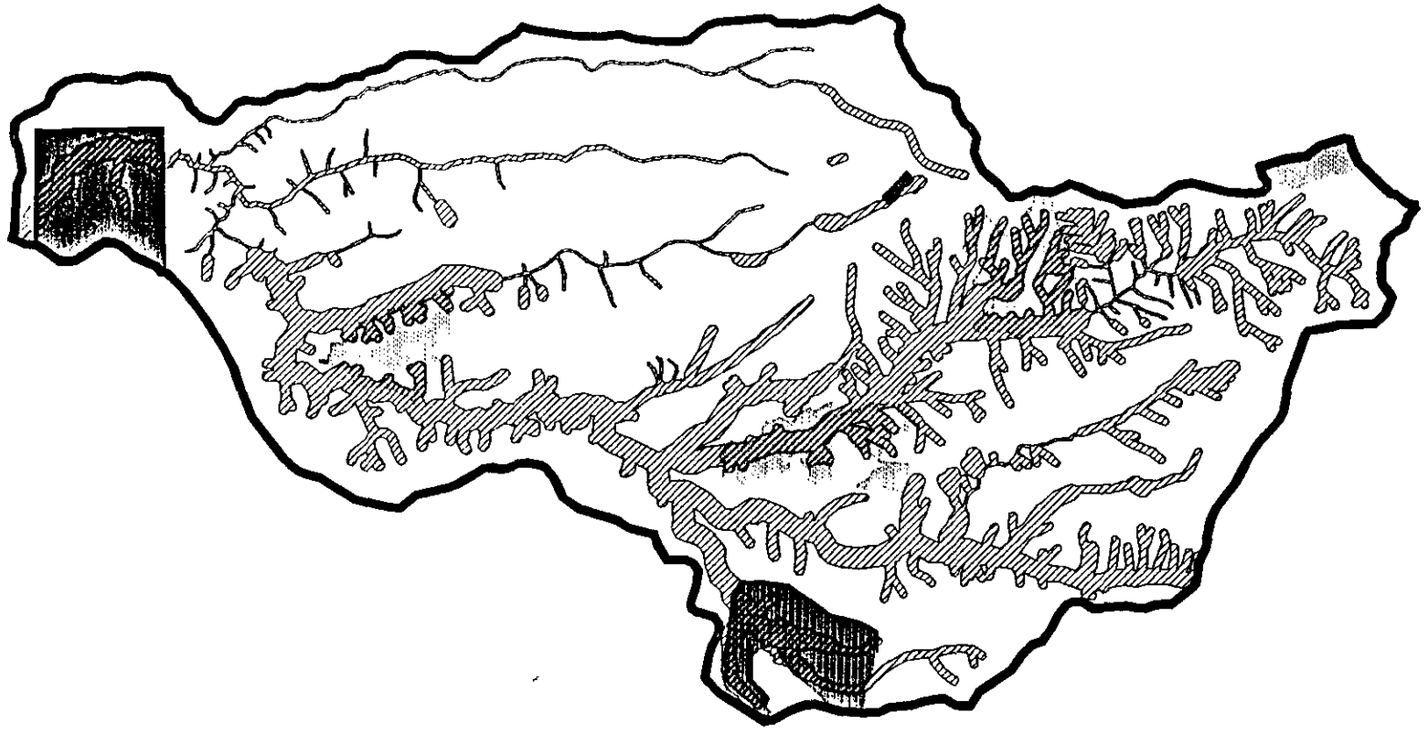
Goal: Achieve and maintain riparian and aquatic habitat conditions for the sustained, long term production of fish, selected wildlife and plant species, and high quality water for the full spectrum of the forest's riparian and aquatic areas. A secondary goal is to maintain a healthy forest condition through a variety of timber management practices.

Eligible Wild and Scenic Rivers

The North Fork Clackamas River is eligible for designation by Congress as a Wild and Scenic river. Management activities should be designed to protect

North Fork Clackamas River Watershed

Land Use Allocations



Key Site Riparian Area (A9)

Woodpecker/Marten Habitat Area (B5)

Timber Emphasis (C1)

General Forest Management (BLM)

Riparian Reserve

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MAP 1-4

the free flowing nature and outstandingly remarkable values until the river is designated or released from consideration. In addition to this, the State of Oregon has designated the North Fork Clackamas River a State Scenic Waterway. The State Scenic Waterways Act requires that the State Land Board approve any alteration of the bed and/or bank of the scenic river or wetlands within the scenic waterway, regardless of the amount of material involved.

Trail Viewshed

Goal: Maintain the scenic quality with a diversity of tree and shrub species of various sizes and ages, distributed in natural appearing patterns. Natural appearing openings may occur to enhance views to landscape features.

Northwest Forest Plan

Riparian Reserves

Goal: Achieve and maintain riparian and aquatic habitat conditions for the sustained, long term production of fish, selected wildlife and plant species, and high quality water for the full spectrum of the forest's riparian and aquatic areas. A secondary goal is to provide habitat connection for late-successional species and dispersal habitat for other terrestrial species.

Matrix

Goal: Provide lumber, wood fiber, and other products on a regulated basis, based on the capability and suitability of the land. The intent is to retain some late seral habitat components (minimum 15%) to facilitate species flow. A secondary goal is to function as connectivity between Late-Successional Reserves (LSR) and to provide habitat for a variety of organisms associated with both late-successional and younger forests. This definition of Matrix is different from the landscape ecology definition of matrix.

CORE TOPICS AND KEY QUESTIONS

The primary issues in the North Fork watershed have been divided into two main areas. The first being those that focus the basic analysis of ecological conditions, processes, and interactions at work in the watershed -- the Core Topics. This is the basic analysis that is addressed in all watershed analyses and addresses the major elements and their relationships in the watershed. The second are those issues that are unique to the North Fork watershed, those that are key drivers of the system -- the Key Questions.

Core Topic Questions

Aquatic

Erosion Processes

What erosion processes are dominant within the watershed? Where have they occurred or are they likely to occur?

Hydrology

What are the dominant hydrologic characteristics (total discharge, peak flows, minimum flows) and other notable hydrologic features and processes in the watershed?

Stream Channel

What are the basic stream morphological characteristics and the general sediment transport and deposition processes in the watershed?

Water Quality

What beneficial uses dependent on aquatic resources occur in the watershed?

Aquatic Species and Habitats

What is the relative abundance and distribution of aquatic species that are important in the watershed? What is the distribution and character of their habitats?

Terrestrial

Vegetation

What is the array and landscape pattern of plant communities and seral stages in the watershed? What processes caused these patterns?

Species and Habitats

What is the relative abundance and distribution of terrestrial species of concern that are important in the watershed? What is the distribution and character of their habitats?

Social

Human Uses

What are the major human uses and where do they occur in the watershed?

Current and reference condition, and trends and causal relationships will be examined for each of the core topic areas (Chapter 2).

Key Questions

These questions were developed around the key issues for the watershed. They are the issues that are of primary concern, unique to the North Fork watershed.

Aquatic

How does the current and past condition of riparian areas effect the sediment regime of the watershed?

Terrestrial

What are the ecological and management implications of a watershed with a timber production emphasis and a predominance of mid seral habitat?

Social

What are the current and future implications and impacts of urban and rural use, such as off highway vehicle use, target shooting, garbage dumping, and dispersed recreation on the physical, biological, and social resources in high use areas of the watershed?

The answers to the Key Questions are presented in Chapter 4.

SUMMARY

Allocations

Most of the federal land in the North Fork watershed is Matrix land (under the Northwest Forest Plan) and in the C1 Timber Emphasis (Mt. Hood Forest Plan) or General Forest (Bureau of Land Management RMP) allocations. Thirty-two percent of federal land in North Fork is in Riparian Reserves. There are no Late-Successional Reserves (LSR), except for a 100 acre LSR for the single spotted owl location. There are no administratively withdrawn areas in North Fork, except for two A9 Key Site Riparian allocations. One of these A9 areas is completely encompassed by the Riparian Reserve network. The other, much larger Key Site Riparian area, in the Winslow subwatershed was determined to be predominantly dry, nonriparian habitat. The area affecting the aquatic resources is protected by the Riparian Reserves, and it is recommended that the A9 allocation be dropped through the Forest Plan amendment process. There are portions of four B5 Pileated Woodpecker/ Pine Marten allocations in the watershed. The North Fork watershed is largely surrounded by the LSR network in the Lower Clackamas watershed, Roaring River, and the Salmon-Huckleberry Wilderness. All existing late seral stands (11% of federal ownership) will be retained in the watershed, according to the Northwest Forest Plan. The B5 allocations in the watershed are not considered to be necessary for late-successional forest connectivity and it is recommended that they be dropped through the Forest Plan amendment process. There is also an eligible Wild and Scenic River in the watershed.

Aquatic

The North Fork watershed is not a watershed plagued by instability. The landform types with the highest potential for sediment delivery are: Resistant Rock-Steep Slopes, Intermediate Rock-Steep Slopes, Weak Rock-Steep Slopes, and Quaternary Landslide Deposits. Approximately 21 miles of the 112 total miles of road in the watershed have the likelihood of delivering sediment to streams. Thirty-three percent of the modeled potential sediment delivery from roads occurs in the Boyer Creek subwatershed. (See Map 2-2 for subwatershed boundaries.) Approximately 30% of the total modeled potential sediment delivery from a combination of both roads and recent harvest units occurs in the upper North Fork subwatershed. All subwatersheds are currently above the Mt. Hood Forest Plan Aggregate Recovery Percentage (ARP) standards. Bee Creek, the subwatershed with the lowest ARP value, is predominantly in private ownership. Very little damage occurred in the North Fork watershed during the February 1996 100-year flood event, during which other portions of the Clackamas subbasin received extensive damage.

The North Fork watershed contains 5.4 miles of anadromous streams, 32 miles of resident fish bearing streams, and 77 miles of non-fish bearing streams. A 50 foot falls at river mile 2.4 of the North Fork Clackamas River, above the confluence with Bee Creek, is a migration barrier for anadromous fish. Steelhead juveniles, adults, and redds occur in the mainstem of North Fork up to the barrier falls. North Fork is an important spawning area for late run coho. Currently, the Riparian Reserves in North Fork are composed of 80% mid seral, 8% early seral and 12% late seral stands. Winslow, Boyer, and the lower reach of Bedford Creek currently have no primary pool habitat. This suggests that the streams lack the adequate organic input, such as large wood, for structures that help create these pools. Boyer Creek has the highest percentage of riparian deciduous vegetation of any of the subwatersheds, with red alder stands comprising 31% of the Riparian Reserves. Sedimentation is high in Boyer Creek, with portions of road 4612 being a potentially high sediment concern. Portions of roads 4611 and 4611-140, in the Winslow subwatershed, are potential high sediment producers to Winslow Creek. Stream temperatures in North Fork are higher than in neighboring Roaring River (an

unimpacted watershed) but below the biological threshold for salmonids (20 degrees C to 23 degrees C).

Terrestrial

The North Fork watershed experienced a succession of large, stand replacement fires in the early 1900's, creating the large amount of mid seral habitat seen in the watershed today. Currently, 15% of the total North Fork watershed is in an early seral condition, 77% in mid seral, and 8% in late seral. The Northwest Forest Plan requires that all remaining late-successional stands should be retained in fifth field watersheds in which 15% or less of the federal land is late-successional forest. Eleven percent of federal lands in the watershed are currently classified as late-successional habitat and will, therefore, be retained until the Riparian Reserves reach a late seral condition. The intensity of the fires in the watershed, coupled with salvage logging afterward, left very few remnant structures (trees, snags, down logs), especially in the western portion of the watershed. The watershed is currently lacking large snags and down woody debris. There is believed to be an adequate supply of small snags in many portions of the watershed. The Ladee Flats area is considered an area of concern for *Phellinus weirii*. Douglas-fir bark beetle outbreaks are of potential concern because of the large tracts of uniform Douglas-fir stands. Windthrow has not been a concern recently, but risk will increase as trees grown in dense stand conditions grow older and more susceptible to wind damage.

Northern bald eagle, red-legged frog, Cope's giant salamander, and northern spotted owl are all T, E, and S wildlife species known to occur in the watershed. Although little bald eagle nesting habitat exists in North Fork, there is a Bald Eagle Recovery Area within 2 miles of the watershed. There is one resident single northern spotted owl in the watershed and it is currently not at a level of incidental take. There is currently no primary habitat for red tree vole (a Survey and Manage species) within the watershed. The North Fork watershed contains very few special habitat areas. There are only four wet meadows and 163 acres of rock and talus habitat, much less than in most watersheds in the subbasin. The rock and talus areas of the North Fork watershed do not meet the preferred habitat conditions of the Larch mountain salamander (a Survey and Manage species). There are 8,456 acres of Inventoried Deer and Elk Winter Range in the watershed. There is currently a lack of forage and optimal cover for deer and elk. The North Fork drainage includes habitat for two species of Sensitive plants, *Corydalis aquae-gelidae* and *Huperzia occidentalis*, both are found growing in or adjacent to seeps, springs, and streams. The meadow in the Boyer Creek subwatershed is of particular concern for noxious weeds.

Social

Recreation features in the North Fork watershed include two abandoned Forest Service campgrounds, approximately seven miles of trails (including all three of the trails in the Clackamas river drainage that are legal for motorized use), access to recreation destinations outside of the watershed, and an eligible Wild and Scenic River. Although no developed facilities like managed campgrounds exist in the watershed, it serves as a recreation destination for campers, off highway vehicle (OHV) users, target shooters, and hunters. Proximity, access, and low level of management presence have also contributed to illegal and anti-social behavior such as garbage dumping, indiscriminate target shooting, underage drinking, assaults, stolen vehicle dumping, and special forest products theft, especially firewood theft.

Dispersed camping in the watershed occurs primarily at North Fork Crossing, located within the Riparian Reserve. The site shows signs of devegetation, compaction, and erosion. The Ladee Flats area has been the focus of unmanaged OHV use, target shooting (causing a high incidence of tree mortality), and garbage dumping in the past. Garbage dumping and unmanaged OHV use are closely associated with the devegetated corridors created by target shooting. The dumping of household garbage is concentrated in

Ladee Flats, but occurs throughout the watershed wherever roaded access is available. Indiscriminate shooting and vandalism occur in all roaded portions of the watershed. A consequence of the corridors created by the shooting ranges and spur roads from timber sales has been an increase in unmanaged OHV use. This use is focused on Ladee Flats because the flat grade allows ease of off road access. This use is not sanctioned by OHV clubs and does not serve the need for a managed OHV trail system. Hunting for deer and elk is a popular activity in the watershed, with a minor amount of hunting for bear and grouse also occurring. Poaching is estimated to be higher than normal for the Clackamas drainage.

Future Management

Over the next 20 years timber management in the North Fork watershed will focus on the thinning and intermediate harvest and intermediate harvest of mid seral stands, with an emphasis on promoting stand growth and windfirmness in Matrix areas and on late seral structure in Riparian Reserves. Due to the limited amount of existing late seral stands in the watershed and current stand conditions, opportunities for regeneration harvest over the next few decades are limited, except in root disease pockets. Riparian Reserve widths based on site potential tree heights, as described in the ROD, were determined to be adequate for the North Fork watershed. No mapped unstable or potentially unstable areas were identified to include in the Riparian Reserve system. Some areas with inherently unstable geologic conditions were identified to merit field verification during project level planning, and to be added to the Riparian Reserve system when appropriate.

The large stand replacement fires that occurred in the watershed during the early 1900's have created a predominance of uniform mid seral habitat in both riparian and up slope areas. The streams in the watershed are currently lacking large woody debris and pool habitat, and there is little large wood recruitment potential in the Riparian Reserves for approximately 30 years. It is recommended that woody debris be added to streams throughout the watershed, although it may not be of an optimal size. Long term recruitment of large wood could be accomplished by thinning to promote late seral structure in Riparian Reserves, by thinning hardwoods to release conifers, and by planting western redcedar. Road restoration should focus on the identified potential high sediment production roads adjacent to Boyer, Winslow, and Whiskey Creeks.

There is very little late seral habitat in the North Fork watershed. The existing 11% late seral refugia will be retained until the Riparian Reserves reach a late seral condition. Over the long term, late seral habitat in the North Fork watershed would be found primarily in the Riparian Reserves, which comprise 32% of federal land in the watershed. Effects of the large amount of mid seral habitat in the watershed include a lack of habitat for species associated with late seral forest, a lack of both forage and optimal cover for deer and elk, and future risk of windthrow and bark beetle infestation.

The watershed is currently lacking large diameter snags, especially in the western portion. There appears to be an adequate number of small snags. It is recommended that mid seral stands be thinned to promote tree growth for long term future snag recruitment. Over the short term, smaller diameter snags should be created only when they are determined to be lacking on a site specific basis. The watershed is currently lacking down woody debris of all sizes and decomposition classes. It is recommended that standing trees be girdled to create down woody debris. Projects including the creation of wildlife structures should evaluate the risk to the existing stands based on factors conducive to Douglas-fir bark beetle. Potential risk resulting from the creation of bark beetle habitat through a combination of windthrow, *Phellinus weirii* pockets, and the creation of wildlife structures should be monitored. Thinning projects should be designed to increase deer and elk forage in the watershed.

Recreation use in the watershed and traffic through the watershed to other destinations is expected to increase as the population of Portland and surrounding

communities increases. Along with increased recreation use, it is expected that the anti-social and/or illegal activities occurring in the watershed now, will continue to increase.

Motorized recreation is a prevalent use within the North Fork watershed. The watershed provides an important setting for a motorized recreation experience which fosters self challenge, skill development, and independence, and which is in a limited supply in the Clackamas River drainage. The unmanaged OHV use on Ladee Flats, however, has resulted in negative effects on scenery and has discouraged organized OHV club and family use in the watershed. Effects of unmanaged OHV use have included localized soil compaction and sedimentation problems, impacted some wetland habitat, and potential deer and elk harassment. It is recommended that a managed OHV Use plan be developed for the North Fork watershed, and that an area closure be implemented which limits all OHV use to designated roads and trails.

Like OHV use, target shooting can offer a recreation experience of self challenge, skill development, and independence. Unmanaged and indiscriminate shooting in North Fork, however, has led to a concern for public safety and has discouraged other uses in the watershed. It is recommended that an Area Closure for all but hunting related shooting be implemented in the watershed.

Because most dispersed camping in the watershed does not occur in the riparian areas, effects to the Riparian Reserves are not as serious a concern as in other watersheds in the Clackamas River drainage. The largest site with the most potential for resource damage to aquatic resources is North Fork Crossing. Other sites located along 4610-150, 4612, 4611, and the homeless camp on BLM land near the river also have potential for resource damage in riparian areas. The elements of dispersed camping which have a negative effect on recreation use of the watershed includes homeless camps, theft, assaults (particularly at North Fork Crossing), underage drinking, driving under the influence of alcohol and drugs, and lack of sanitation. It is recommended that toilets be provided in high use dispersed camping sites, such as North Fork Crossing and Lookout Springs, and that permit-only camping be considered in these areas. Increased law enforcement is considered necessary to deal with illegal activities. North Fork Crossing should be managed to ensure compliance with the Aquatic Conservation Strategy.

Garbage dumping occurs along all system and nonsystem roads, on timber sale landings, and in rock pits within the watershed, but is concentrated in Ladee Flats. Continued aggressive cleanup measures are recommended, along with increased emphasis on public information.

PUBLIC WORKSHOP

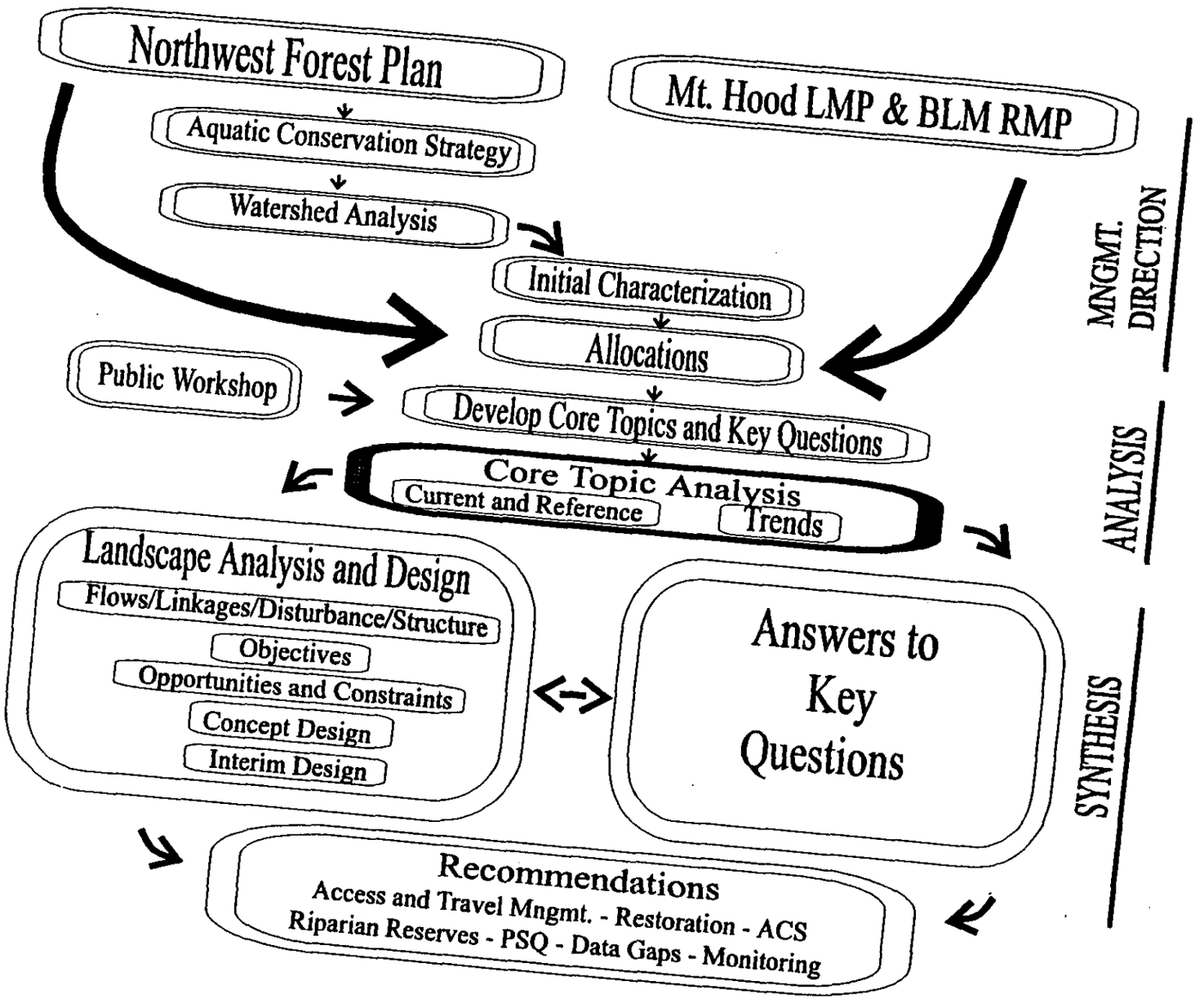
A public meeting was held on Friday, May 29 at the Estacada Senior Center. The topic of concern was the North Fork watershed analysis and the objective was to capture the questions and suggestions of those citizens present. Most are long time residents of the area who are quite familiar with the watershed. Some have been recreating or working in the waatershed for years. Their concerns and knowledge covered a wide range of topics but among the most popular were species sighting information, roads, fishing, and OHV use. The following is a summary of their comments, concerns, suggestions, and interesting facts about the watershed:

* Anadromous fish barrier on North Fork River
* Alder / devil's club riparian area in Lower North Fork subwatershed
* Lower stretch of the North Fork Clackamas River -- really pretty, white water cascades
* Old cattle allottment
* Identification of favorite hunting camps
* Question raised as to whether there were obstructions to fish on created ponds in private ownership
* Are there impassable culverts on private land?
* North Fork watershed is not a big recreational fishing watershed
* Some fishing opportunities in the lower part of the watershed for brook trout
* Easy access for fishing in first half mile of Boyer Creek
* Need managed OHV use
* Identified potential OHV routes in the watershed. Areas were identified that OHV clubs would like to adopt and work on.
* Lack of large and even small wood in streams throughout the watershed
* Lower part of the North Fork Clackamas River - small waterfalls and bedrock substrate
* Concern about closing roads in the watershed. Would like all roads to stay open for public access and salvage opportunities. Do not close roads without provable benefits.
* Reported past sightings of osprey, Harlequin duck, and ruffed grouse in the watershed
* Identified areas where cutthroat trout hve been caught in the watershed, and where steelhead smolts have been sighted
* Don't close the access road to Roaring River
* Identified areas of frequent elk sightings

The following is a list of those present at the meeting along with their given cities of residence:

Dan Guttridge, Estacada
Norman Goetz, Portland
Avis Rana, Oregon City
John Shoop, Estacada
Cole Gardiner, Portland
Gary Guttridge, Estacada
Joe E. Evans, Oregon City
Susan Hadson, Oregon City
Rod Klawitter, Estacada
Gordon McGhee, Clackamas
Douglas W. Smith, Estacada
Noel Hamel, Estacada
Jerry Myra, Oregon City
Chuck Steahly, Corbett
John Clark, Eagle Creek
Jon Clark, Eagle Creek
Leroy Layton, Estacada
Dan Herrick, Silverton

Chapter 2
Core Topic Analysis



Current and Reference Condition

A. Erosion Processes

Geology

The North Fork Clackamas River watershed is comprised of five geologic units which were identified during previous work (Hammond, et. al., 1982; Peck, et. al., 1964). A geologic base map for this watershed was compiled from both sources, with modifications based on topography. The units are briefly described below in their approximate order of occurrence, from youngest to oldest.

Qls Quaternary landslide deposits: Large ancient poorly sorted deposits of slumps and large debris flows and debris slides. Most are located on the steep valley side slopes in the western fourth of the watershed.

Qb Basalt lava flows: Young lava flows that cap the flat-topped ridge (known as Ladee Flats) that forms the southwest border of the watershed. The lava flows originated from a vent somewhere to the east and filled an old valley. The old valley walls have since been removed by fluvial erosion, leaving the resistant lava flows on the present day ridge top.

Tsf Sardine formation: Upper unit, pyroxene andesite lava flows and minor pyroclastics found mostly in the northeastern portion of the watershed. Includes the summit area of Squaw Mountain, an eroded volcanic vent that was one of the sources for the Sardine Formation, upper and lower units.

Tsa Sardine formation: Lower unit, andesitic lavas and indurated pyroclastics including abundant tuff breccias, lapilli tuff, and tuff; deeply weathered and found in a broad northwest to southeast band across the center of the watershed.

Tcr Columbia river basalt: A series of thick lava flows separated by thin interbeds that occurs in a small area near the confluences of Fall Creek and Bee Creek with the North Fork Clackamas River. This unit forms steep valley walls in that area.

The geologic units can be grouped into four general categories. The bedrock units are grouped according to their relative resistance to physical and chemical erosion.

Weak Rock: Tsa
Intermediate Rock: Tsf
Resistant Rock: Qb and Tcr
Quaternary Landslide Deposits: Qls

These four categories can be used with three slope classes to create ten general landform types, which are explained in the following section.

Geomorphology

The North Fork Clackamas River watershed consists of steeply incised valley walls in the western third of the watershed and less incised, moderately to gently sloping ridges and drainages in the eastern two-thirds of the watershed. Most of the watershed has been shaped by fluvial erosion, resulting in "v" shaped valley cross sections. Although no glacial deposits have been previously mapped in this watershed, the topography suggests that there are three small glacially modified cirques on the northern and western slopes of Squaw Mountain. Elsewhere elevations are below 4000 feet and unlikely to have supported the development of glaciers. The effects of glaciation in this watershed have been minor and have been ignored in the delineation of the landform types.

The watershed has been divided into ten landform types (Map 2-1) based on their susceptibility to landsliding, which is primarily a function of geology, slope angle, and in some cases, drainage density. These landforms are described below. Common slope angles are given for each landform type, but in each case, minor inclusions of slopes with higher or lower angles have been made.

Qls Quaternary landslide deposits: Occur in the western portion of the watershed. Slope angles range from 10% to 60%. All of these deposits are located within a weak bedrock unit or at a weak rock/resistant rock contact.

RRGS Resistant rock-gentle slopes: The resistant ridge top of Ladee Flats. Slopes range from 0% to 20%.

RRMS Resistant rock-moderate slopes: Forms some of the north-facing to east-facing upper valley walls of the North Fork Clackamas River and Winslow Creek. Slopes range from 21% to 50%.

RRSS Resistant rock-steep slopes: Rare in the watershed but occurs locally in four small areas along the main stem of the North Fork in the western half of the watershed. Slope angles exceed 50%.

IRGS Intermediate rock-gentle slopes: Found throughout the central and eastern portions of the watershed. Slope angles range from 0% to 30%.

IRMS Intermediate rock-moderate slopes: Also found in the central and eastern portions of the watershed. Slope angles range from 31% to 50%.

IRSS Intermediate rock-steep slopes: Found in small areas in the eastern portion of the watershed, primarily along the main stem drainage. Slope angles exceed 50%.

WRGS Weak rock-gentle slopes: This landform type has the largest area in this watershed. Occurs on the broad ridges between Fall Creek, Bee Creek, Bedford Creek, and the North Fork in the western half of the watershed and on the slopes near Boyer Creek in the eastern half of the watershed. Slopes range from 0% to 30%.

WRMS Weak rock-moderate slopes: Occurs on many of the valley sideslopes along the above listed drainages. Slopes range from 31% to 50%.

WRSS Weak rock-steep slopes: Found primarily in the western half of the watershed along some valley walls of the North Fork and the lower Fall and Bee Creek valleys. Slopes exceed 50%.

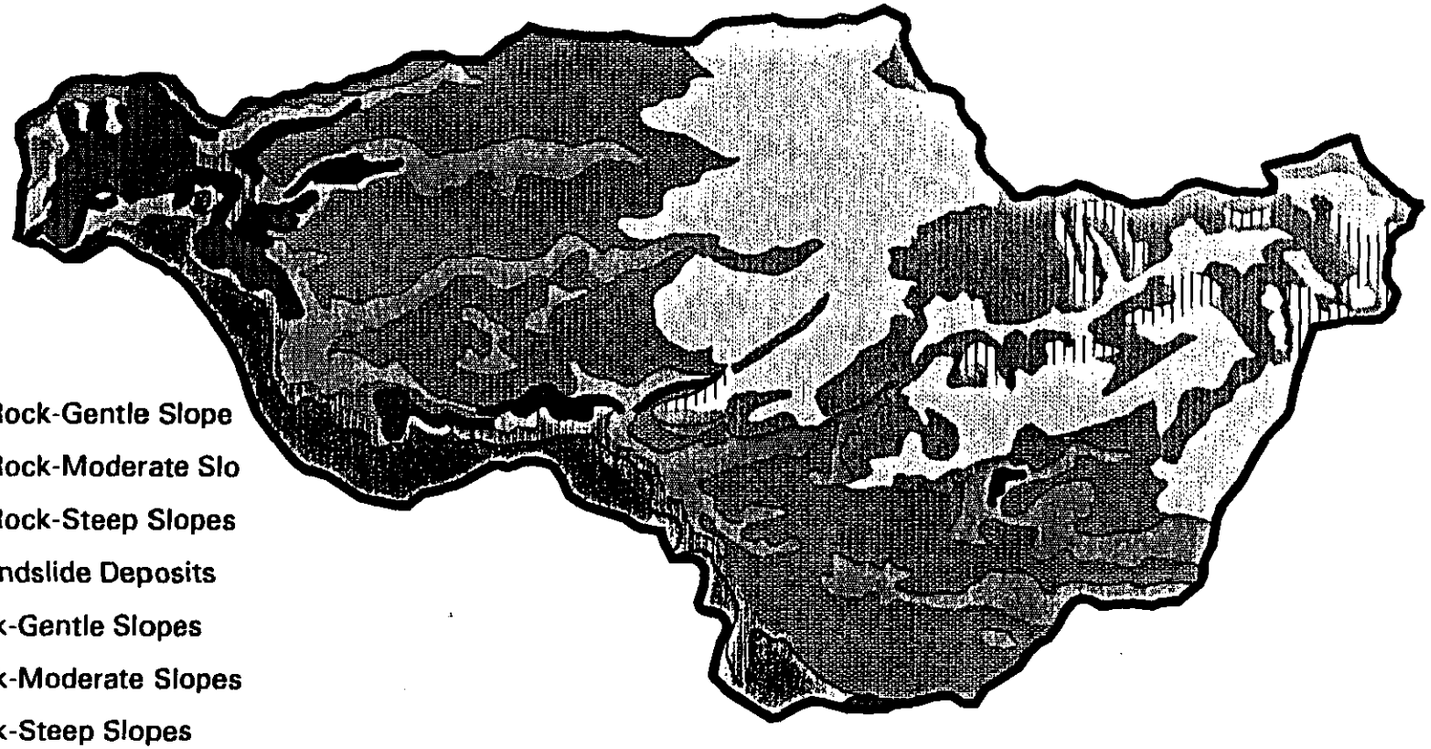
Landslides

In general, this is not a watershed plagued by instability. Problems are largely limited to the deeply incised drainages in the western third of the watershed, where slope angles exceed 50% and sometimes 70%; and within the large ancient landslide deposits (Qls), also in the western portion of the watershed. There are some areas of steeper slopes in the eastern portion of the watershed where the relative potential for landsliding is high.

"In general, this is not a watershed plagued by instability."

The landslide potential and relative sediment delivery ratings for the landform types are based largely on professional judgement and experience with similar landforms and are useful only when making broad, qualitative comparisons between landforms in this watershed; they are, by no means, definitive. If more specific comparisons are required (e.g., comparisons between landforms in other watersheds), a qualified geologist, geotechnical engineer, or geomorphologist should be consulted.

North Fork Clackamas River Watershed
Landform Type



- Intermediate Rock-Gentle Slope
- Intermediate Rock-Moderate Slo
- Intermediate Rock-Steep Slopes
- Quaternary Landslide Deposits
- Resistant Rock-Gentle Slopes
- Resistant Rock-Moderate Slopes
- Resistant Rock-Steep Slopes
- Water
- Weak Rock-Gentle Slopes
- Weak Rock-Moderate Slopes
- Weak Rock-Steep Slopes
- High Risk Landforms

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MAP 2-1

Table 2-1 shows the relative landslide potential for each landform type. It essentially represents a landform's propensity for unqualified slope failure. Table 2-2 shows the types of mass wasting and erosion processes that are likely to occur on a particular landform. The ratings are between landform types and not the other sediment transport processes shown in the table. For example, it is valid to conclude from the table that debris flows are less likely to occur on the landform type RRMS than on type RRSS; in contrast, it is not valid to conclude that within landform type RRSS, the occurrence of debris flows is equivalent to that of debris slides and rockfall. Table 2-3 lists each landform type and its relative sediment delivery rating for mass wasting. It refers to the probability of sediment reaching a stream as a result of a given landslide. It is worth noting that landslide potential and relative sediment delivery are not necessarily equivalent because of variations in the delivery capability of certain landslides (e.g., debris flow vs. debris slide) and the proximity of the event to streams (drainage density).

Table 2-1. Landslide Potential by Landform Type.

LANDFORM TYPE	SYMBOL	RATING	ACRES
Quaternary Landslide Deposits	Qls	H	701.86
Resstant Rock - Gentle Slopes	RRGS	L	1403.78
Resistant Rock - Moderate Slopes	RRMS	M	397.69
Resistant Rock - Steep Slopes	RRSS	H	130.36
Intermediate Rock - Gentle Slopes	IRGS	L	5076.90
Intermediate Rock - Moderate Slopes	IRMS	M	2646.08
Intermediate Rock - Steep Slopes	IRSS	H	511.80
Weak Rock - Gentle Slopes	WRGS	L	6181.61
Weak Rock - Moderate Slopes	WRMS	M	3011.46
Weak Rock - Steep Slopes	WRSS	H	564.70

Note: Rating scale is H = high, M = moderate, L = low, n/a = not applicable.

"The landform types with the highest potential for sediment delivery are : Qls, RRSS, IRSS, WRSS."

Table 2-2. Dominant Sediment Transport Processes by Landform Type.

	Debris Flow	Debris Slide	Earth-flow	Slump	Creep	Rock-fall	Surface Erosion	Stream Bank Failures
Qls	H	H	M	H	H	n/a	H	H
RRGS	n/a	L	L	L	L	n/a	L	L
RRMS	M	L	L	L	M	n/a	M	M
RRSS	H	H	n/a	L	M	H	H	H
IRGS	L	L	L	M	L	n/a	L	L
IRMS	M	M	M	M	M	n/a	M	H
IRSS	H	H	L	M	M	M	H	H
WRGS	L	L	M	M	L	n/a	L	L
WRMS	M	M	M	M	M	n/a	M	M
WRSS	H	H	L	H	H	M	H	H

Note: Rating scale is H = high, M = moderate, L = low, n/a = not applicable.

Table 2-3. Relative Sediment Delivery by Landform Type*.

LANDFORM TYPE	SYMBOL	RATING
Quaternary Landslide Deposits	Qls	M
Resistant Rock - Gentle Slopes	RRGS	L
Resistant Rock - Moderate Slopes	RRMS	M
Resistant Rock - Steep Slopes	RRSS	H
Intermediate Rock - Gentle Slopes	IRGS	L
Intermediate Rock - Moderate Slopes	IRMS	M
Intermediate Rock - Steep Slopes	IRSS	H
Weak Rock - Gentle Slopes	WRGS	M
Weak Rock - Moderate Slopes	WRMS	M
Weak Rock - Steep Slopes	WRSS	H

*Sediment delivery via stream-bank failures is not considered in this table. Rather, it refers only to sediment delivered by debris flows, debris slides, earthflows, slumps, creep, surface erosion and rockfall.
Note: Rating scale is H = high, M = moderate, L = low, n/a = not applicable.

Many landslides, particularly debris flows, are associated in other watersheds with the contact between the upper and lower members of the Sardine Formation (Tsf-Tsa contact). The arrangement of a more resistant rock unit overlying a less resistant rock unit is highly conducive to many types of landsliding, including debris flows, debris slides, slumps, rockfall, and even topple. This is especially true when the lower unit is more cohesive and less permeable than the upper unit.

The following geologic conditions within this watershed are inherently unstable and merit special attention during project planning and field investigations. Some of these areas are listed below.

* Contacts between weak and resistant rock. Changes in permeability at these contacts often result in springs

or shallow groundwater tables. Altering the groundwater conditions in these areas can trigger debris slides and debris flows. Important contacts include the following:

- Contacts between resistant rock and weak rock on steep to moderate slopes (RRSS-WRSS contacts and RRSS-WRMS contacts).

- Contacts between the upper and lower members of the Sardine Formation on steep and moderate slope (IRSS-WRSS and IRMS-WRMS contacts).

* Along the margins of dikes and sills. The heat associated with dike and sill emplacement tends to alter and weaken the adjacent rock making it more prone to mass wasting. Dikes and sills are not shown on the landform map.

* Along stream banks within the RRSS, IRSS, WRSS, and Qls landforms. Slumps, debris slides, and stream bank failures may occur next to down cutting or laterally-cutting streams.

* On slopes with gradients in excess of 60 % where shallow soils overlie less permeable materials. These conditions are most commonly met on landform types RRSS, IRSS, and WRSS. Areas meeting these conditions are prone to shallow failures.

* Along the margins of ancient landslides or earthflows. Changes in groundwater levels near these margins often trigger debris slides, debris flows, and slumps.

* On scarps of ancient landslides. These areas are steep, have shallow soils, and are prone to debris slides and debris flows. The scarps are not designated on the landform map.

* At the headlands of tributaries with steep gradients. Historically, many such areas have experienced debris flows, and those presently filled or filling with colluvium may fail with the slightest provocation. These conditions are most likely to be met within the RRSS, IRSS, and WRSS landform types.

* In the vicinity of fault zones on steep slopes. Increased fracturing and weathering in these areas decreases stability. Faults are not shown on the landform map.

There is some overlap among the geologic conditions listed above. The presence of these conditions does not automatically mean that the area is unstable, but it does mean that the area needs to be investigated carefully during project level planning.

Overall Soil Productivity

In this watershed there are 19,373 acres of soil types that possess moderate to high site productivity (as measured by Douglas-fir site class). The Soil Productivity Ratings are as follows:

Low = site class <4,
Moderate = site class 3-4,
High = site class >3

Low = 1,220 ac
Low to Mod. = 44 ac
Mod. = 12,657 ac
Mod. to High = 6,716 ac

These soil types occur on flats and slopes of the lower drainage. The soils that exist on the flats have excellent water holding capacities and high nutrient cycling ability which makes them highly productive. Seasonal and year-round high water tables are sometimes present on the flats and should be managed carefully.

Approximately 1,264 acres of soil types in the drainage exhibit low relative productivity. They are potentially screen 4 (Determination of Land Not Suitable for Timber Production, Daoust et al, 1984) soil types. This means that natural regeneration of these soil types may not adequately stock a young stand (USFS, R-6 stocking standards) within five years after complete

removal of an overstory stand by human or natural causes. Most of these soil types are very shallow and rocky. They exist on steep sideslopes and ridgetops that are interspersed with talus and rubble, primarily at elevations above 2,600' in the watershed.

Soil Erosion Potentials

Erosion potential of soils in the watershed is predominantly moderate:

Low	= 1,354 ac
Moderate	= 18,643 ac
High	= 640 ac

This is due to several factors. First, a large portion of the watershed has flat or gentle relief not conducive to high degrees of runoff. Secondly, many of these soils are deep and have a large water holding capacity, thus water tends to be stored rather than becoming runoff. However, where these soil types occur on slopes greater than 30% in the upper reaches of the watershed, they become very susceptible to erosion.

On slopes greater than 30%, Vegetation is key in providing protective cover for highly erosive soils. The Mt. Hood Forest Plan specifies target protective ground cover percentages for erosive soil types in an effort to safeguard them from accelerated erosion that could affect forest productivity, water quality, and aquatic habitat.

The condition of soil resources in the watershed has not been assessed. It is known that forest management activities ranging from timber harvest to recreational development, and wildfire, have affected soil resources on many acres to some degree. But to what extent is unknown and can be considered an information gap in this watershed analysis effort.

Sensitive Soil Types

Sensitive soils are those which have inherent properties (physical, biological, and chemical characteristics) that make them susceptible to detrimental soil impacts such as, but not limited to, compaction, accelerated erosion, and displacement. These disturbances have the potential to directly decrease forest productivity. The importance of identifying sensitive soil types is to alert forest managers where to exercise additional caution when implementing management activities on them.

Nine percent (1,903 ac.) of the watershed area is mantled with sensitive soil types. They are distributed primarily in the upper reaches of the watershed, existing on steep, rocky slopes, and ridgetops at elevations above 2600'. Most of the sensitive soils in the watershed are the "miscellaneous land types" as described in the Soil Resource Inventory. The remainder are soils derived from glacial deposits.

Land management activities on sensitive soil types should strive to limit detrimental soil impacts. Standards and Guidelines from the Mt. Hood Forest Plan and Best Management Practices (BMP's) for all activities on sensitive soils should be identified prior to project implementation to prevent and minimize negative impacts to site productivity (direct effects), water resources (indirect effects), and existing detrimental soil conditions (cumulative effects).

Sediment Delivery

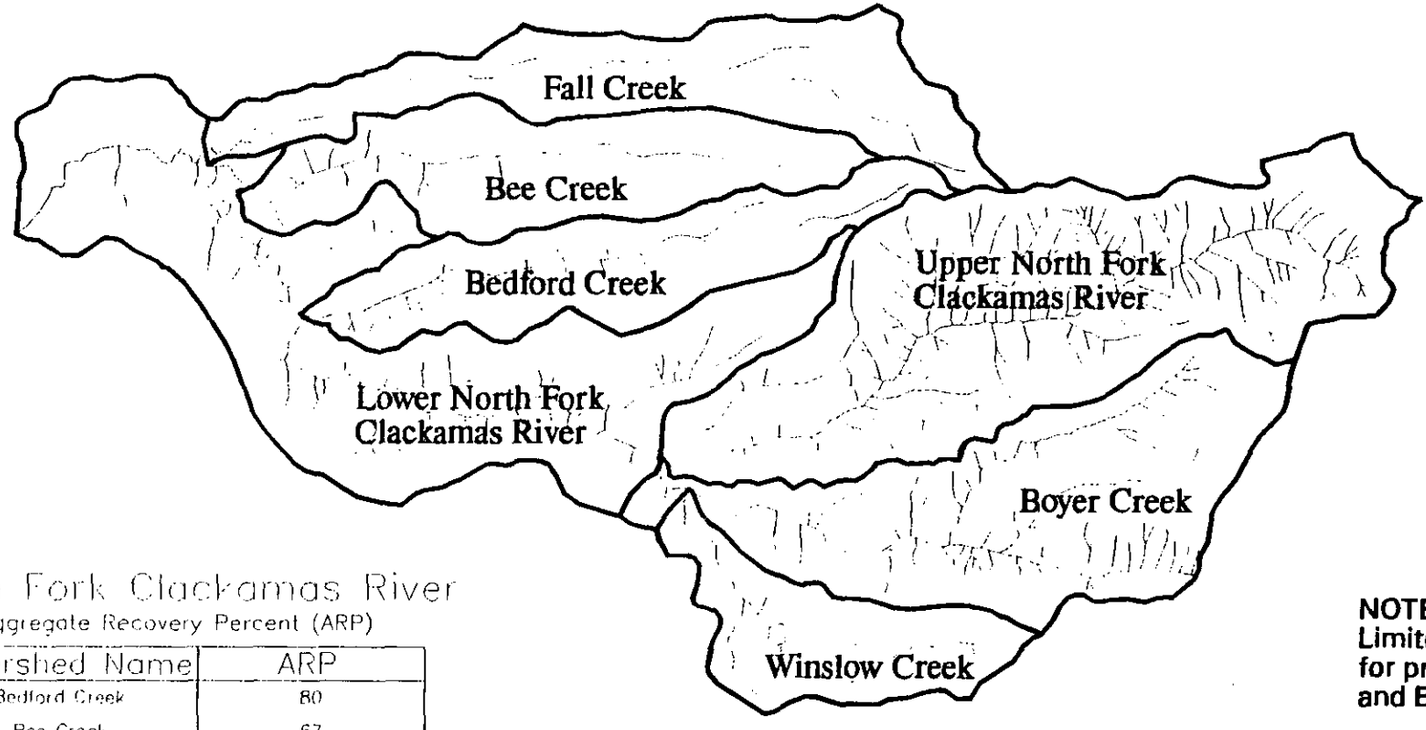
The North Fork watershed has been divided into seven subwatersheds, ranging in size from 1,131 acres to 4,926 acres (Map 2-2). The sediment delivery and hydrologic function analyses were stratified at the subwatershed level.

Historically, sediment delivery was more episodic than continual with high levels of delivery occurring during periods following recent large scale fires and floods. Causal agents for the sediment delivery were rain-on-snow events, floods or landslides. Currently, roads and timber harvest units also contribute to sediment delivery in North Fork.

Methodology for estimating sediment delivery to streams closely follows methods for evaluating surface erosion from hillslopes and roads described in the *Standard Methodology for Conducting Watershed*

North Fork Clackamas River Watershed

Subwatersheds and Streams



North Fork Clackamas River

Aggregate Recovery Percent (ARP)

Watershed Name	ARP
Bedford Creek	80
Bee Creek	67
Boyer Creek	87
Fall Creek	83
Lower North Fork Clackamas River	88
Upper North Fork Clackamas River	86
Winslow Creek	94

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NOTE:
Limited stream information for private land in Fall Creek and Bee Creek.

MAP 2-2

Analysis (Washington Forest Practices Board 1993). The objectives of the methodology as applied to North Fork are:

* To evaluate and document the relative potential for sediment delivery from roads.

* Evaluate consistency with the Aquatic Conservation Strategy Objectives (ACS).

* To prioritize activities and locations for restoration.

Natural or undisturbed rates of erosion for the landform types within the North Fork watershed are unknown. Swanson and Grant (1982) estimate average surface erosion rates for forested areas as .007 tons/acre/year. Therefore, surface erosion and sediment delivery estimated in the methodology used here could be considered as an increase due to recent management activities. Total vegetative recovery for surface erosion is assumed after five years for harvest units and road obliteration and revegetation.

Data limitations necessitated some alteration of analysis methodology from that described by the Washington Forest Practices Board. These departures retain the logic and assumptions of the original methodology. While this methodology is based on the current scientific understanding of forest management and watershed processes, its predicted outputs have not been evaluated on the Mt. Hood National Forest. The results should not be considered as exacting measures of potential sediment yield, but instead provide a framework for understanding relative effects of different management activities in the watershed and a comparison of sediment delivery rates among subwatersheds.

The modeled potential sediment delivery from roads and timber harvest units, by subwatershed are summarized in Table 2-4. Map 2-3 shows the road segments and harvest units with the highest potential to deliver sediment to streams.

Roads

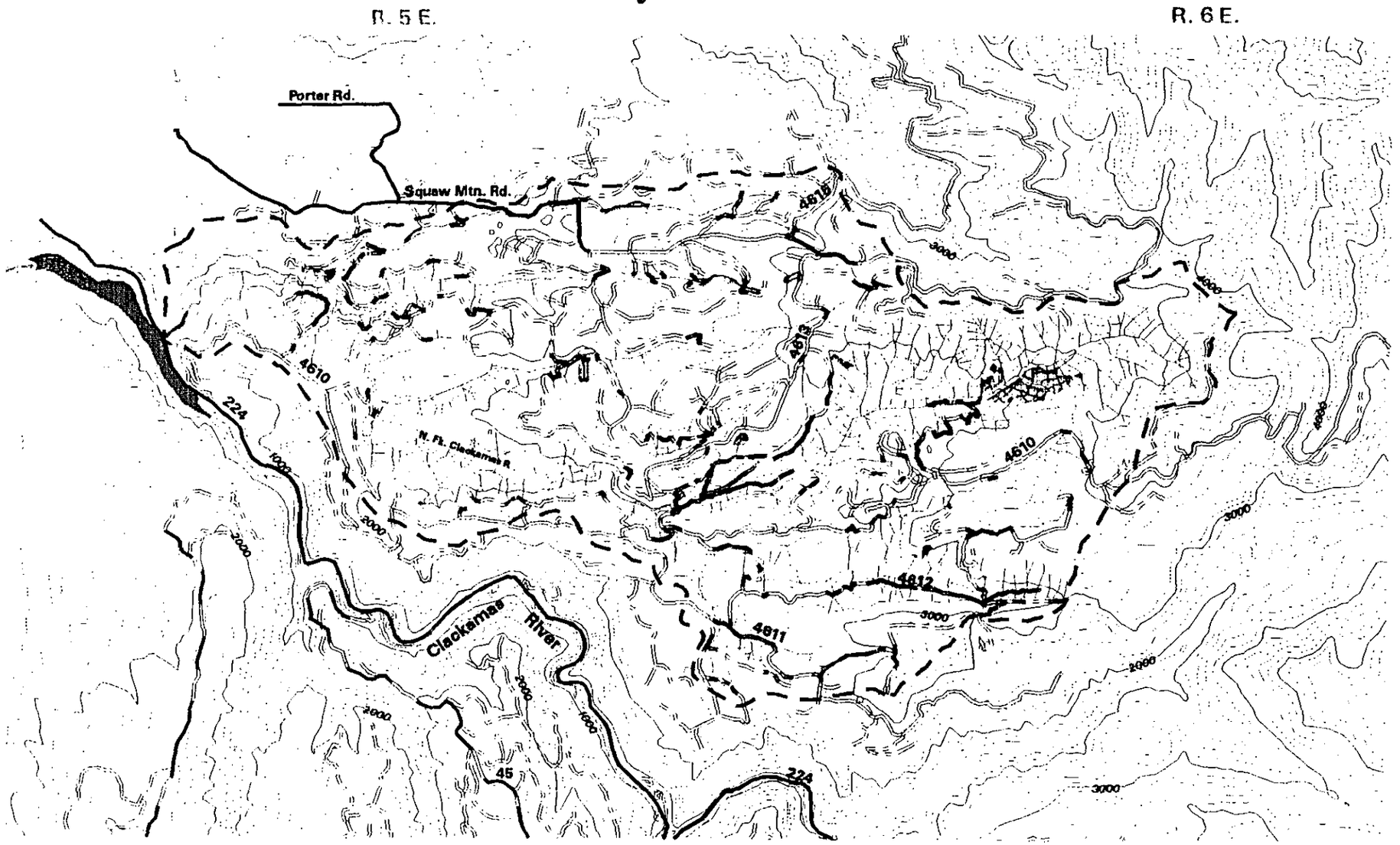
Roads may deliver chronic levels of sediment to streams over long periods of time from unvegetated cutslopes and running surfaces. Impacts to water quality occur when sediment is delivered directly to the stream system at road crossings where runoff accumulated in road ditch lines is diverted directly into streams. Roads that are located in close proximity to streams can also deliver sediment via overland flow to stream channels from culvert outflow. (Table 2-4.)

The assessment of erosion from roads focuses on the three main factors associated with the road prism: cutslopes, fillslope, and road surface. Sediment from roads was predicted using erosion rates based on landform type, area of the road, and road surface type. Of the potential sediment, 100% was assumed to be directly delivered to the stream for road segments within 300 feet of a road/stream crossing. Road segments within 200 feet of a stream running parallel to, but not crossing the stream, were assumed to deliver 10% of the potential sediment to the stream through overland flow.

Thirty-three percent of the potential sediment delivery from roads occurs in the Boyer Creek subwatershed. Bedford Creek, Bee Creek, and Fall Creek subwatersheds are likely to have more potential sediment delivery than is shown by the model, due to some information gaps on private land. We were lacking some secondary road information, and the location of driveways which could add to the potential sediment delivery. Information was also incomplete on private land for intermittent streams. Approximately 21 miles of the 112 miles of road in the North Fork have the likelihood of delivering sediment to streams.

North Fork Clackamas River Watershed

Modeled Sediment Delivery from Roads and Harvest Activities



High Harvest Sediment Delivery

Low Harvest Sediment Delivery

Mod Harvest Sediment Delivery

Single Lane Paved

Gravel, Suitable For Passenger Cars

Gravel, Suitable For High Clearance

Double Lane Paved

Extreme Road Sediment Delivery

High Road Sediment Delivery

Low Road Sediment Delivery

Mod Road Sediment Delivery

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MAP 2-3

Table 2-4. Potential sediment delivery from roads and timber harvest units.

NORTH FORK CLACKAMAS RIVER	ROADS				TIMBER HARVEST				TOTAL	
	Sediment Delivered		Road Length Delivering Sediment		Sediment Delivered		Area Delivering Sediment		Sediment Delivered From Roads & Harvest	
Subwatershed	Tons/yr.	% of Road Sediment	Miles	% of Road Length	Tons/yr	% of Harvest Sediment	Harvest Area Acres	% of Harvest Acres	Tons/yr.	% of Total Sediment
Bedford Creek	2.73	4%	1.05	5%	21.57	10%	27.46	11%	30.19	10%
Bee Creek	5.35	11%	2.05	10%	28.8	14%	39.71	15%	45.06	15%
Boyer Creek	16.80	33%	4.89	23%	5.64	3%	7.42	3%	24.22	8%
Fall Creek	5.92	12%	3.75	18%	32.61	15%	40.1	15%	46.02	15%
Lower North Fork Clackamas River	7.01	14%	2.43	12%		0%		0%	7.01	2%
Upper North Fork Clackamas River	7.54	15%	4.12	20%	122.04	58%	144.21	56%	151.75	49%
Winslow Creek	5.42	11%	2.72	13%		0%		0%	5.42	1%
Watershed Total	50.77	100%	21.01	100%	210.66	100%	258.9	100%	309.67	100%

"Approximately 49% of the total potential sediment delivery from roads and timber harvest occurs in the Upper North Fork subwatershed."

Timber Harvest

Areas harvested within the last five years that are within 300 feet of a stream were considered to have potential to deliver sediment to streams. Thinning units were not included in the model. The model looked at area of the harvest unit and landform type erosion rate.

Fifty-six percent of the potential sediment delivery from harvest units occurs in the Upper North Fork subwatershed. The model predicts no potential sediment delivery from harvest units in the Lower North Fork and Winslow Creek subwatersheds.

Approximately 49% of the total potential sediment delivery from roads and timber harvest occurs in the Upper North Fork subwatershed. The next highest subwatershed, for total potential sediment delivery, is Bee Creek and Fall Creek with 15%.

B. Hydrology

Table 2-5 displays several watershed parameters influencing hydrologic processes within each of the subwatersheds in the North Fork drainage. Parameters examined include road density, drainage density, channel network expansion, and hydrologic recovery.

"A 100-year flood event recently occurred in the Clackamas River subbasin, in February 1996. Portions of the subbasin received extensive flood damage. Very little damage occurred in the North Fork watershed."

Peak Flows

Peak flows are critical to watershed function. The relatively frequent peak flows (2-year to 25-year return period) are referred to as "channel forming" or "channel maintenance" flows, responsible for shaping the general character of stream channels, adjacent riparian areas, and associated habitats. The relatively infrequent (50-year to 100-year) peak flows are floods which generally transport and redistribute large quantities of sediment and debris, often causing damage to road infrastructure and dramatic changes to aquatic and riparian habitats.

A 100-year flood event recently occurred in the Clackamas River subbasin, in February 1996. Portions of the subbasin received extensive flood damage. Very little damage occurred in the North Fork watershed.

Transient Snow Zone

Flood events in the North Fork Clackamas River are similar to other documented floods in the Cascades. These peak flow events occur during the rainy season following a rapid and substantial depletion of snowpack during a prolonged rain-on-snow period in the "transient snow zone" (a zone of significant snowpack accumulation). This was demonstrated during the February 1996 flood event. Approximately 56% of the North Fork watershed is within the normally occurring transient snow zone.

Created Openings

Research elsewhere in the Cascades has shown that more snow accumulates in openings than under forest canopies and that during rain-on-snow events the runoffs from these areas are more rapid. Timber harvest activities (particularly clearcuts) and other created openings (roads, windthrow areas, fires, etc.) are areas of increased snow accumulation. Rapid runoff from these areas increases the magnitude of peak flows during rain-on-snow events, which can result in channel scour, down cutting, or widening of the stream channel.

Currently, 3,168 acres (15%) of the North Fork watershed are clearcut areas that have not yet developed a closed forest canopy, 1,435 acres of which are found on federal land within the watershed. There are 112 miles of road in the watershed, for a total road density of 3.47 miles/mile^2 (Table 2-5). The highest road densities occur in the Bee Creek (5.46 mi/mi^2) and Fall Creek (4.86 mi/mi^2) subwatersheds, both of which are primarily in private ownership.

Table 2-5. Watershed Parameters Effecting North Fork Clackamas River Hydrologic Processes.

	Total	Total	Total Road	Road Density	Total Stream	Drainage Density	Stream Crossings	Channel Expansion		Hydro Recovery ARP
								Low Est.	High Est.	
SUBWATERSHED NAME	(Acres)	(Sq. Mi)	(Miles)	(Mi/Sq. Mi)	(Miles)	(Mi/Sq. Mi)	(#)	(%)	(%)	(%)
Fall Creek	2221.17	3.47	16.86	4.86	7.6	2.19	13	13.0%	32.4%	83%
Lower North Fork Clackamas River	4796.04	7.49	27.14	3.62	22.15	2.96	17	5.8%	14.5%	88%
Bee Creek	2121.85	3.32	18.1	5.46	7.08	2.14	10	10.7%	26.8%	67%
Upper North Fork Clackamas River	4925.97	7.70	16.83	2.19	41.6	5.40	19	3.5%	8.7%	86%
Bedford Creek	1896.19	2.96	7.23	2.44	9.07	3.06	6	5.0%	12.5%	80%
Boyer Creek	3362.27	5.25	18.68	3.56	20.6	3.92	25	9.2%	23.0%	87%
Winslow Creek	1312.88	2.05	7.07	3.45	6.05	2.95	11	13.8%	34.4%	94%
Total	20636.37	32.24	111.91	3.47	114.15	3.54	101	6.7%	16.8%	84%

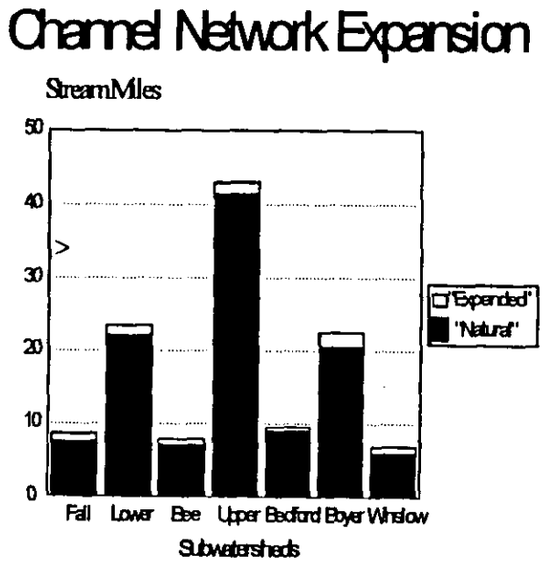
Stream Expansion assumes a distance of 200 feet for low and 500 feet for high from the closest ditch relief culvert on either side of the stream crossing, adding an additional 400 feet for low and 1000 feet for high to the effective channel length.

Channel Network Expansion

Road surfaces and cut slopes are essentially impermeable to rainfall and snowmelt. They intercept shallow subsurface flow and concentrate surface runoff. Road ditches function as extensions of intermittent streams, increasing overall drainage density and transporting water more rapidly than natural processes. Increased road densities result in more water being delivered to streams within a shorter timeframe, effecting the frequency and magnitude of peak flows.

The potential channel network expansion attributable to roads was calculated by estimating the length of road directly accessing streams, and adding that value to the length of affected streams. Since the exact spacing of ditch relief culverts could not be determined for each road in each subwatershed, a "best case" scenario (200 foot spacing) and a "worst case" scenario (500 foot spacing) were analyzed (Table 2-5). The lower values appear to be realistic for most roads and watersheds, based on field observations and common construction practices. Channel networks appear to have expanded 6.7% overall, with subwatershed values ranging from 3.5% (Upper North Fork) to 13.8% (Winslow Creek) (Figure 2-1). Winslow, Fall, and Bee Creek subwatersheds have the greatest percentage of channel network expansion.

Figure 2-1. Channel Network Expansion Related to Roads.



Aggregate Recovery Percentage (ARP)

The effects of management activities on hydrologic function and hydrologic recovery were assessed using the Aggregate Recovery Percentage (ARP) methodology. The ARP model examines the effect of harvested openings and roads on hydrologic recovery.

The Mt. Hood National Forest Land and Resource Management Plan identified an ARP value "threshold" of 65% for the North Fork watershed. This means that at least 65% of the watershed should be in a hydrologically recovered condition (defined as coniferous forest with at least 70% crown closure and an average diameter of at least 8 inches). ARP values of less than 65% suggest a very high likelihood of increased magnitude and frequency of peak flows associated with rain-on-snow events and subsequent channel degradation. The concept of a single absolute "threshold" has been called into question by recent research. While no absolute thresholds exist in the real world, subwatersheds with lower ARP values are at greater risk for damaging peak flows.

ARP values of the seven subwatersheds in North Fork range from 67% (Bee Creek) to 94% (Winslow Creek) (Table 2-5). All subwatersheds are currently above the Mt. Hood Forest Plan standards. Bee Creek, the subwatershed with the lowest ARP value, is predominantly in private ownership. Considering the small amount of damage that occurred on federal lands in the watershed during the recent flood event, it appears that North Fork is in a hydrologically recovered condition and that the Forest Plan thresholds are valid.

"All subwatersheds are currently above the Mt. Hood Forest Plan ARP standards. Bee Creek, the subwatershed with the lowest ARP value, is predominantly in private ownership."

Base Flow

Base flow is critical to watershed health during times of little or no precipitation, providing habitat for fish and other aquatic organisms, sustaining habitat for riparian plants and animals, and maintaining cover and travel corridors for wildlife. Decreases in base flows are a concern to the watershed because of reduction in effective habitat for aquatic organisms; and the possible decrease in water quality, i.e., increased water temperatures, decreased dissolved oxygen levels, and increased algal and pathogen populations.

Although limited information exists on base flows in the North Fork watershed it is assumed that because of the watershed's extensive stand replacement fires and

subsequent salvage logging during the early to mid 1900's there could have been a slight increase in baseflow.

Currently the Riparian Reserves consist of 16 % hardwoods with individual subwatersheds ranging from 2% to 31%. Research by Hicks, et. al., in 1991 suggests that reductions in streamflow following timber harvest may be related to the regrowth of deciduous riparian species which transpire larger quantities of water than the natural conifer vegetation. This suggests that base flows overall in the North Fork watershed may be similar to the base flows occurring prior to the fires of the early 1900's. Specific subwatersheds such as Bee and Boyer with Riparian Reserves containing 29% to 31% hardwoods respectively, may have fallen below the base flow level prior to the fires because of the high percentage of hardwoods in the Riparian Reserves.

C. Stream Channel

Riparian and Aquatic Habitat Conditions

In the early to mid 1900's fire swept through much of the North Fork watershed. Because of the lack of survey information during that time it is uncertain to what extent the riparian area (trees and woody material) was affected. Salvage and green timber harvest were actively going on during this time and it continues today.

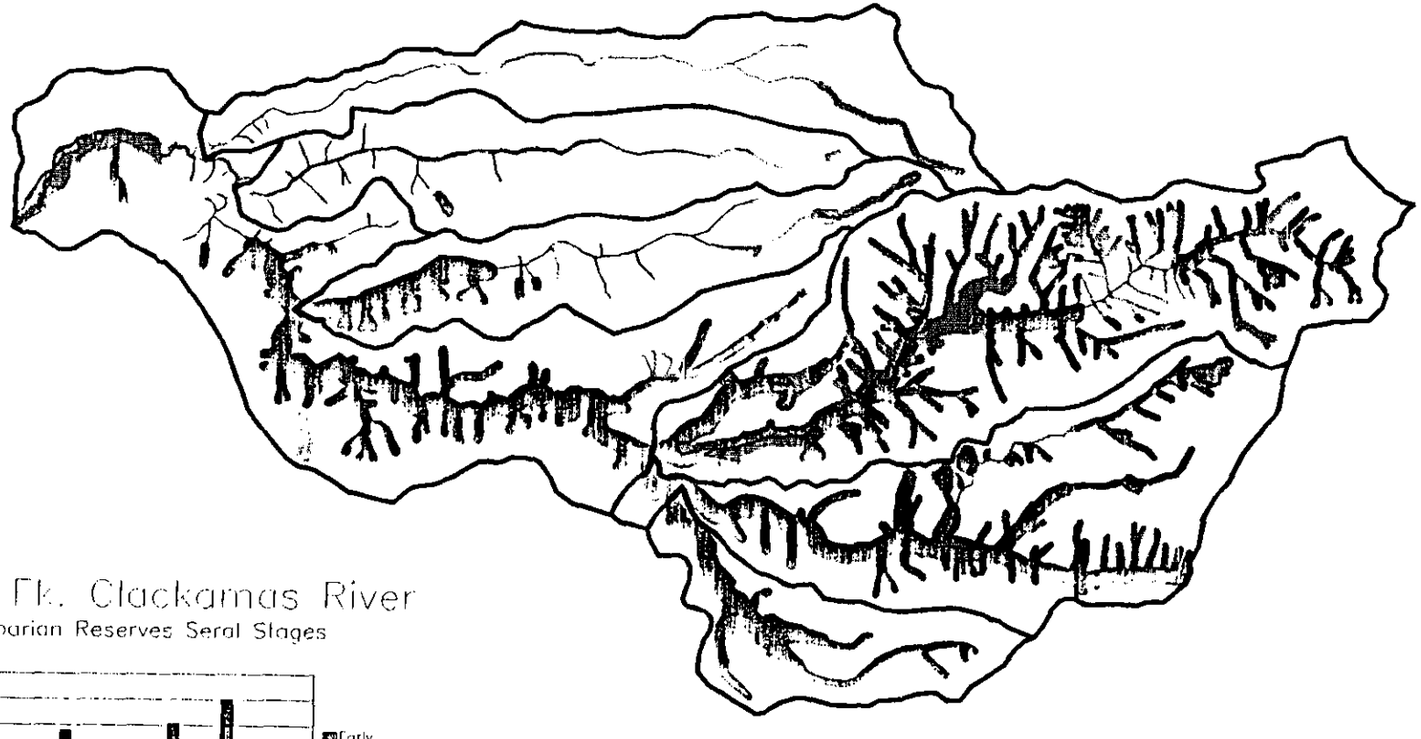
The North Fork watershed is influenced by its past fire history. Today the Riparian Reserves are composed of 80 % mid seral, 8 % early seral and 12% late seral stands (Map 2-4). The projected large woody debris recruitment potential in the North Fork watershed within the Riparian Reserves is related to seral stage for each subwatershed. Low potential recruitment areas are associated with early seral and high potential recruitment areas are late seral.

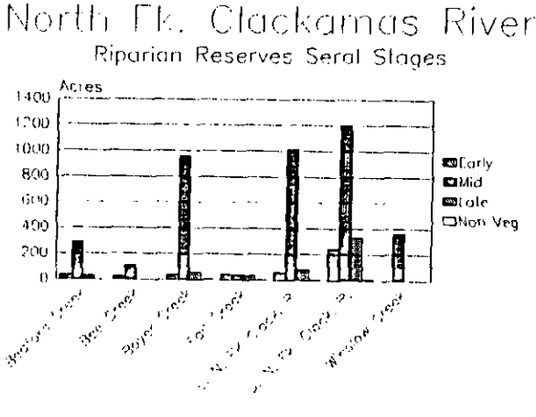
"Today the Riparian Reserves are composed of 80 % mid seral, 8 % early seral and 12% late seral stands"

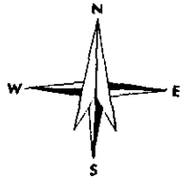
Current habitat conditions are measured by large woody debris (LWD), small woody debris (SWD) and primary pools per mile. Large woody debris is delivered and removed into the stream channels by natural processes and human activities. Natural processes include landslides, floods, fire, the accumulation of wood from adjacent riparian areas, and the natural tendency of wood to migrate downstream. Human activities such as timber harvest, road construction, and instream LWD removal affect the presence of large wood in the stream. Large wood influences channel morphology by affecting the longitudinal profile, pool formation, channel pattern and position, complexity, cover, stream velocity and nutrient storage. Pools provide important habitat for adult salmonids during spawning migrations, base flow thermal refugia, and protective cover. In addition, pools provide important rearing and overwintering habitat for juvenile steelhead, salmon, resident fishes, and amphibians.

Estimated range of natural variability (RNV) for LWD, SWD, and primary pools were derived from streams within the Willamette basin by stream order that have limited management history. The effects of fire suppression was not evaluated for these wilderness streams. Figures 2-2, 2-3, and 2-4 show the natural variability of the unmanaged wilderness streams compared to the streams in the North Fork watershed. Figures 2-2 and 2-3 includes the standards found in the Mt. Hood Forest Plan for large and small woody debris. All reaches of Winslow Creek fall below the RNV for LWD. Portions of Winslow and lower North Fork are below the RNV for SWD. This can result in the reduction of aquatic habitat quality and affect the natural stream channel functions such as pool formation, regulation of bedload movement, and nutrient routing. Table 2-6 compares the existing primary pool frequencies of the streams in the watershed with the Mt. Hood Forest Plan and the

North Fork Clackamas River Watershed
Riparian Reserve with Seral Stages







Early
Late
Mid
Non Forest

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MILES

MAP 2-4

Figure 2-2 Comparison of LWD/Mile in stream reaches in the North Fork Clackamas River Watershed with Willamette Basin unmanaged stream reaches.

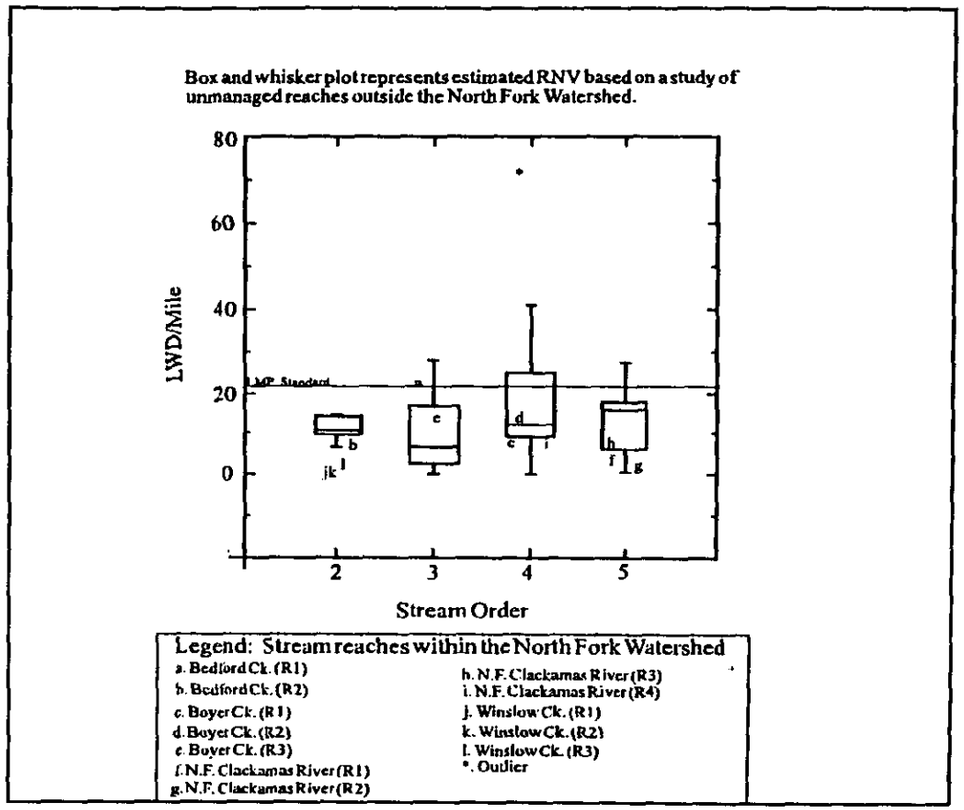


Figure 2.3 Comparison of SWD/Mile in stream reaches in the North Fork Clackamas River Watershed with the Willamette Basin Unmanaged stream reaches.

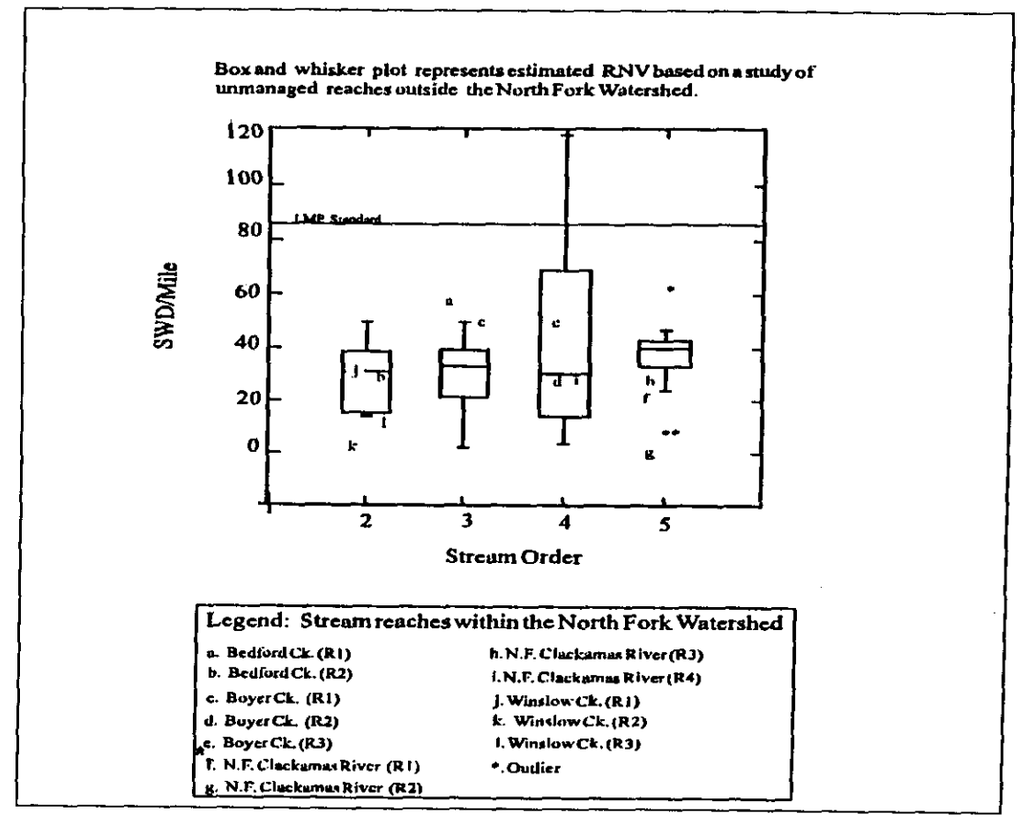
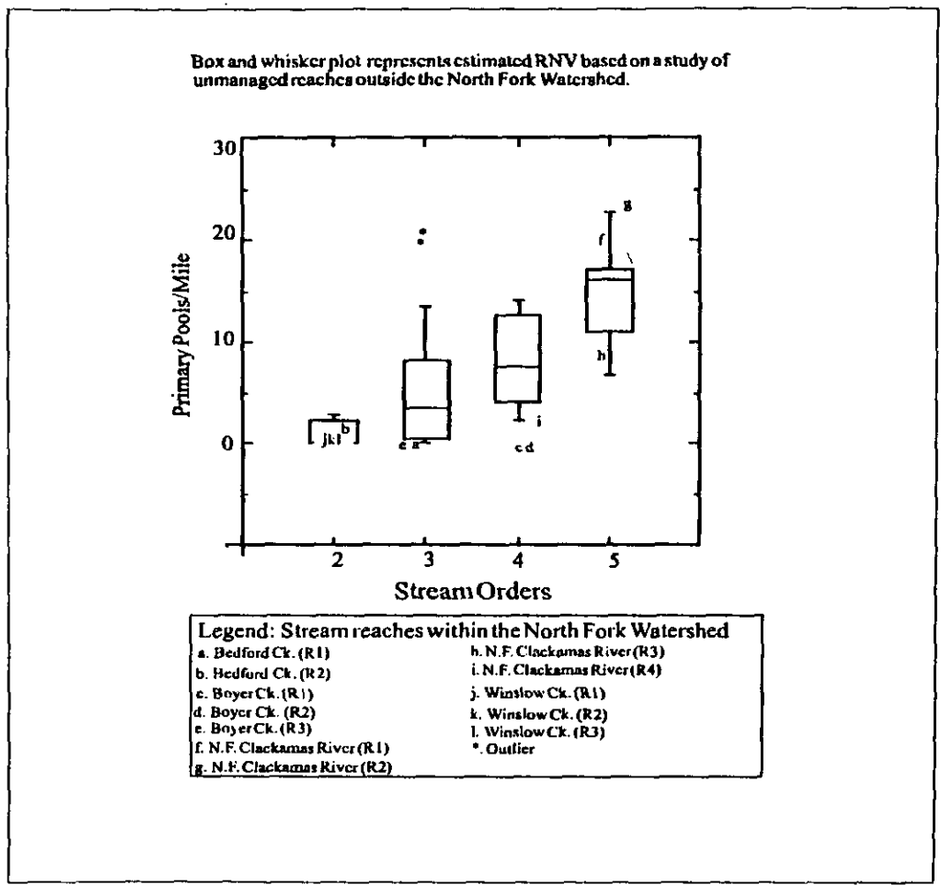


Figure 2-4 Comparison of primary pools/mile is stream reaches in the North Fork Clackamas River Watershed with the Willamette Basin Unmanaged stream reaches.



The box and whisker plots provide information about the center, spread, skewness of data and outlying values. The box is drawn with a horizontal line inside the box representing the median of the data set or 50% of the data points. The upper and lower lines of the box correlates with 75% and 25% of the data points respectively. The whiskers represent extreme data values.

Columbia River Policy Implementation Guide (PIG) standards. Winslow, Boyer, and the lower reach of Bedford Creek are absent of primary pools. This suggests that the streams lack the adequate organic input such as wood for structure that help create these pools. Stream gradient and substrate are also factors that influence the formation of primary pools. It appears that some of the stream reaches in the watershed are within the range expected in a natural system but all fell below the Mt. Hood Forest Plan standards.

Upper and Lower North Fork Subwatersheds (includes Whiskey and Dry Creeks)

North Fork is a stream recovering from past fire history and subsequent salvage logging. The stream lacks the large diameter wood to produce roughness elements. Land forms tend to be stable and banks vegetated. There are areas of bedrock with the dominant substrate being cobble. Riparian Reserves are composed of mid seral with a component of red alder. Alder is more pronounced in the lower North Fork then upper North Fork. The lower North Fork has good fish habitat with quality pool development. A small A9 Key Site Riparian land allocation is located within the upper Bedford subwatershed. This allocation is completely within the Riparian Reserve network.

Restoration projects have occurred on North Fork at North Fork Crossing from the bridge downstream a quarter mile. These projects consist of wood structures and riparian plantings of cedar, for long and short term large woody debris recruitment into the riparian area. The North Fork Reservior provides good rearing and overwintering habitat for salmonids. A 50 foot barrier falls limits anadromy to below river mile 2.4.

At the mouth of Whiskey Creek there is a 75 foot waterfall which is a barrier to fish passage. Dominant substrate within Whiskey Creek is sand and gravel. Pools make up approximately 25% of the habitat. Within the upper reaches there is an accumulation of LWD and slash. This area has numerous side channels and deposits of unconsolidated sand and gravel. At approximately river mile 1.25 the stream becomes intermittent.

Dry Creek enters the North Fork at North Fork Crossing. The stream is cobble/rubble dominated with an average gradient of 5%. LWD is mainly absent in the lower reaches but has moderate concentrations throughout the remainder of the stream. A restoration project has occurred at the mouth of Dry Creek consisting of a ford crossing Dry Creek, bank stabilization, and boulder placement to block vehicle access into the creek.

"A 50 foot falls at river mile 2.4 above the confluence of Bee Creek is a migration barrier for anadromous fish."

Table 2-6. Comparison of Existing Pool Frequency Conditions in Creeks in theNorth Fork Watershed with Mt.Hood Forest Plan and PIG Standards.

STREAM	RIVER MILE	PRIMARY POOLS/MILE	MHFP DFC	PIG
BEDFORD SUBWATERSHED				
Bedford Ck . R1	0 - 2.1	0	86	96
Bedford Ck. R2	2 .1 - 4.9	2.1	NI	184
BOYER SUBWATERSHED				
Boyer Ck. R1	0 - 0.7	0	76	70
Boyer Ck. R2	0.7 - 3.0	0	63	70
Boyer Ck. R3	3.0 - 3.1	0	NI	96
NORTH FORK SUBWATERSHED				
North Fork R1	0 - 2.1	18.2	32	26
North Fork R2	2.1 - 2.9	23.8	60	56
North Fork R3	2.9 - 11.9	7.3	50	70
North Fork R4	11.9 - 14.3	2.6	93	70
WINSLOW SUBWATERSHED				
Winslow Ck. R1	0 - 0.5	0	54	96
Winslow Ck. R2	0.5 - 0.7	0	88	70
Winslow Ck. R3	0.7 - 2.5	0	70	96

MHFP DFC - Mt. Hood National Forest Land and Resource Management Plan 1990 Desired Future Conditions
PIG - Columbia River Policy Implementation Guide/Salmon Summit
NI - No Information

"Winslow, Boyer, and the lower reach of Bedford Creek are absent of primary pools. This suggests that the streams lack the adequate organic input such as wood for structure that help create these pools."

Bedford Subwatershed

Bedford Creek has been heavily influenced by fire and timber harvest. Riparian vegetation is primarily mid seral with alder making up 17% of the riparian vegetation. Stream gradient is fairly high ranging from 3% near the mouth to 9% in the headwaters. Instream habitat is composed mainly of riffles with pools being less frequent in the upper reaches. Dominant pool substrate is sand indicating high deposition. Effective fish cover in the lower reach is overhanging vegetation and in the upper reach is woody debris. Stream bank stability was rated good with adequate ground cover. There are numerous side channels throughout the stream.

Boyer Subwatershed

Boyer Creek like the other streams in the North Fork watershed has been effected by past fire history, timber harvest, and road building. Riparian vegetation is mainly mid seral. Alders make up 31 % of the overall riparian vegetation, the highest amount compared to the other subwatersheds. It is the largest fish bearing tributary entering the North Fork Clackamas River. Stream gradient ranges from 7% at the mouth to 3% in the headwaters. Streambanks are fairly stable within the lower reaches due to small boulders and abundant underbrush. In the headwaters the stream banks exhibit frequent cutting and erosion with deposits of unconsolidated sand and gravel. Portions of road 4612 are potentially high sediment producers into Boyer Creek. Between river mile 0.7 and 3.0 braiding and side channels are common with the side channels dry during summer low flows.

Winslow Subwatershed

Winslow Creek has been effected by past fire history, timber harvest and road building. Riparian vegetation is mainly mid seral with alder. Stream gradient averages 5%. Dominant substrate is gravel with some bedrock. The gravel size is ideal for resident trout spawning. Stream braiding is evident in portions of the stream indicating the need to move sediment through the system. Portions of roads 4611 and 4611-140 are potential high sediment producers to Winslow Creek because of their locations within the Riparian Reserve. Within the Winslow subwatershed there is a large A9 Key Site Riparian land allocation. This area was determined to be predominantly dry nonriparian habitat. The area affecting the aquatic resources is protected under the Northwest Forest Plan within the Riparian Reserves.

Spawning Gravel

In 1995 a spawning gravel quality study was conducted to look at fine sediment in trout spawning areas (USDA, 1995) along the North Fork Clackamas River. The three sites selected were below Bedford Creek (lower), at road 4613 crossing (middle), and at road 4610-150 crossing (upper). The upper site was used to compare to data collected by Whitt in a 1978 spawning gravel survey. There was a large increase in sediment composition in the 1995 data for this site, but it is highly suspect because sampling efforts by Whitt focused on suitable anadromous patches of spawning gravels instead of trout spawning patches. Suitable resident trout spawning gravels (pea size) are typically found in areas of deposition which can have high concentrations of sand and silt. Resident rainbow and cutthroat trout redds are generally a couple inches deep in these areas. The sampling techniques used in the 1995 study probably overestimated the percentage of sediment by using the full depth (15 cm) of the sampler. The Mt. Hood Forest Plan standards indicates spawning gravels should contain no more than 20% fine sediments (particles less than 1.0 mm diameters) on an area weighted average. The upper and middle sites exceeded this fine sediment standard but the lower site was within.

Trend Monitoring

North Fork Clackamas River is one of six drainages on the Clackamas River which conducted trend monitoring in 1993. Monitoring sites were located on the mainstem North Fork. Parameters monitored to characterize the sediment regime were V Star (the

proportion of fine sediments that occupy the scoured volume of a pool), Riffle Stability Index (RSI, the percent of sediment particles in a riffle that move at bankfull flows), and D50 (the mean particle size in a riffle). The first year analysis was conducted (USDA, 1993) for these parameters and current sediment levels appeared to be low. The three North Fork sites, because of past fire history and salvage logging in the 1910's - 1930's, were categorized as fire impacted. Other stream categories were unimpacted (little or no forest management) and impacted (timber harvest and road building).

The V Star and RSI analysis showed little difference between the impacted and unimpacted watersheds. There was a statistical difference between the impacted and unimpacted watersheds compared to the fire impacted watersheds. There are three possible reasons for this. First, the effects of the past fires and subsequent salvage logging in the early to mid-1900's are still being observed. Secondly, the size of the watershed. The sampled North Fork subwatersheds are smaller then other sampled Clackamas drainage subwatersheds. Finally, the upper and middle sites on the North Fork are considered "C" channel types compared to "B" channel types in the other watersheds.

General characteristics of type C Channels are low gradient, meandering, point-bar riffle dominated channels with broad well defined floodplains. These usually represent the major depositional reaches in a stream. Type B channels are characterized as moderately entrenched with a moderate gradient, with riffle dominated channels, and with frequently spaced pools.

D. Water Quality

Recreational use of dispersed sites has the greatest potential to affect water quality in the North Fork watershed. Human fecal matter could enter the streams from the dispersed sites. The effects of biological contamination is unknown due to a lack of water quality monitoring.

Temperature

Stream temperatures are affected by direct solar radiation which depends on the quality and quantity of shade, vegetative and/or topographic. Natural disturbances such as landslides, windthrow, and fire; and human activities such as timber harvest and road building have the potential to influence stream temperature by altering streamside vegetation and channel form. The health and productivity of fish and other aquatic organisms are directly related to stream temperature. Water temperatures in streams can vary daily, seasonally, and spatially.

The North Fork has three monitoring sites for profile sampling to determine temperature changes by stream order. They are located from the headwaters of North Fork to the confluence with Bedford Creek. These sites have continuous recorders and are located below Bedford Creek (lower), above Boyer Creek (middle), and in the upper North Fork (upper). Low flow summer stream temperatures were measured from 1991-95 during the months of June through September (data on file, Clackamas River Ranger Districts). There is a gradual increase in stream temperatures from the upper to the lower sites. The seven day maximum stream temperatures were within the RNV for the Clackamas River subbasin 14.5 - 20.0 degrees C (REAP, USDA, 1993) with the exception of 1993 when the water temperature was colder for both the middle and upper sites (Fig 2-5). The lower site exceeded the state water quality standard of 17.8 degrees C in 1994 (Fig 2-5). Figure 2-6 illustrates the average maximum temperature for major tributaries near the North Fork watershed. North Fork temperatures are higher then Roaring River (an unimpacted watershed) but below the biological threshold for salmonids (20 degrees C to 23 degrees C).

Macro-Invertebrates

Aquatic macro-invertebrate sampling was conducted on the North Fork below Bedford Creek in 1991 and

Figure 2-5

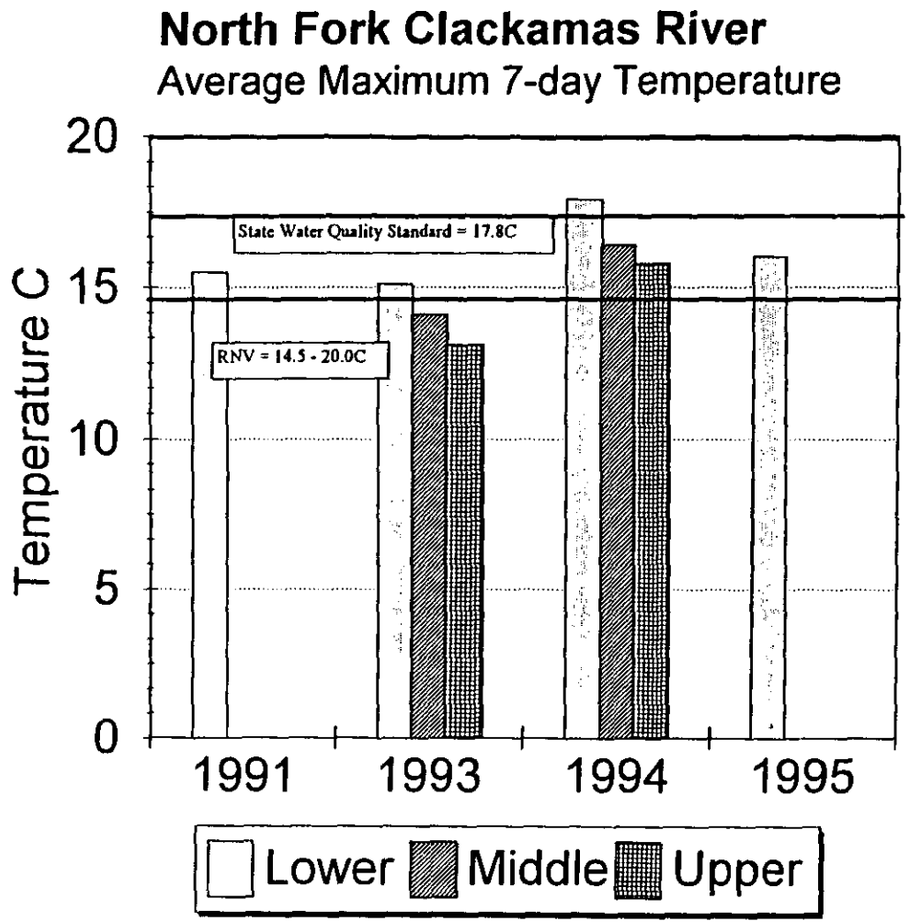
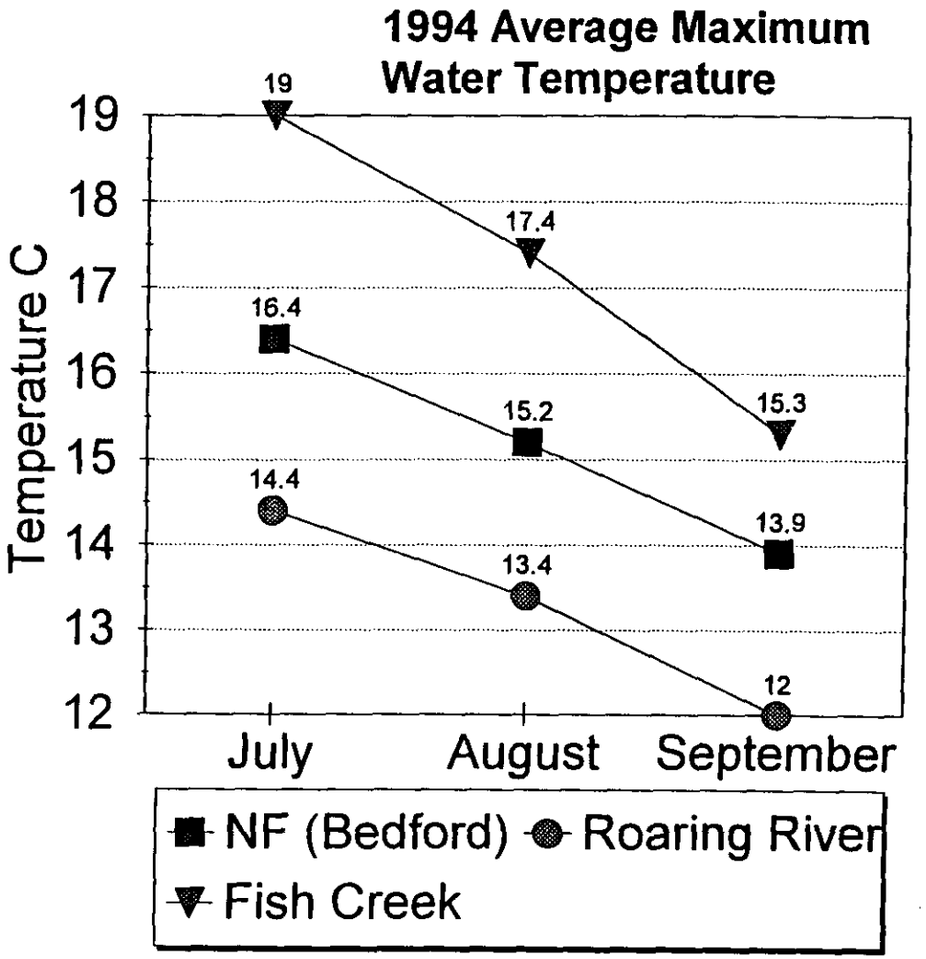


Figure 2-6



1995, and at the mouth of Boyer Creek in 1991. This type of sampling can provide important baseline information to help evaluate watershed condition and water quality. Data analysis was done using a modified Environmental Protection Agency (EPA) Rapid Bioassessment Protocal (Aquatic Biology Associates, 1991).

The 1991 results indicate that both North Fork and Boyer Creek have taxa typical of Western Cascade streams. They both contain higher percentages of taxa that are tolerant of sediment and temperature than intolerable taxa, which can indicate poor habitat quality due to increased stream temperatures, increased canopy openings, and/or fine sediment accumulation. The dominant functional feeding group is the collector/gatherers which can indicate a possible impairment or limitation in the stream habitat. An indicator of good water quality is a stream with high percentages of shredders and scrapers. North Fork has a low percentage of shredders which can indicate insufficient input of organic matter into the stream and/or limited stream retention capabilities such as logs and boulders to maintain the organic material in the channel. The lack of instream retention capabilities relates to North Fork's extensive stand replacement fires of the early and mid 1900's and correlates to today's riparian vegetation composed mainly of mid seral stands. Boyer Creek's low percentage of scrapers could be an indicator of sedimentation. Sedimentation is high in Boyer Creek with portions of road 4612 being a potentially high sediment concern.

E. Aquatic Species and Habitats

Fish Distribution

Fish present in the North Fork watershed consist of late and early run coho salmon, summer and winter steelhead, spring chinook salmon, resident rainbow trout, and resident cutthroat trout. Other fish occupying the watershed are large scale suckers, sculpin, longnose dace, and pacific lamprey.

A 50 foot falls on the North Fork Clackamas at river mile 2.4 above the confluence of Bee Creek is a migration barrier for anadromous fish. Fall and Bee Creeks are two major tributaries below the barrier falls. Bee Creek has approximately three miles of additional anadromous habitat and Fall Creek has a 50 foot barrier falls at river mile 0.1. All 5.4 miles of anadromous habitat are located on private and BLM land adjacent to the Forest Service boundary. Native populations of resident rainbow and cutthroat trout occupy the mainstem of North Fork and it's major tributaries of Fall, Bee, Bedford, Dry, Boyer, Whiskey and Winslow Creeks. The North Fork watershed consists of 5.4 miles of anadromous streams, 32 miles of resident fish bearing streams, and 77 miles of non-fish bearing streams (Map 2-5).

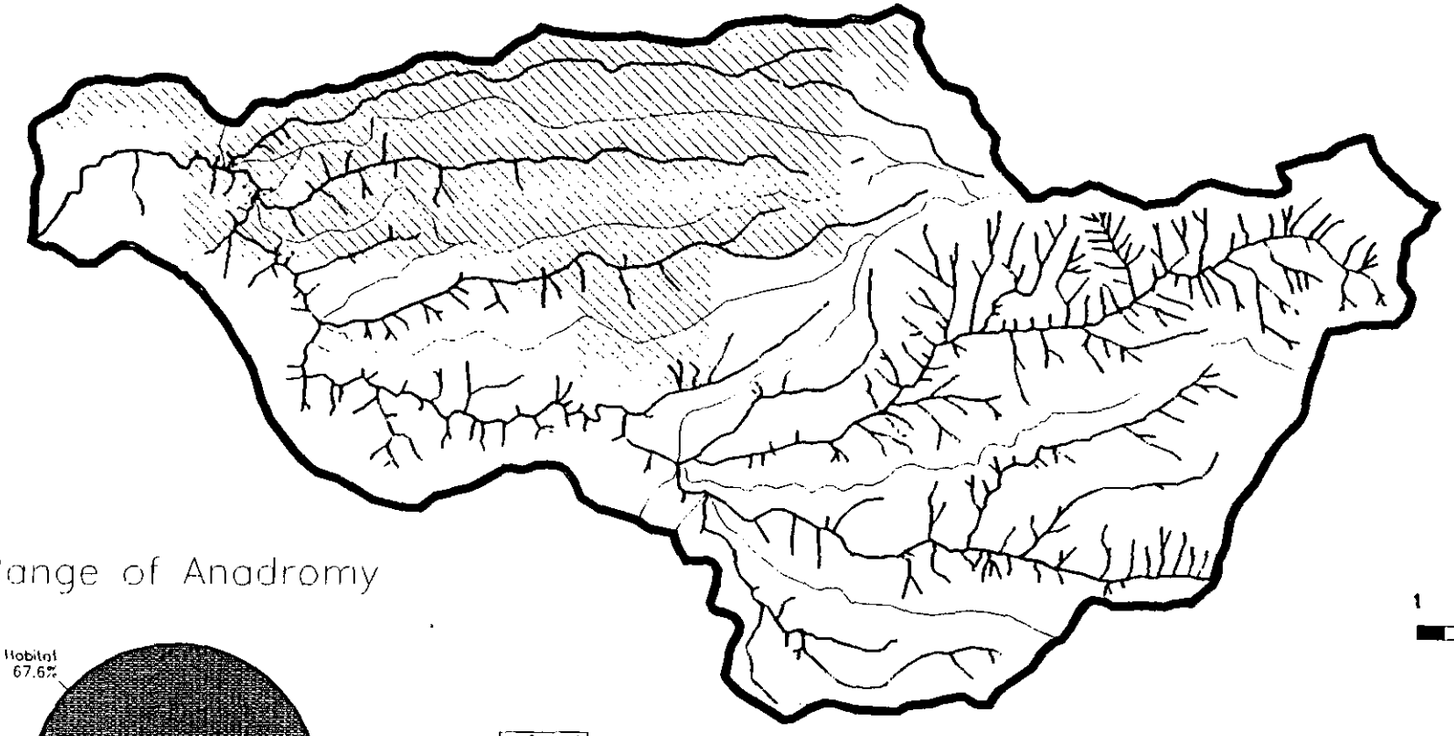
"The North Fork watershed consists of 5.4 miles of anadromous streams, 32 miles of resident fish bearing streams, and 77 miles of non-fish bearing streams."

Little historical information exists on the distribution and population of fish which occupy the North Fork watershed. However, estimates of historic numbers of anadromous fish have been made for the Clackamas River subbasin upstream of North Fork Dam (ODFW, 1992). Table 2-7 displays status of fish species and stocks above North Fork Dam.

Native late run coho salmon and winter steelhead are declining. Commercial and recreational harvest, coexistence of hatchery stocks, reduced habitat quality, and the effects of hydroelectric facilities have contributed to the decline of these stocks.

North Fork Clackamas River Watershed

Range of Anadromy and Fish Barriers



N
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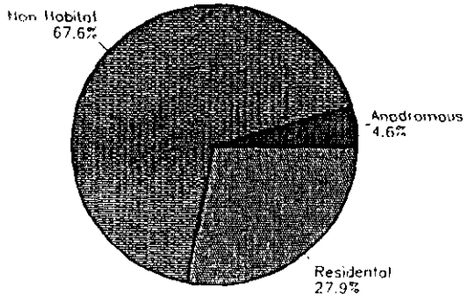
MILES

Range of Anadromy



- Anadromous
- Non Fish Habitat
- Residental Fish Habitat
- Natural Fish Barrier
- Private Land

NOTE:
Range of anadromy is impeded by natural barriers on Fall Creek (2.0 miles), Mainstem North Fork Clackamas River (2.4 miles) and Bee Creek (5.4 miles).

MAP 2-5

Table 2-7. Fish Species and Stock Status.

Common Name	Scientific Name	Stock Origin	Status
Coho salmon	*Oncorhynchus kisutch*	early run - H	increasing
		late run - W	declining
Spring chinook salmon	*Oncorhynchus tshawytsha*	W/H	increasing
Winter steelhead	*Oncorhynchus mykiss*	H	declining
		W	declining
Summer steelhead	*Oncorhynchus mykiss*	H	stable
Cutthroat trout	*Oncorhynchus clarki*	W	unknown
Rainbow trout	*Oncorhynchus mykiss*	W	unknown
Brook trout	*Salvelinus confluentus*	H	unknown
Mountain whitefish	*Prosopium williamsoni*	W	unknown
Sculpin	*Cottus sp.*	W	unknown
Large scale sucker	*Catostomus macrocheilus*	W	unknown
Longnose dace	*Rhinichthys cataractae*	W	unknown
Pacific lamprey	*Entosphenus tridentatus*	W	unknown

Anadromous Fish

Steelhead

In 1991 Nehlsen, et. al., identified the Clackamas River native late run winter steelhead as being at a "moderate" risk of extinction. The Oregon Department of Fish and Wildlife (ODFW) recognizes the late run winter steelhead as a "stock of concern". In 1994 all native stocks of steelhead from Alaska to southern California were petitioned for listing under the Endangered Species Act.

The North Fork contains suitable spawning and rearing habitat for both summer and winter steelhead. The river's high gradient, high stream velocity, and pocket pools are ideal steelhead habitat. Bee Creek contains an additional three miles of potential habitat. Steelhead juveniles, adults, and redds occur in the mainstem of North Fork up to the barrier falls at river mile 2.4 (Beyer, 1992).

Coho

The North Fork Clackamas River has been designated a State Scenic Waterway and is considered eligible to become a Wild and Scenic River. Its eligibility was based on fisheries values being outstandingly remarkable due to the presence of late run winter coho below the barrier falls at river mile 2.4. The late run coho salmon is recognized as the last self sustaining wild run of coho salmon in the lower Columbia River (Cramer and Cramer, 1994). One year class has declined 95 % in two generations.

In 1991 Nehlsen, et. al., designated the Clackamas River native late run coho as at "moderate" risk of extinction. This stock is also listed as "sensitive" on both the state Sensitive Species List (ODFW, 1992) and the Regional Forester's Sensitive Species List. Hatchery origin early run coho also occupy the North Fork.

The most productive coho systems are generally associated with side channels and slack water such as the North Fork Reservoir. North Fork is an important spawning area for late run coho. They utilize the river for both spawning and rearing. The arm of the North Fork Reservoir is used by some juvenile fish migrating downstream.

"North Fork is an important spawning area for late run coho."

Spring Chinook

Historically the Clackamas River was considered one of the largest producers of spring chinook salmon

(ODFW, 1992). In the mid 1800's commercial harvest in the Columbia River for chinook drastically reduced the indigenous stocks from the Clackamas River. Today the spring chinook run in the Clackamas and North Fork consists of both native and hatchery fish. It is believed by local fisheries biologists that pure native spring chinook are nonexistent. It is thought that spring chinook in the wild have interbred with hatchery strays and that little if any wild genes are left in the gene pool (Shively, personnel communication). The North Fork is not a major contributor to the Clackamas River for the production of spring chinook.

Resident Fish

Rainbow and Cutthroat Trout

Native rainbow and cutthroat trout are present in the mainstem and tributaries of North Fork. Cutthroat may be abundant in certain streams but additional sampling is needed to verify. The ODFW stock the North Fork Reservoir with hatchery rainbows. These fish are blocked from entering the upper reaches of the watershed by the barrier falls at river mile 2.4.

Other Fish

Large scale suckers, pacific lamprey, and longnose dace occupy the lower North Fork below the barrier falls at river mile 2.4. Sculpin are present throughout the watershed. Large numbers of large scale suckers were observed during a snorkeling survey in 1992 spawning in the North Fork and utilizing prime steelhead spawning sites (Beyer, 1992).

Trends

The North Fork watershed is influenced by its past fire history. Today the Riparian Reserves are largely composed of mid seral stands moving towards late seral conditions. Future riparian conditions are expected to improve in channel habitat as late seral conditions are achieved and the potential for large woody debris is increased. This will increase habitat complexity and pool frequency. Fine sediments will have a greater rate of retention as structure and roughness elements such as large woody debris occurs. As Riparian Reserves recover there will be more shade which means decreasing summer water temperatures.

Sediment delivery into streams should decrease with the implementation of the Aquatic Conservation Strategy (ACS) and the designation of Riparian Reserves including unstable and potentially unstable lands. Subwatersheds of Fall and Bee Creeks which are predominantly in private ownership may experience increases in sedimentation if the demand for wood products or residential development increases, leading to an increase in timber harvest. Sediment production from unmanaged off road vehicle (OHV) use should also decrease in the future if a managed OHV plan is implemented.

Increased sediment delivery over that of background levels in Weak Rock-Steep Slope, Intermediate Rock-Steep Slope, Resistant Rock-Steep Slope, and Quaternary Landslide Deposit landform types could occur in the future if regeneration harvest or road construction occur in these areas. Many of these areas are located within the Riparian Reserve network, where regeneration harvest will not occur (see Map 3-3, Concept Design). Site specific investigation of these landforms of concern and the design of harvest units will reduce the potential for sediment delivery.

The effects of roads on aquatic resources will be reduced as restoration activities occur such as road obliteration, erosion control, and stabilization of road drainages to lower sediment delivery rates to streams.

Summer base flows should slightly increase as the riparian hardwood stands are converted to conifer stands. This should increase the carrying capacity for salmonids.

Peak flows should not increase significantly over the short-term (next 20 years) in subwatersheds predominantly in federal ownership. Harvest units currently in an early seral condition should become hydrologically recovered. Timber management emphasis over the next 20 years on federal lands will be on thinning of mid seral stands (see Map 3-4, Interim Design). Hydrologic recovery may become more of a concern in the future. The North Fork watershed is predominantly in the Northwest Forest Plan Matrix, and in the Forest Service C1, Timber Emphasis and BLM General Forest allocations. Aggregating harvest units in the future to reduce forest fragmentation (see Map 3-3, Concept Design), rather than dispersing harvest units among subwatersheds, could conflict with Mt. Hood Forest Plan standards for hydrologic recovery and could increase peak flows. Decreasing road densities will help to decrease the effects to peak flows.

The recovery of at risk fish stocks, especially the late run coho salmon, will continue to depend on high quality habitat in the lower 2.4 miles of North Fork. Aquatic habitat within the BLM land should continue to improve with implementation of the ACS, but the portion within private ownership is uncertain.

It is expected that the functional feeding group composition should improve from collector/gatherers back to shredders as the stream retention capabilities are increased by large woody debris and boulders that help maintain the organic material in the channel. Scrapers will also increase as sedimentation levels decrease due to restoration activities occurring with the implementation of the ACS.

Current and Reference Condition

A. Vegetation

Landscape Structure

Map 2-6 is a landscape structure map which displays the current condition of the North Fork watershed. The structural elements of the North Fork landscape are divided into six broad categories:

- Matrix (landscape ecology definition)
- Hardwood patches
- Immature forest patches
- Wetland patches
- Aquatic patches
- Rock patches.

The "matrix" within the North Fork watershed, based on the criteria of relative area, connectedness, and control over landscape dynamics (Forman and Godron 1986, Diaz and Apostol 1992), is defined as mature forest, a combination of large and small sawtimber. The matrix is composed of three different structural classes: large conifer, closed small sawtimber, and open small sawtimber. Immature forest patch structural classes include grass/forb/shrub, open sapling pole, and closed sapling pole stands.

Other patch types identified within the North Fork watershed are considered "special habitats" (see Map 2-7), these include hardwood patches (both mixed red alder/conifer stands and stands of pure red alder (*Alnus rubra*), wetland patches (grass/forb dominated meadows), one aquatic patch (a small portion of North Fork Reservoir), and rock patches (rock outcrops and talus slopes). These areas contribute to species and habitat diversity within the watershed for animals, vascular plants, and also lichens, mosses, and fungi.

North Fork has very few special habitats compared to other watersheds in the Clackamas subbasin. There are four wet meadows identified in the watershed, the largest of which is 16 acres. There are some small wet areas and patches of Sitka alder (*Alnus sinuata*) which do not appear on Map 2-7. Some of those small wetlands have been impacted by unmanaged off highway vehicle (OHV) use in the Ladee Flats area. There are 163 acres of rock and talus habitat in North Fork, proportionately less than in most of the watersheds in the subbasin. There are no lakes in the watershed, except for a small portion of North Fork Reservoir. There are a few small manmade ponds on private land.

There are large areas of red alder in the watershed, approximately 1,290 acres. Most of these are in riparian areas. The largest concentrations are in Boyer and Lower North Fork subwatersheds.

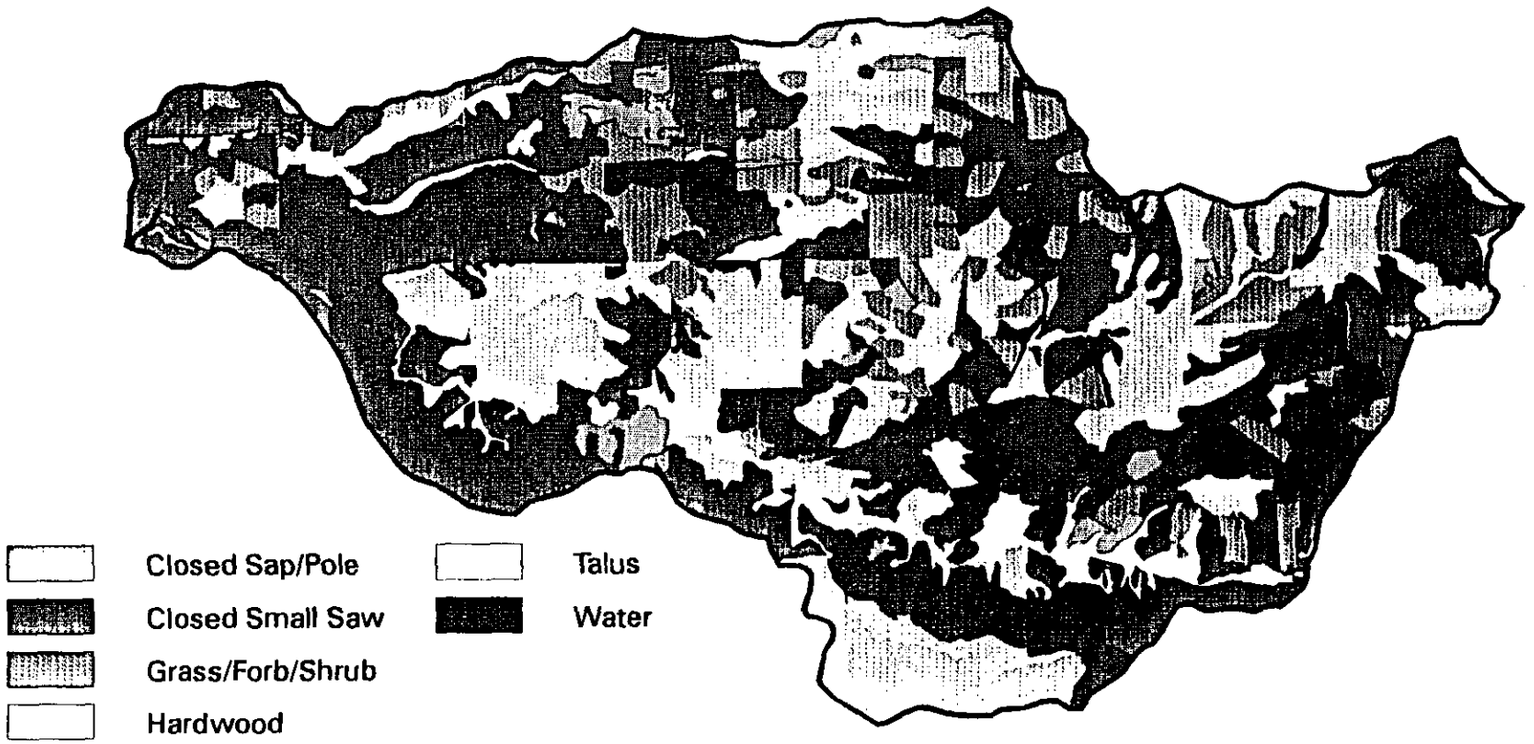
Seral Stages

Seral stages within the North Fork watershed can be grouped into three broad developmental stages: early, mid, and late seral (Table 2-8). Currently, 15% of the vegetated acres in North Fork are in an early seral condition, 77% in mid seral, and 8% in late seral (Map 2-8). The three seral stages vary by both species composition and structure of the vegetation. Seral stage is an important ecological driver within the watershed affecting a variety of ecosystem functions, including wildlife species use and migration, nutrient cycling, hydrologic function, production of snags and coarse woody debris, and disturbance processes (fire, insects, disease, and windthrow), among many others. Seral stage also greatly influences aesthetic and potential economic aspects of the watershed.

"Currently, 15% of the entire North Fork watershed is in an early seral condition, 77% in mid seral, and 8% in late seral."

North Fork Clackamas River Watershed

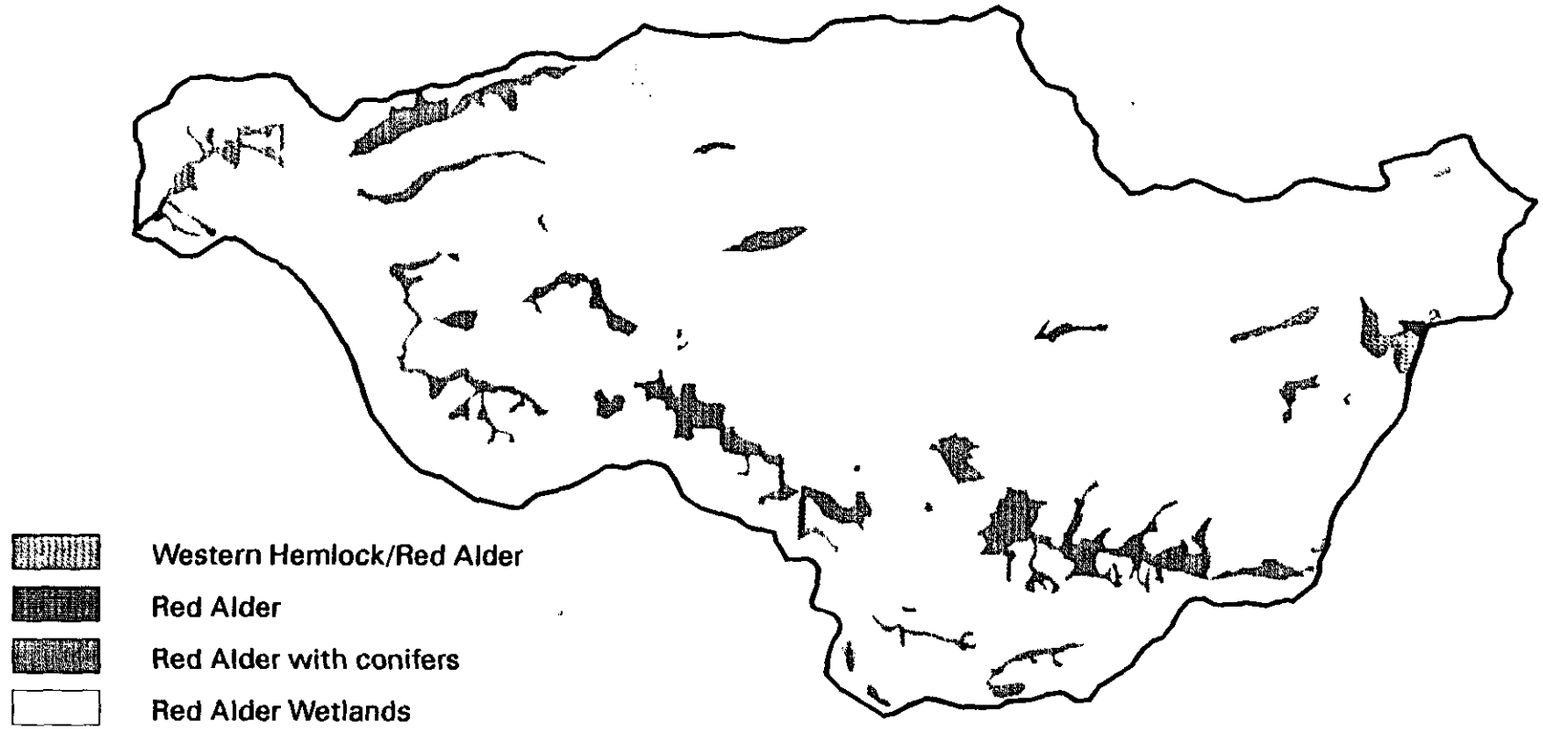
Landscape Structure



MAP 2-6

North Fork Clackamas River Watershed

Special Habitats



- Western Hemlock/Red Alder
- Red Alder
- Red Alder with conifers
- Red Alder Wetlands
- Wet Meadows
- Rocky Land
- Rock with scattered conifers
- Talus with scattered conifers
- Water

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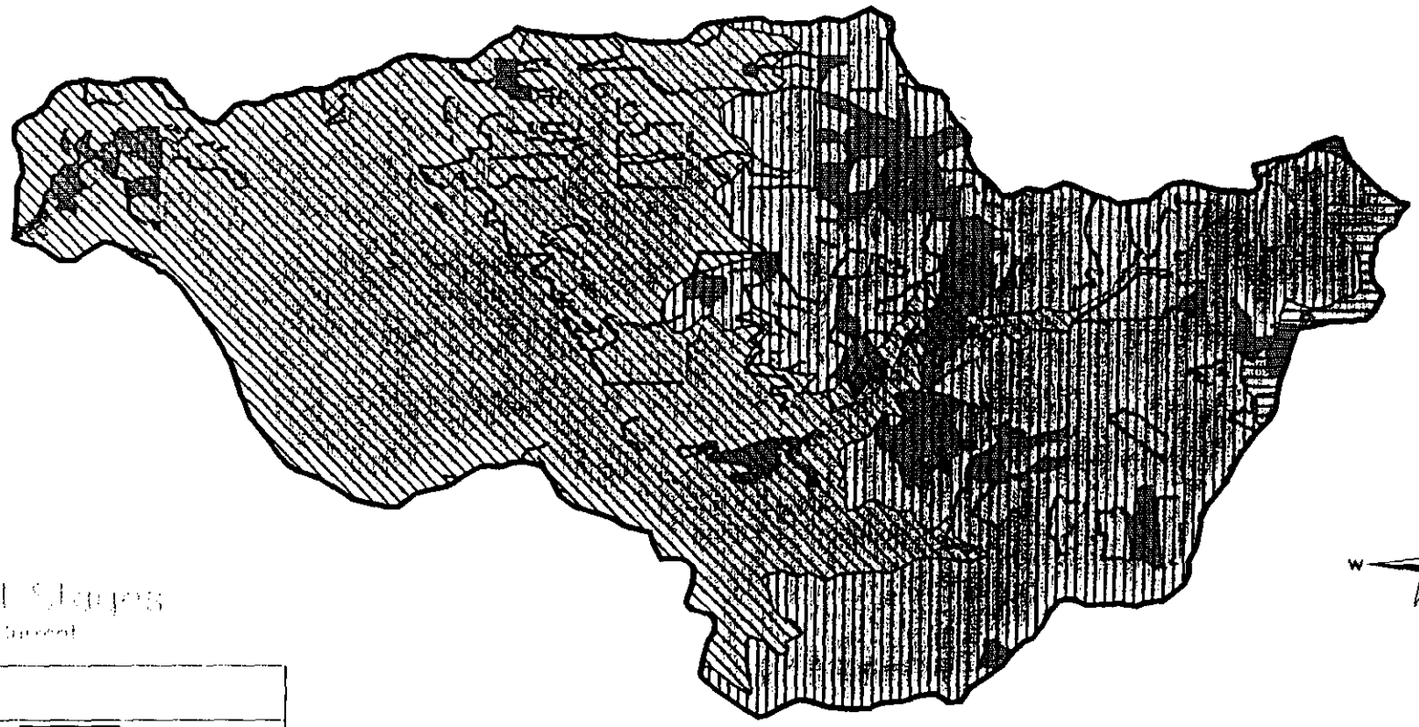
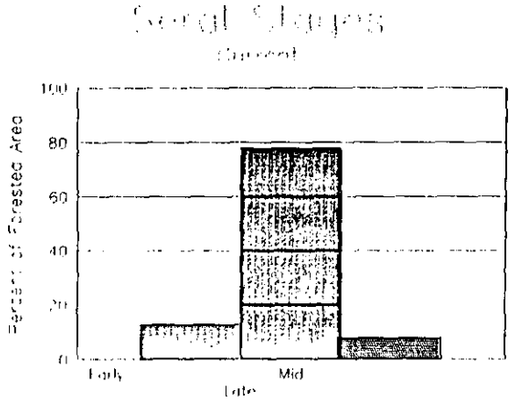
MAP 2-7

North Fork Clackamas River Watershed

Seral Stages - Current





EARLY
LATE
MID
NON -VEG.

Mtn, Hemlock Zone
Silver Fir Zone
Western Hemlock Zone

N
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MILES

MAP 2-8

For this analysis, seral stages were defined according to stand structure rather than stand age. This means that some older stands on poorer sites are included in the mid seral rather than the late seral category. Late seral stands were defined as stands dominated by conifers at least 21 inches in diameter. The late seral category includes both old growth and mature stands that have not yet fully developed old growth characteristics. The mid seral category includes closed sapling/pole stands (average stand diameter less than 8 inches, dense canopy) and small sawtimber (stands dominated by conifer trees ranging from 8-21 inches in diameter). The early seral category consists of grass/forb/shrub stands (clearcuts that have not yet advanced to the sapling/pole stage), shelterwoods, meadows, and open sapling/pole stands (conifers greater than 10 feet tall, less than 60% canopy cover).

"Eleven percent of federal lands in the watershed are currently classified as late seral habitat. The Northwest Forest Plan requires that all remaining late-successional stands should be retained in fifth field watersheds in which 15% or less of the federal land is late-successional forest."

Table 2-8. Percentage of area in early, mid and late seral stands.

	FEDERAL LANDS (Forest Service & BLM)	TOTAL WATERSHED
EARLY	10%	15%
MID	79%	77%
LATE	11%	8%

Late-Successional Habitat

Eleven percent of federal lands in the watershed are currently classified as late seral habitat (Map 2-9). These are stands dominated by conifers at least 21 inches in diameter. The North Fork watershed contains very few stands that would be classified as "old growth". Most of the stands classified as late seral are larger second growth that have not yet developed all of the characteristics of an old growth forest. Most of the late seral stands in North Fork originated in the late 1800's or early 1900's.

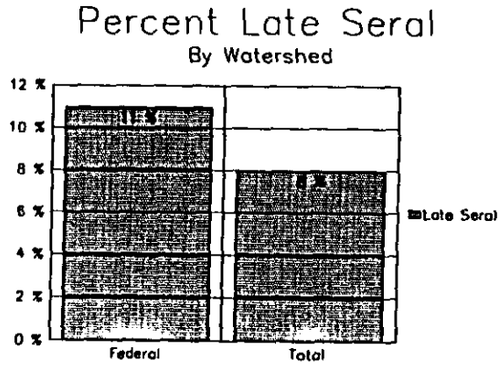
The Northwest Forest Plan requires that all remaining late-successional stands should be retained in fifth field watersheds in which 15% or less of the federal land is late-successional forest. Late-successional forest was defined by the Northwest Forest Plan as mature (80+ years) and old growth stands. This was approximated for analysis purposes as being stands with conifers greater than 21 inches in diameter. For the North Fork watershed late-successional forest was assumed to be equivalent to late seral. The intent is for these isolated late-successional patches to function as refugia where old growth associated species, particularly those with limited dispersal capabilities, are able to persist until conditions become suitable for their dispersal into adjacent stands.

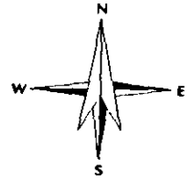
Current Age Distribution

Map 2-10 shows the current age distribution of stands on Forest Service land in the North Fork watershed. There are a few stands (shown in green) that are over 250 years old, a total of 200 acres. Some of this older forest is owned by Portland General Electric (PGE). The remainder of the watershed demonstrates the history of fire in North Fork. The northern portion of the watershed (shown in green) originated from fires in the late 1800's, and the area shown in blue is the result of stand replacement fires in the early 1900's. The area shown in magenta originated from a combination of logging and stand replacement fires in 1929 and 1939. The remainder of the age classes, from 1950 to the present, are the result of timber harvest.

North Fork Clackamas River Watershed

Late Successional Habitat





Late Seral

Critical Habitat Unit (OR-10)

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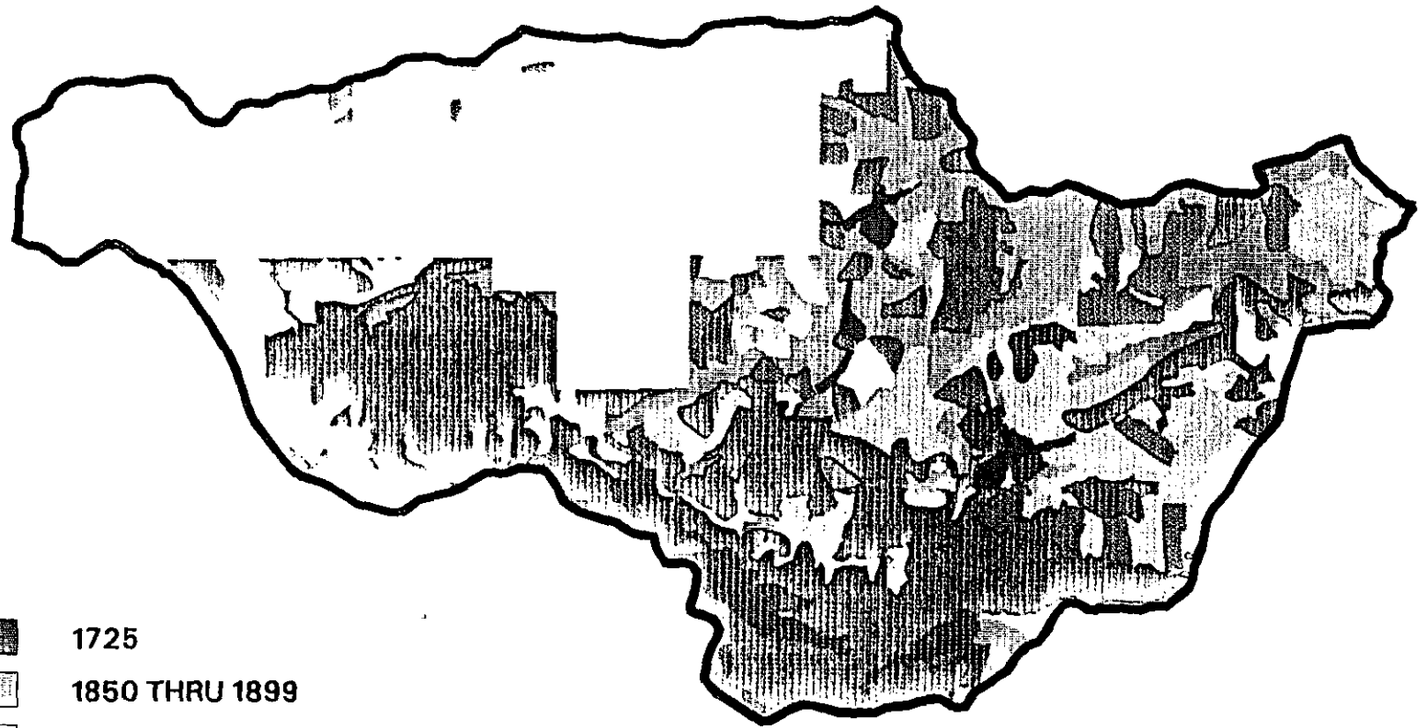
MAP 2-9

North Fork Clackamas River Watershed

Current Age Distribution



- 1725
- 1850 THRU 1899
- 1900 THRU 1919
- 1920 THRU 1949
- 1950 THRU 1979
- 1980 +

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NOTE:
Stand age information only available for Forest Service land.

MAP 2-10

Forest Series

Map 2-8 also shows the forest series that occur within the North Fork watershed: western hemlock, Pacific silver fir, and mountain hemlock. Forest series represent major differences in ecological factors such as plant community composition, growing season length, snow accumulation, productivity (particularly, the maximum size attained by mature trees), and wildlife use patterns.

Fifty-five percent of the watershed is in the western hemlock series, 43% is in the Pacific silver fir series. Two percent is in the mountain hemlock zone on the eastern border of the watershed.

Range of Natural Variability

The idea of the range of natural variability (RNV) is based on the fact that ecosystems are not static and that they vary over time and space. The dynamic nature of ecosystems exemplifies the need for us to consider ranges of conditions under natural disturbance regimes, rather than single points in time. A key assumption of this concept is that when systems are "pushed" outside the RNV there is a substantial risk that biological diversity and ecological function may not be maintained.

In 1993, the Pacific Northwest Region undertook an assessment of the RNV for several ecosystem elements that are believed to be key to ecosystem health and sustainability. The Regional Ecological Assessment (REAP) analysis was done at the subbasin scale (USDA 1993). Historic conditions were defined for the period between 1600 and 1850.

Figures 2-7 and 2-8 show the relationship between the current condition of the North Fork watershed and the estimated RNV in the Clackamas subbasin (from REAP) for two of the identified key ecosystem elements, amount of early and late seral vegetation. Only Forest Service lands within the subbasin were included in the REAP analysis. These numbers are expressed as percent of the total area (either watershed or subbasin) within each forest series.

The amount of early seral vegetation is within the estimated range of natural variability in the Pacific silver fir and mountain hemlock series (Figure 2-7). There is currently 4% less early seral in the western hemlock series than in the estimated RNV.

The amount of late seral vegetation within the North Fork watershed is below the estimated RNV in all three forest series (Figure 2-8). This is due to the predominance of mid seral habitat within the watershed, largely the result of stand replacement fires in the early 1900's, 1929, and 1939.

Figure 2-7. Current condition compared to historic range of amount of early seral vegetation. Values shown are percentage of the total area within each forest series.

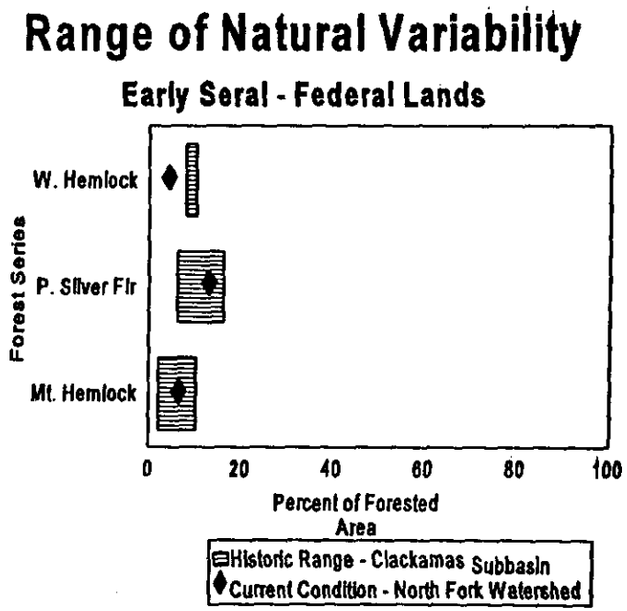
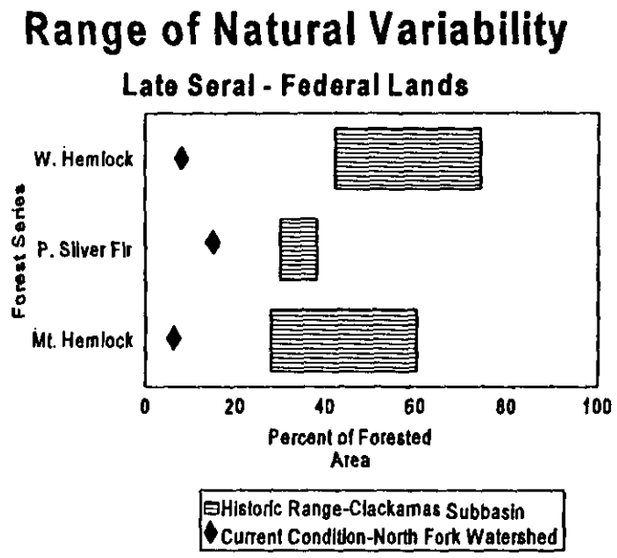


Figure 2-8. Current condition compared to historic range of amount of late seral vegetation. Values shown are percentage of the total area within each forest series.



Landscape Pattern

Current

Overall percentage of the area within various seral stages is not the only aspect of the distribution of vegetation that should be considered. The spatial arrangement is also important. Landscape pattern is a critical determinant of landscape scale ecological processes.

Some ecologically important features of landscape pattern are the amount of edge habitat, degree of fragmentation of late-successional forest (and conversely, connectivity of late-successional forest), and the amount of interior habitat. Fragmentation is one aspect of landscape pattern that has received a great deal of attention. As fragmentation of a landscape increases, the amount of interior forest habitat decreases, and the amount of edge habitat increases. Increasing edge benefits some species and is detrimental to others (Marcot and Meretsky, 1983; Rosenberg and Raphael, 1986; Temple and Cary, 1988; Yahner, 1988). As fragmentation increases, the amount of interior forest habitat decreases, impacting organisms which require large patches of interior habitat (Franklin and Forman, 1987). The North Fork watershed is largely unfragmented mid seral habitat, with an area of fragmented late seral forest.

Connectivity

The Northwest Forest Plan developed a strategy of a network of reserve areas to meet the needs of late-successional forest species. Connectivity of late-successional habitat, as addressed in the strategy, can be broken into three major categories.

"North Fork's role in the Northwest Forest Plan's connectivity strategy is in the Riparian Reserves and the small blocks (11% of the watershed) that are late seral habitat."

* LSR's (Late-Successional Reserves): intended to be large, contiguous blocks of habitat that can sustain populations or subpopulations of most late-successional associated species. The intervening matrix does not need to be late-successional habitat but must provide needs for dispersing individuals.

* Riparian Reserves: provide connectivity for less mobile species unlikely to survive outside late-successional forests even during dispersal.

* Isolated small blocks of late-successional habitat in the matrix for species to move between LSR's and

for refugia for sessile species.

There is no LSR in the North Fork watershed, except for one 100 acre northern spotted owl LSR. North Fork watershed is matrix, and is largely surrounded by the LSR network in Lower Clackamas, Roaring River, and the Salmon-Huckleberry Wilderness. North Fork's role in the Northwest Forest Plan's connectivity strategy is in the Riparian Reserves and the small blocks (11% of the watershed) that are late seral habitat.

Interior Habitat

Map 2-11 shows the current interior habitat that is present within the watershed. Interior habitat was defined as late seral stands that are at least 500 feet from any opening (natural or created). Five hundred feet is used as a convention, actual width of a functional edge varies due to many site specific factors. Mid seral stands, roads, and the watershed boundary were not counted as edge for this analysis.

North Fork has 558 total acres of interior habitat (.03% of the vegetated acres in the watershed). The largest and most contiguous blocks of interior habitat are located in the central portion of the watershed.

Historic Landscape Pattern

"Forty percent of the watershed was early seral in 1944, 56% was mid, and 4% was late seral."

Fire, historically, was the dominant landscape pattern forming disturbance in this portion of the Cascades. Map 2-12 shows the distribution of seral stages in the North Fork watershed in 1944. This map is from a vegetation map that was completed for Oregon and Washington in 1944. The mapping was done at a large scale, and is not entirely spatially accurate at the smaller, watershed scale.

Shortly before 1944 there were some large stand replacement fire events in the North Fork watershed. Forty percent of the watershed was early seral in 1944, 56% was mid, and 4% was late seral. The mid seral stands were the result of stand replacement fires in the late 1800's and younger closed sapling pole stands, originating from a fire in 1902. The early seral stands were the result of both logging and stand replacement fires in 1929 and 1939 in the Ladee Flats area.

Logging began as a major land use in the North Fork watershed in 1920 in the Ladee Flats area. Logging continued until a stand replacement fire burned through the watershed in 1929. Salvage logging followed, until another stand replacement fire occurred in 1939.

The intensity of fires in the area, coupled with salvage logging afterward, left very little remnant structures (trees, down logs) in the existing up slope stands or riparian areas. There are more remnant trees and snags remaining in the eastern portion of the watershed than in the western portion.

There was very little late seral forest in the watershed in 1944. Since that time some of the older mid seral stands have grown into late seral, and some of the late seral forest that existed at that time has been harvested.

Fire Regimes

The Mt. Hood National Forest has been divided into eleven fire ecology groups based on vegetation, fire frequency, and behavior (Evers et al., 1994). The North Fork watershed contains only one of these groups, Fire Group 8. It is the "warm, moist western hemlock and Pacific silver fir" fire ecology group. This group is a stand replacement fire type, with a fire frequency of 50-300+ years.

North Fork Clackamas River Watershed

Current Interior Forest

Edge

Interior Forest

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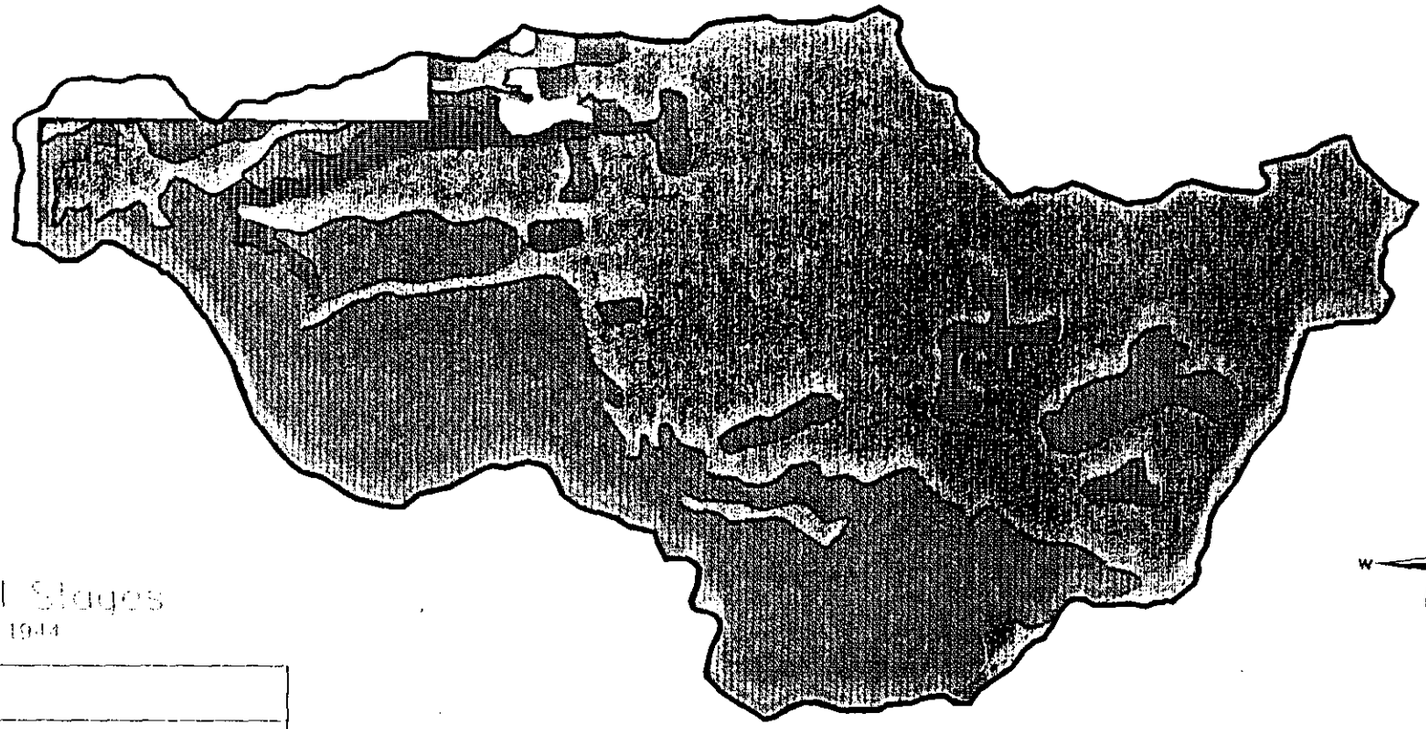
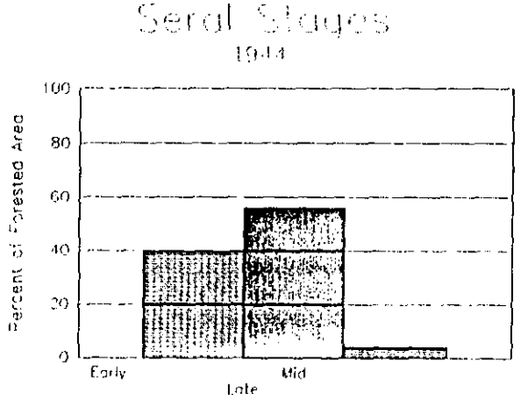
MAP 2-11

North Fork Clackamas River Watershed

Historic Seral Stages - 1944





EARLY
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AGRIC.

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MILES

MAP 2-12

Insects, Disease and Windthrow

Phellinus

Laminated root rot, caused by *Phellinus weirii,* is a serious root disease affecting Douglas-fir in the Pacific Northwest. Although this root disease does not destroy entire stands over large areas, the determination of whether the effects of this root rot in an infested stand are considered beneficial or detrimental depends on the management objectives.

On the Mt. Hood National Forest, westside districts, it is estimated that 10% of the total area is infected with root rot. Laminated root rot occurs in small scattered pockets of a few trees to about 2.5 acres. Infected trees experience significant growth and volume loss. Young trees die directly from this disease, while older trees (50 years) are predisposed to other damaging agents (generally Douglas-fir bark beetle, *Dendroctonus pseudotsugae*; and windthrow) and eventually die.

When infected trees die, the pathogen continues to live saprophytically in stumps and roots. *Phellinus weirii* spreads by root contact between infected trees or infected stumps and susceptible trees. It plays a significant role in maintaining endemic bark beetle populations over time and provides host material during times when conditions are favorable for epidemics.

"The Ladee Flats area is considered an area of concern for Phellinus weirii due to the frequency of centers and large size of pockets."

Management practices have encouraged buildup of laminated root rot inoculum when harvest leaves behind intact infected stumps and root systems and the site is replanted with highly susceptible species such as Douglas-fir. Under unmanaged conditions, natural processes would limit spread and keep the inoculum density low when windthrown trees uproot the stump and roots and the site is occupied by nonsusceptible species such as shrubs and hardwoods.

On the Mt. Hood National Forest, laminated root rot is found throughout in scattered small pockets. In the North Fork watershed, laminated root rot is found in both aggregated patterns with distinct centers and in diffuse patterns with hard to detect centers. The Ladee Flats area is considered an area of concern for the Clackamas River Ranger Districts due to the frequency of centers and large size of pockets (10 acres). The area of largest concentration is shown on Map 2-13.

Windthrow of infected trees is common and has resulted in understocked stand conditions. Laminated root rot has been documented on Ladee Flats since 1945 in plantation records. Current management of these large pockets are removing the susceptible species through regeneration harvest and replacing with resistant and immune species. This strategy provides benefits (fiber, cover, etc) while allowing time for the *P. weirii* inoculum to die.

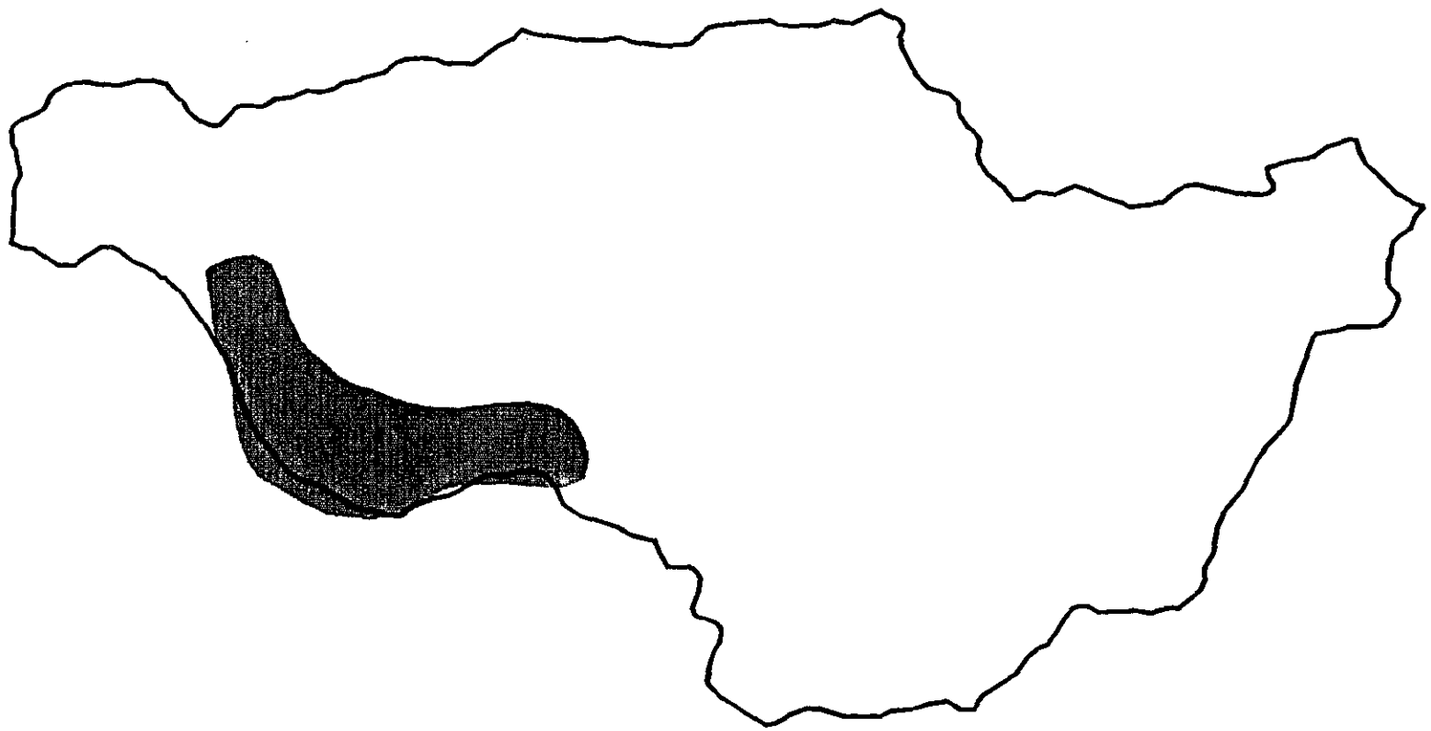
Other Disturbance Agents

Wind has been a minor disturbance agent in the past since most of the watershed is in young immature stands. Windthrow has been occurring primarily in laminated root rot pockets and in the older mature stands which have been fragmented.

In December 1983, a severe windstorm caused damage to tree crowns which took most stands approximately five years to recover from as indicated by diameter growth. However, as the young stands mature, wind damage is likely to increase. Four factors contributing to wind damage are stand conditions, physical environment, management, and the prevalent damaging winds.

North Fork Clackamas River Watershed

Insects and Disease



NOTE:
Insect damage is presently not a concern in this watershed.

Phellinus (Poria) weirii

SCALE 1:84480

1 0 1 2

MILES

N

W E

S

MAP 2-13

"An important long term objective for managing second growth stands and their health would be to manage for windfirmness of stands as they grow older and more susceptible."

Stands grown in dense conditions all their lives are particularly susceptible to windthrow when surrounding trees are removed. Dense stands depend on mutual support (from neighboring trees) to remain standing. When this support is removed (trees are cut), these stands have a high risk for windthrow during the next wind event (Groome, 1988).

An important long term objective for managing second growth stands and their health would be to manage for windfirmness of stands as they grow older and more susceptible. Trees that have been exposed to winds when they are young and rapidly growing are less likely to suffer severe damage at an older age than those that have grown in tight stands. Thinning young stands helps to maintain stem strength and create healthier, larger root systems which anchor better as trees grow older, larger, and more susceptible to wind damage (Oliver, 1990). Additional measures to design units and treatment prescriptions which consider prevailing winds and the physical environment would help to prevent catastrophic events over time.

Bark beetle activity has mainly been concentrated in the laminated root rot pockets in association with windthrow, and disturbance has been considered minor. Douglas-fir bark beetle (*Dendroctonus psedotsugae*) are present at endemic levels throughout the Clackamas River drainage. When abundant favorable breeding habitat becomes available, usually from windthrow, bark beetle population can rise to epidemic levels creating mortality in live trees. Creation of wildlife structures especially in shaded or moist environments can provide favorable habitat for bark beetle.

This is especially a concern for the North Fork watershed where large tracts of uniform Douglas-fir stands are being managed. Creation of fresh down logs and snags over thousands of acres provide a high risk to these second growth stands. The critical threshold of down material needed to spark rapid Douglas-fir bark beetle increase is not known with certainty. Based on experience in westside forests, generally, when three or more trees per acre are blown down or felled and are fully shaded, Douglas-fir bark beetle begins to increase to levels where future attack and mortality of standing live trees can be expected (Bridgewater, 1991).

Several factors contribute to increased risk of bark beetle outbreaks: number of fresh trees (3+/acre), size of tree (12"+ diameters), breeding habitat under shaded conditions, moist conditions, and allowing beetles to complete their life cycle of one year. Current management proposes up to 6 down logs per acre and creation of 2-4 snags/acre (from green trees). Logs should be at least 20 inches in diameter and wildlife trees should be 22 inches in diameter.

B. Species and Habitat

Amphibians

With the absence of significant wetlands and/or meadows in the watershed, streams and riparian areas offer the most likely habitat for amphibian species found in this area. Species known to occur in the drainage include red-legged frog (*Rana aurora*), tailed frog (*Ascaphus truei*), Pacific giant salamander (*Dicamptodon tenebrosus*), and Cope's giant salamander (*Dicampodon copei*). All of the species listed above were found in or along streams and all but the Pacific giant salamander carry some type of protection designation (see Threatened, Endangered, and Sensitive section below). Presence of other amphibian species is likely as terrestrial habitat, water quality, and water temperatures are favorable. Aquatic amphibians may also inhabit the small manmade ponds found on the private lands within the watershed.

Special Habitats

Special habitats are those which provide a unique niche for species associated with them. These species may not be dependent on these habitats but use them as primary breeding and/or nonbreeding habitat. A list of potential users of North Fork's special habitats can be found in the Analysis File. The North Fork watershed contains little of these habitat types as they relate to animal species. As stated previously (see Vegetation section, Landscape Structure), only four wet meadows are present within the drainage and rock/talus makes up 0.8% of the total land base. Since so few special habitats exist in the drainage, the ones that remain may play an important role for species utilizing them. In addition, there are no lakes, caves, mines, or cliffs present. The lack of these habitats may contribute to the absence of species known to use them, some of which warrant special consideration and/or protection through policies, regulations and/or laws (i.e., T,E, & S). However, two wooden buildings and three bridges within the watershed may provide habitat for bats, although surveys indicated no use.

"Because the North Fork watershed contains so few special habitats, these areas may play an important role for species utilizing them."

Threatened, Endangered, and Sensitive Species (T, E, and S)

Table 2-9 displays information on T,E, and S (animal) species of concern on the Clackamas River Ranger Districts. Of those species, four are known to occur in the watershed. These species include: northern bald eagle (*Haliaeetus leucocephalus)*, red-legged frog (*Rana aurora*), Cope's giant salamander (*Dicamptodon copei*), and northern spotted owl (*Strix occidentalis caurina*). See the district biologist for locations. Habitat exists for other species but confirmation of their presence is unknown. The North Fork Analysis File contains a list of species potentially occurring in the drainage and their protective status, if any.

Northern Bald Eagle

Nesting habitat is found in all forest types bordering coastal, lake, or river areas. Nests are normally in the supercanopy of trees and located within a half-mile of water. Although little nesting habitat exists within the watershed, a Bald Eagle Recovery Area lies within two miles of the watershed. The purpose of the Recovery Area is to provide optimum nesting habitat. The North Fork watershed may provide dispersal and foraging habitat as birds have been observed using the area.

Red-legged Frog

Known to inhabit moist forests and valley riparian areas, this frog has been found in terrestrial and aquatic habitat up to 5,500 feet elevation. Breeding waters vary, but they are most commonly found in water having little or no flow. Although not common on the west side of the northern Oregon Cascades, documented sightings have occurred in the North Fork watershed. Breeding habitat may occur in meadows, slow streams, or in the ponds found on both private and federal lands within the drainage.

Cope's Giant Salamander

This salamander is normally found within streams and seepages in moist temperate coniferous forests, from sea level to approximately 4,400 feet elevation; temperatures of streams generally do not exceed 18 degrees C. Several streams within the drainage may provide habitat as documented sightings have occurred. However, Cope's are difficult to distinguish from Pacific giant salamanders so sighting reliability is questionable.

Northern Spotted Owl

The northern spotted owl is a federally listed threatened species that is closely associated with late seral forest ecosystems. Nesting occurs in cavities of

Table 2-9. Threatened, Endangered, and Sensitive Species

SPECIES	STATUS BY AGENCY			HABITAT IN NORTH FORK?	KNOWN OCCURRENCE IN NORTH FORK?
	USFWS	State (Oregon)	USFS		
Spotted owl	Threatened	Threatened	Threatened	Yes	Yes
Bald eagle	Threatened	Threatened	Threatened	Yes	Yes
Peregrine falcon	Endangered	Endangered	Sensitive	No	No
Harlequin duck	------	Sensitive	Sensitive	Yes	No
Sandhill crane	------	Sensitive	Sensitive	No	No
Pacific Western big-eared bat	Former C-2	Sensitive	Sensitive	No	No
Wolverine	Former C-2	Sensitive	Sensitive	No	No
White-footed vole	Former C-2	Sensitive	Sensitive	No	No
Red-legged frog	Former C-2	Sensitive	Sensitive	Yes	Yes
Western pond turtle	------	-------	Sensitive	No	No
Painted turtle	-----	-----	Sensitive	No	No
Cope's giant salamander	-----	Sensitive	Sensitive	Yes	Yes
Larch Mountain Salamander*	-----	Sensitive	Sensitive	No	No
Tailed Frog	-----	Sensitive	Sensitive	Yes	Yes

United States Fish and Wildlife Service
United States Forest Service
*C3 -Survey & Manage Species

mature and/or over mature trees, roosting normally takes place in dense multi-layered forests, and foraging ranges across many habitat types.

The North Fork watershed contains a portion of Critical Habitat Unit OR # 10 (USFWS, 1992). The Federal lands within the drainage currently have 10,600 acres of suitable habitat (i.e., habitat available for nesting, roosting, and foraging) and 12,815 acres of dispersal habitat (i.e., habitat which satisfies needs for foraging, roosting, and protection from predators). Table 2-10 summarizes information about the single owl in the watershed. One resident single (a territorial, single owl which has been located a minimum of three times) has been confirmed in the drainage and is currently not at a level of incidental take. Take occurs when less than 1,182 acres of suitable habitat is found within a 1.2 mile radius of an owl activity center. No known spotted owl pairs are present in the watershed.

Table 2-10. Suitable Habitat Acres and Take Occurrences for the Northern Spotted Owl within the North Fork Watershed.

Owl #	Suitable Habitat Acres w/l 0.7 mi.	Suitable Habitat Acres w/l 1.2 mi.	"Take" Situation?
RS # 5292	613	1453	No

RS - Resident Single
Take occurs when less than 1182 acres of suitable habitat is found within a 1.2 mile radius of an owl activity center.

"Northern bald eagle, Red-legged frog, Cope's giant salmander, and northern spotted owl are T, E, & S species known to occur in North Fork watershed."

Survey and Manage Species

Survey and Manage species, also referred to as C-3 species, are species which require protection through survey and management standards and guidelines as outlined in the Northwest Forest Plan's Record of Decision (ROD). Two animal species, one mammal and one amphibian, are of concern in this portion of the analysis. Direction from the ROD requires that each of these species be managed under survey strategy #2, "survey prior to activities and manage sites."

Red Tree Vole

The red tree vole (*P.longicaudus*), a highly specialized tree-dweller, depends on Douglas fir trees for nesting and foraging. Its nests are built 6 to 150 feet off the ground and it feeds on resin ducts of Douglas-fir needles.

Currently no primary habitat exists within the watershed. Primary habitat consists of stands classified as large conifer (stands with at least 30% canopy closure attributed to trees greater than 21 inches diameter breast height) greater than 300 acres, which occur at less than 3,000 feet elevation, and are in the western hemlock or Pacific silver fir vegetation zones (Mellen, 1995). Secondary habitat comprises 654 acres of the watershed and is described as stands classified as large conifer between 75 and 300 acres, which occur at less than 3,000 feet elevation, and are in the western hemlock or Pacific silver fir vegetation zones. Secondary habitat is found mainly near Boyer and Winslow creeks. Marginal habitat, found scattered throughout 1,986 acres of the drainage, is classified as closed small conifer (stands with at least 60% canopy closure and trees between 8 and 21 inches diameter breast height) greater than 75 acres, which occurs at less than 3000 feet elevation, and are in the western hemlock or Pacific silver fir vegetation zones.

Larch Mountain Salamander

This species (*Plethodon larselli*), also listed as Sensitive by the Forest Service, is associated with steep, wooded, talus slopes where the rocks are of small size and there are relatively large amounts of decaying plant material and small quantities of soil. They have been found in various types of talus areas, including some with little or no moss or other

vegetative cover on the rocks. They have also been observed in woody, overgrown areas where talus is not readily visible unless ground surface is disturbed (personal communication, A. Young, 1996).

Within the North Fork watershed, little habitat is available for this species. Although the drainage contains 163 acres of rock/talus, it is not located in the steep, wooded areas preferred by the Larch mountain salamander.

Pine Marten/Pileated Woodpecker Management Areas (B5)

Currently, four B5 Management Areas exist within the watershed (Map 1-4). The desired future condition for B5 areas as outlined in the Mt. Hood Forest Plan, states that B5 areas are to contain characteristics such as high densities of quality den and nest snags and defective green trees, limited recreational and motorized vehicle access, and a healthy, older forest with mid-level canopy reaching maturity. Key habitat features for pine marten (*Martes americana*) are large patches of late-successional forest, intact forests along riparian zones, and coarse woody debris of varying decay stages to support prey species. Key habitat features for pileated woodpeckers (*Dryocopus pileatus*) are mature/over mature stands, large amounts of down woody material, large defective trees (for nesting, roosting, and foraging), and large snags.

At present, the watershed is mainly in a mid seral condition, lacks snags and down woody debris, and has very little (if any) contiguous blocks of late seral forest. Surveys for pine marten have not been conducted in the drainage and no sightings have been documented. Pileated woodpecker use is evident in much of the drainage, especially where remnant snags exist.

Snags and Coarse Woody Debris

Approximately 49 snag associated (animal) species potentially occur within the watershed (see Analysis File). Most primary cavity nesters are generalists and can make use of snags in any seral condition. However, three species of woodpecker (black-backed, three-toed, and pileated) require snags to be in late seral conditions. Two other avian species, the mountain bluebird and western bluebird, require snags in an early seral condition, and four species (barred owl, pine marten, flying squirrel, and northern spotted owl) require late seral forests.

Surveys completed over the last several years indicate that certain structural elements that are often found after catastrophic fire disturbance (patches of unburned trees, scattered large snags, large downed logs) are absent or are present in low densities in harvest created openings. Figures 2-9 to 2-12 display the densities of medium and large snags and down wood in different structural stages. The figures show that managed stands contain, on average, far fewer large snags and logs than unmanaged stands. Large snags and down log density are also influenced by stand structure and forest series. In general, the large conifer stands have greater densities of large and medium sized logs than small sawtimber stands. The mountain hemlock zone contains far fewer snags than the other series.

Mt. Hood Forest Plan Standards and Guidelines call for leaving enough snags in new harvest units to support, over time, at least 60% of the biological potential (carrying capacity) of cavity excavators. Estimates of biological potential currently tier to a model devised by Neitro, et. al. (1985). The model shows that approximately 2.6 snags per acre are necessary to achieve 60% biological potential for woodpeckers at the stand level. A weakness of this approach is that no agreement exists that this level of snag retention provides for an equivalent level of biological potential for other snag associated species (e.g., nearly all bats, arboreal rodents, bluebirds, swallows, and denning carnivores). Currently, snag levels appear to be above the Mt. Hood Forest Plan standards in all large conifer stands, below standards in most small saw stands, and below standards in all managed stands. This information, combined with the fire history, vegetative structure, and past harvest activity, would indicate that the watershed is lacking sufficient amounts and/or classes of snags.

Figure 2-9. Snag Density - Unmanaged Stands

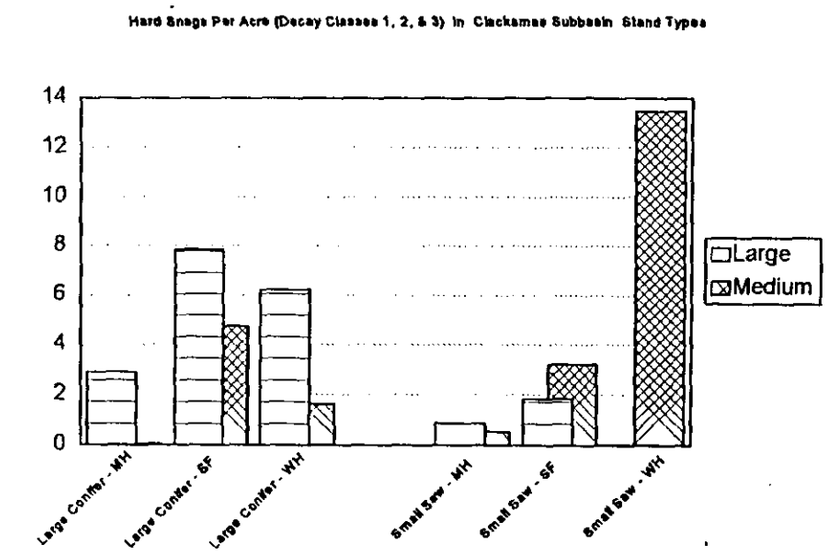


Figure 2-10. Snag Density - Managed Stands

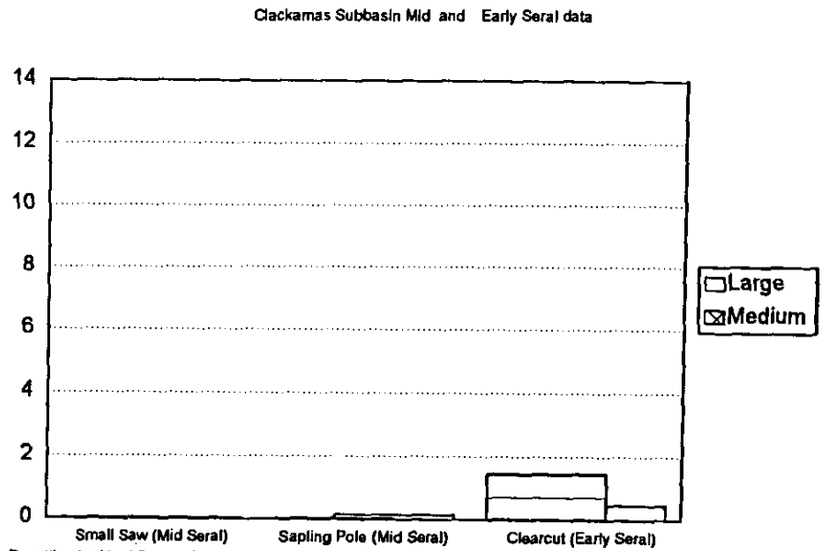
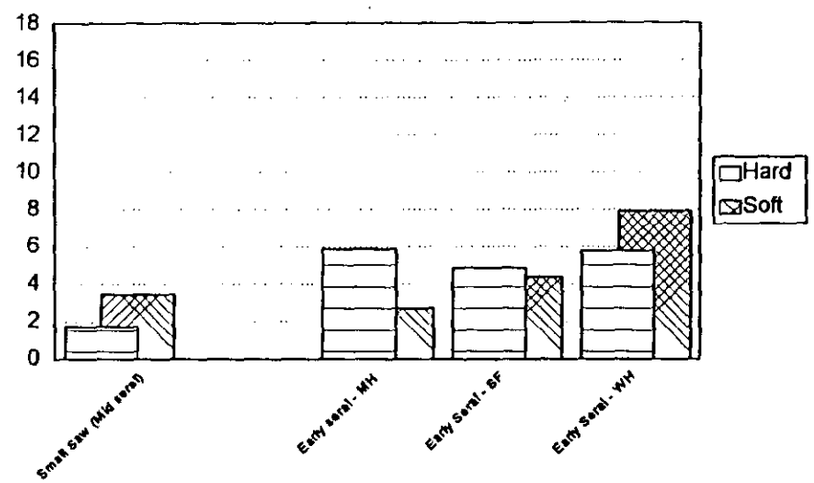
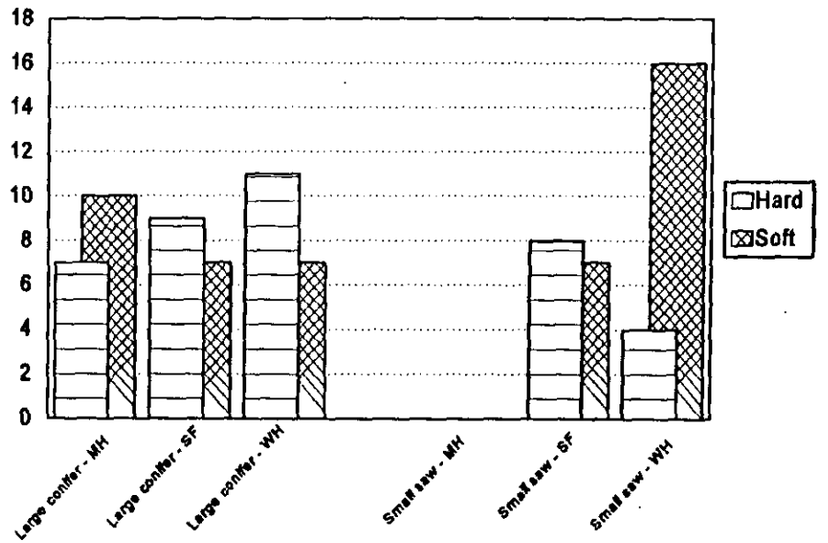


Figure 2-11. Log Density in Managed Stands (Plantations)



Hard: Decay Classes 1, 2, and 3 Soft: Decay Classes 4 and 5. MH: Mountain Hemlock series. SF: Silver Fir series. WH: Western Hemlock series.

Figure 2-12. Log Density in Unmanaged Stands



Based on Forest-wide data from natural stands in late and mid seral. MH: Mountain hemlock series. SF: Silver fir series. WH: Western hemlock series. Hard: Includes decay classes 1, 2, and 3. Soft: Includes decay classes 4 and 5

Coarse woody debris is important for denning areas; as a source of invertebrate prey species for insectivorous birds and salamanders; and habitat for voles, shrews, and various fungi which are used by the northern flying squirrel and other small mammals. Coarse woody debris density and condition is available from surveys conducted in 1987 and 1992. Figures 2-11 and 2-12 illustrate the distribution of coarse woody debris in the managed and unmanaged stands, respectively. Coarse woody debris availability corresponds well with the snag availability discussed earlier. Logs are most abundant (15-20 logs/acre) in large unmanaged conifer stands and least abundant (5-6 logs/acre) in managed stands. ROD standards for regeneration units in the Matrix (240 lineal feet/acre, 20" minimum diameter) is equivalent to 15 pieces per acre while Mt. Hood Forest Plan standards for other harvest types (salvage, thinning, etc.) is 100 linear feet/acre, equivalent to 6 pieces per acre.

Deer and Elk

The North Fork watershed contains approximately 20,636 acres, of which roughly 41% (8456 ac) is Inventoried Deer and Elk Winter Range as designated by the Mt. Hood Forest Plan (see Map 2-14). Within that designation, winter range is separated into two categories, "normal" and "severe". Normal winter range generally falls below 2,800 feet elevation while severe winter range falls below 2,300 feet elevation. Forestwide Standards and Guidelines pertaining to Inventoried Deer and Elk Winter Range indicate goals statingmandate that by the year 2000, open road densities should not exceed two mi/sq mi (FW-208).

Table 2-11 displays the existing winter range road densities (on Federal lands) within the drainage and

Table 2-11. Deer and Elk Winter Range (WR) on Federal Lands.

WR Type	WR Acres	WR Road Mi.	WR Sq.Mi.	Total Rds/sq.mi	Meets FP S and G?
Crucial (severe)	3308	14.89	5.17	2.88	No
High (severe)	335	2.35	0.52	4.49	No
Moderate (normal)	4813	26.03	7.52	3.46	No
Total	8456	43.27	13.21	3.27	------

FP - Mt. Hood National Forest Land and Resource Management Plan
S and G - Standards and Guidelines (FW-208 in this case)

Table 2-12. Deer and Elk Habitat Availability.

Cover types and habitat characteristics based on Habitat Effectiveness Model, Wisdom, et. al.

Cover Type	Habitat Characteristic(s)	Acres	Percent
Forage	Grass, Forb, Shrub, Meadow	2608	14
Hiding	Hardwood, Closed Sap Pole, Open Sap Pole	6870	33
Thermal	Closed Small Saw, Open Small Saw	9371	45
Optimal	Large Conifer	1574	8

Forage - Palatable vegetation of nutritional value.
Hiding - Any vegetation capable of hiding 90% of a standing adult deer at 200 feet or less.
Thermal - Stands at least 40' tall. Used for thermoregulation.
Optimal - Stands having dominant trees greater than 21" DBH and at least 70% canopy closure. Used for hiding, thermoregulation, avoiding disturbance, and if necessary, foraging.

indicates that in all cases, road densities exceed those recommended by the Mt. Hood Forest Plan.

In addition to normal and severe winter range designations, values of range have been placed on the habitat. These values, "crucial", "high", and "moderate", are for determining type and duration of seasonal restrictions placed on harvest operations occurring in winter range. A description of these values and their guidelines can be found in the Analysis File.

Road densities, as well as availability, sizing/spacing, and quality/quantity of forage and cover, all form the overall habitat effectiveness of a given area. Table 2-12 displays the current condition of habitat availability for the watershed. This information indicates a lack of forage and optimal cover in the drainage.

Two known migration routes traverse the watershed. Both seem to follow a northwesterly direction which meanders through various habitat types and are almost always associated with some type of water. (See Map 3-1).

Potential calving/fawning grounds, characterized by water, downed logs, hiding cover, and available forage, have been identified along Bedford Creek and the North Fork Clackamas River (see Map 2-14).

"The North Fork watershed contains approximately 20,636 acres of federal land of which roughly 41% (8456 ac) is Inventoried Deer and Elk Winter Range. There is a lack of forage and optimal cover in the watershed."

Plant Species of Concern

Threatened, Endangered, and Sensitive Species (T,E, and S)

There are no known Threatened or Endangered plant species within the North Fork watershed. Streams associated with the North Fork drainage includes habitat for two species of Sensitive plants. Two plant species found in and adjacent to cool canopied streams in North Fork include *Corydalis aquae-gelidae* (cold water corydalis) and *Huperzia occidentalis* (fir club moss). *Huperzia occidentalis* and *Corydalis aquae-gelidae* are found growing in or adjacent to seeps, springs, and streams. The former is found on duff, moss covered rocks, and downed logs and the latter, in cool headwater habitats and in the gravels of moderately scoured streambeds.

Survey and Manage Species

The Northwest Forest Plan calls for the survey and management of several species of fungi, lichens, bryophytes, and vascular plants. Information on the occurrences of these species within the North Fork watershed is lacking, especially for nonvascular plants. Of these species, two vascular plants, *Corydalis aquae-gelidae* and *Allotropa virgata,* have documented sightings. Finalized Survey Protocols and Management Recommendations are due out for these species in 1996.

Noxious Weeds

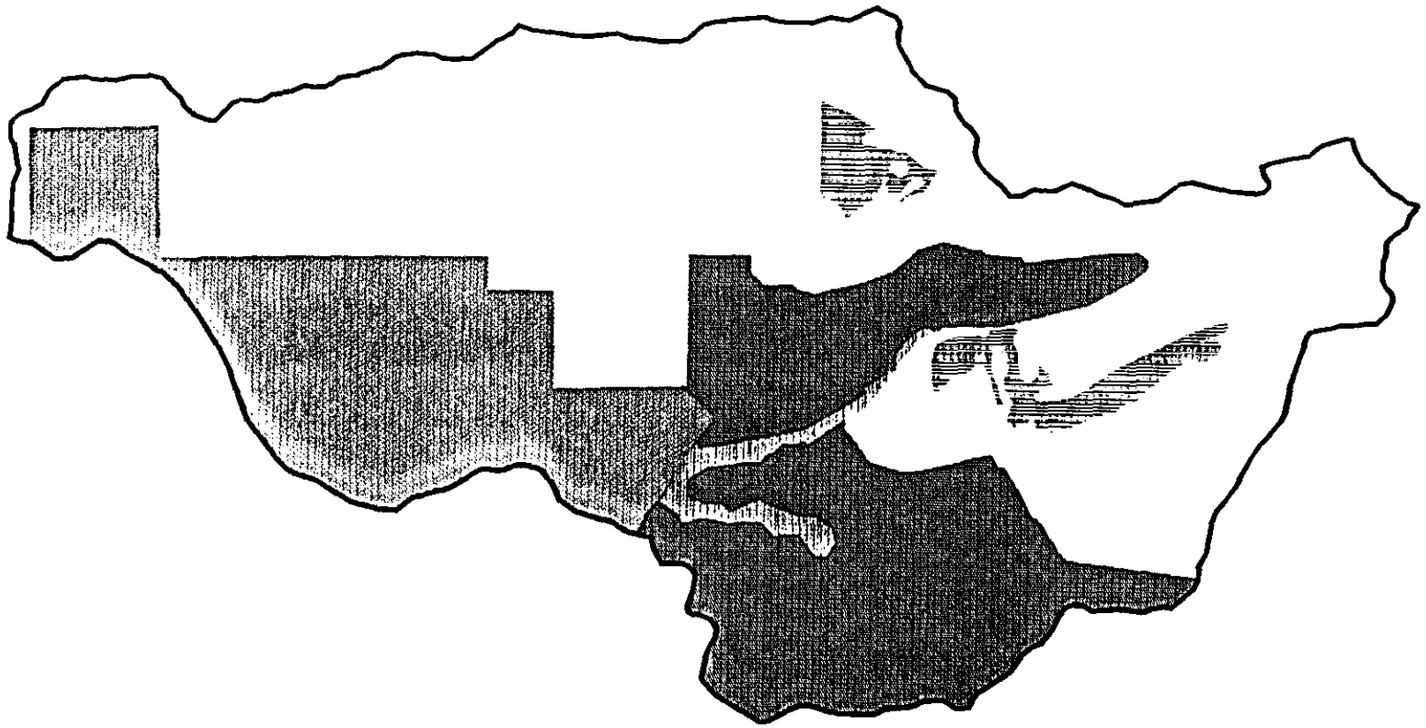
The introduction of nonnative plant species, especially noxious weeds, is a potential threat to native biological diversity. Noxious weed invasions can reduce biodiversity through the displacement of plant species necessary for wildlife habitat and can also adversely effect reforestation, visual quality, and recreational activities. Noxious weed species occurring within the North Fork watershed include *Hypericum perforatum* (St. Johnswort), *Senecio jacobaea* (tansy ragwort), *Cirsium arvense* (Canada thistle), and *Cytisus scoparius* (scotch broom). These species are found throughout the watershed in areas associated with roads, timber harvest activities, and recreational use. Nonnative seed can be carried to areas of ground disturbance through vehicle use, logging equipment,

and contaminated erosion control and forage seed mixes, as well as by wind and biological vectors. An area of particular concern for noxious weeds in the watershed is the meadow in Boyer Creek subwatershed.

"The North Fork drainage includes habitat for two species of Sensitive plants. Corydalis aquae-gelidae (cold water corydalis) and Huperzia occidentalis (fir club moss). Both are found growing in or adjacent to seeps, springs, and streams."

North Fork Clackamas River Watershed

Big Game Habitat on Federal Land



Crucial
High
Moderate
Potential Calving/Fawning Area

SCALE 1:84480

1 0 1 2

MILES

N
W E
S

MAP 2-14

Trends

Vegetation Pattern Trends

Chapter 3, Landscape Analysis and Design, displays the desired vegetation patterns for the North Fork watershed, as described in the Northwest Forest Plan, the Mt. Hood Forest Plan, and the BLM Resource Management Plan. Map 3-3 is the Concept Design, which shows the long-term vegetation pattern for the watershed. Map 3-4 is the Interim Operating Plan, which is a graphic illustration of the desired vegetation pattern and structure over the next 20 years. Chapter 3 describes in detail how these maps were developed. The future trends in vegetation patterns in North Fork will be based on the implementation of these designs, from management direction described in the Northwest Forest Plan, the Mt. Hood Forest Plan, and the BLM Resource Management Plan.

Over the next 20 years (Interim Design, Map 3-4) most of the North Fork watershed will remain in a mid seral condition. Stand management will focus on thinning of mid seral stands. Early and mid seral stands in areas to be aggregated in the future will be thinned to enhance windfirmness and stand growth and vigor. Early and mid seral stands in Riparian Reserves will be thinned to promote late seral characteristics.

Table 2-13. Long-term Future Vegetation Pattern.

PATTERN TYPE	ACRES	WHERE	% OF TOTAL WATERSHED
Aggregated	5938	Matrix / C1, Timber Emphasis / General Forest (BLM)	29 %
Interim Retention of Late Seral	1527	Remaining late seral refugia (< 15% of federal lands)	7 %
Managed Mosaic	956	Matrix C1, Timber Emphasis Where landform and adjacent allocations make the area too dissected to be in an aggregated pattern	5 %
Projected Aggregated	5774	Private timberland	28 %
Retain and Promote Late Seral	4479	Riparian Reserves	21 %
Managed Late Seral with Small Perforations (< 2 ac.)	1440	River Viewshed	7 %
Variable Canopy with Small Perforations	692	Trail Viewsheds	3 %

The Concept Design, Map 3-3, shows that over the long-term most of the North Fork watershed will be in an early or mid seral condition. Twenty-eight percent of the watershed (Table 2-13) is in private ownership that is zoned as forestland. It is projected that this area will be in an aggregated pattern in the future, with some larger early seral openings and younger mid seral blocks. Twenty-nine percent of the watershed will be in an aggregated pattern on Federal lands. This will consist of larger patches of early and mid seral habitat ranging from 0-120 years old, arranged in a mosaic pattern across the landscape. Snags, down logs, and some live trees will be retained in these areas, as prescribed by management direction. The Concept Design shows that most of the late seral habitat in the North Fork watershed in the future will be in the Riparian Reserves.

Species Trends

Plants

The future establishment of *Corydalis aquae-gelidae* will be enhanced by the Riparian Reserve network. The increased riparian canopy will reduce fluctuations in shade, moisture, and water temperatures and decrease the potential for high intensity scouring of the channel.

The retention of coarse woody debris in future harvest units may provide potential habitat for *Huperzia occidentalis* in addition to several bryophyte, fungi, vascular plants, and lichen species listed as Survey and Manage species in the Northwest Forest Plan. The logs may provide transitional islands for the recovery of these species.

Animals

Timber harvest and its associated activities, specifically road building and overstory tree removal, may decrease habitat for amphibians. Species associated with Riparian Reserve habitat are expected to remain stable or increase due to improved riparian conditions. In the future, suitable spotted owl habitat will be located primarily in the Riparian Reserves. The Matrix lands are expected to provide for dispersal needs.

As implementation of policies occurs, special habitats are expected to remain stable or slightly improve. Over the short term, early seral habitats, such as big game forage, are expected to be adequate. However, long term forage needs may decrease.

With the Portland/Metro area human population increasing, hunting pressure, especially in the short term, is expected to increase. This could lead to a decrease in big gamw effectiveness.

Current and Reference Condition

The focus of recreation use in the North Fork Clackamas River watershed is motorized dispersed recreation and the watershed receives some of the highest use in the Clackamas River drainage. The Average Daily Traffic (ADT) count on road 4610 at mile post 30.82 in 1994 was 2,700 vehicles, as high or higher than any other watershed in the drainage. This includes administrative and commercial as well as recreation traffic. Recreation features in the watershed include two abandoned Forest Service campgrounds, approximately seven miles of trails (including all three of the trails in the Clackamas River drainage legal for motorized use), access to recreation destinations outside the watershed, and an eligible Wild and Scenic River (Map 2-15). A range of recreation experiences from roaded natural, roaded modified, and semi-primitive motorized are available. Although no developed facilities like managed campgrounds exist in the watershed, it serves as a recreation destination for campers, off highway vehicle (OHV) users, target shooters, and hunters. Use is high and concentrated even though there are no natural features like lakes or mountain vistas to attract users.

The two primary features of the watershed which attract use are its close proximity to the Portland metropolitan area, including the town of Estacada, and the low level of management presence. These two factors contribute to a recreation experience of independence, challenge, and skill development. Proximity, access, and lack of management presence has also contributed to illegal and anti-social behavior such as garbage dumping, indiscriminate target shooting, underage drinking, assaults, stolen vehicle dumping, and special forest products theft, especially firewood theft. Although these activities occur in every watershed of the Clackamas River drainage, the concentration of the uses has been noted as high by Forest Service Law Enforcement Officers, Forest Service employees, and the public.

"The watershed receives some of the highest use in the Clackamas River drainage."

Because no use figures are available for dispersed recreation, analysis of use is based on anecdotal information from Forest Service employees and the public. For the purpose of this analysis, stratification of the watershed includes the river corridor of the North Fork Clackamas River, the Ladee Flats area, and public land in the rest of the watershed.

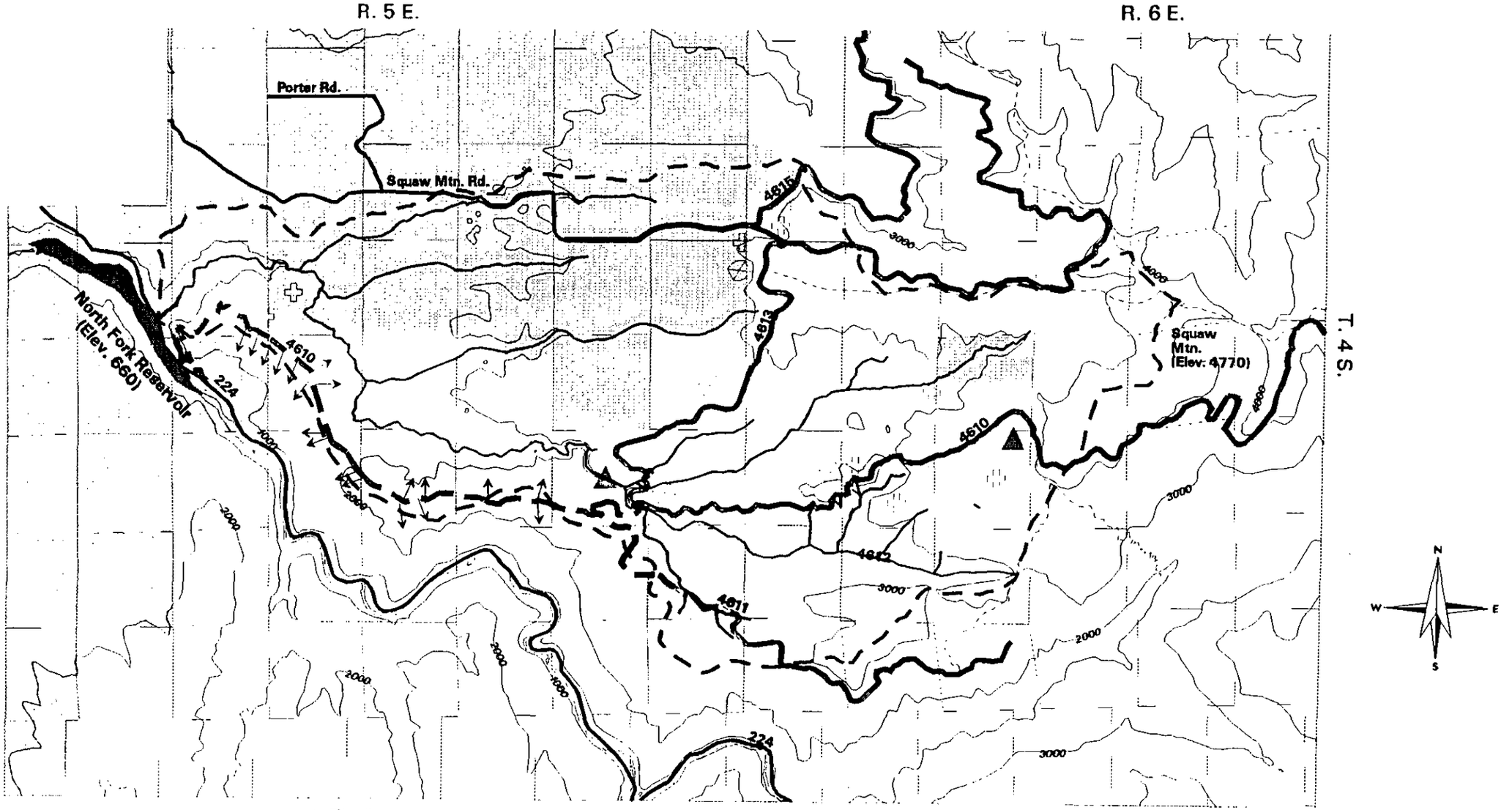
North Fork Clackamas River

"Steep valley side slopes, a constrained river valley, and a general lack of roaded access limit recreational use of the river."

The entire 12.6 mile length of this river has been found eligible for Wild and Scenic River designation (Map 2-16) because of its free flowing nature and the presence of late winter run coho salmon. The lower 2.6 miles of the river on Bureau of Land Management (BLM) land has been classified Recreational and the upper 10 miles has been classified Scenic. Until a final eligibility study has been completed, management direction includes retention of the 1/4 mile interim boundary on both sides of the river above the average annual high water mark. Within this boundary, the Visual Quality Objectives (VQO) specified in the Mt. Hood Forest Plan are Retention in the foreground for the Scenic segment and Partial Retention in the foreground for the Recreational segment. In addition, in 1988 the river was designated a State Scenic Waterway through the Oregon Rivers Initiative. The State Scenic Waterways Act requires that the State Land Board approve any alteration of the bed and/or banks of a scenic river or wetlands within the scenic waterway .

North Fork Clackamas River Watershed

Recreation



Private Land Ownership

LaDee Flat

Main Route Closed to Shooting

Dispersed Target Shooting

Main Routes thru Watershed

Double Lane Paved

Trail

Streams

Abandoned F.S. Campground

Target Shooting Area

Dispersed Camping Area

OHV User Trail

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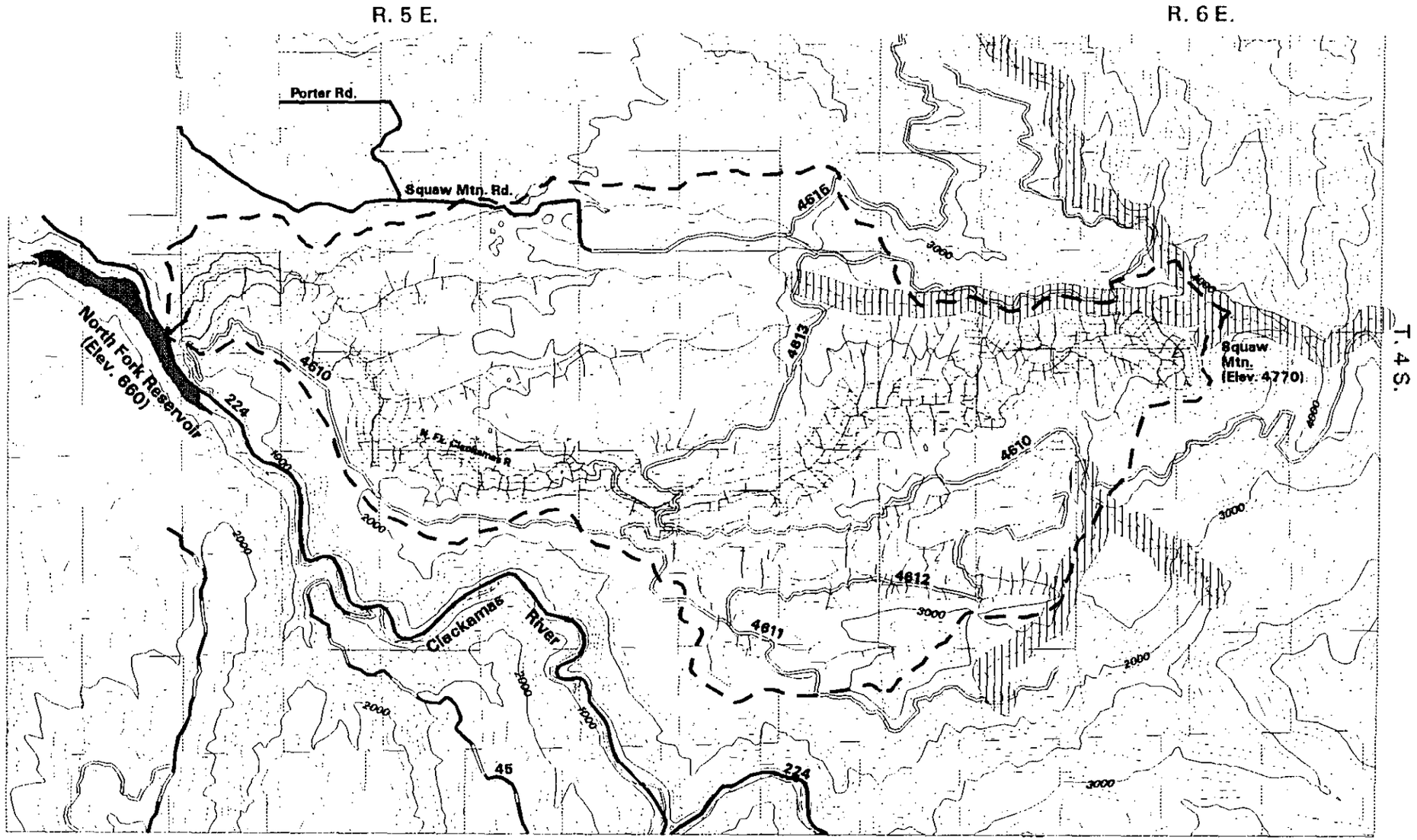
1 0 1 2

MILES

MAP 2-15

North Fork Clackamas River Watershed
Viewshed



Single Lane Paved

Gravel, Suitable For Passenger Cars

Double Lane Paved

Trail

Eligible Wild Scenic River

Trail Viewshed

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MILES

N W E S

MAP 2-16

Steep valley side slopes (average 40%), a constrained river valley, and a general lack of roaded access limit recreational use of the river. Dispersed camping occurs primarily at North Fork Crossing which was a developed Forest Service campground until the early 1980's when it was closed for lack of funding. Currently the site receives heavy use from campers and is both a popular underage party site and homeless camp. Located within the riparian area, the site shows signs of devegetation, compaction, and erosion in excess of Mt. Hood Forest Plan standards and has been the site of restoration work to control vehicle access and restore hydrologic processes. Public health and safety are important issues in this campground because of the lack of sanitation facilities, garbage, and reported instances of assault and theft.

The North Fork watershed supports recreational fishing. Although there are native winter steelhead, spring chinook, and coho salmon which occupy the lower 2.4 miles of the river below the barrier falls, current regulations do not allow fishing for these species. The sport fishery includes native rainbow and cutthroat trout and hatchery run summer steelhead and stocked rainbow trout.

The North Fork watershed can also provide the angler with a primitive fishing experience. Except for a few road crossings, access to most of the streams involves hiking. This helps to isolate and protect the fish from human harassment and increased angling pressure as well as providing a primitive setting. North Fork Crossing provides the public easier access to the North Fork, Dry, and Boyer Creeks for native rainbow and cutthroat trout fishing. The east arm of the North Fork Reservoir also offers easy access for the angler.

"Proximity, access, and lack of management presence has also contributed to illegal and anti-social behavior such as garbage dumping, indiscriminate target shooting, underage drinking, assaults, stolen vehicle dumping, and special forest products theft, especially firewood theft."

Ladee Flats

Ladee Flats, as its name indicates, is a large, flat, low elevation terrace between the river canyons of the Clackamas River and the North Fork Clackamas River. The main access route through the area is road 4610 which is also the main access route through the watershed. Although the area south of 4610 technically falls within the Lower Clackamas watershed, public use is associated with the North Fork Clackamas River watershed and is included in this analysis. During the 1980's and 90's, Ladee Flats became a popular dispersed recreation destination because of its close proximity to Portland and Estacada and the ease of its roaded access. Initially the area was a popular destination for unmanaged target shooting beginning at an abandoned airstrip on BLM land bordering the west side of 4610. As use of this unofficial shooting range increased, the public began to create more unofficial shooting ranges in the Ladee Flats area and at least nine unofficial ranges were identified in 1992 by FS personnel in a three mile stretch along 4610. A high incidence of tree mortality occurred in these shooting ranges because targets were hung on trees without adequate backstops and resulted in long, devegetated corridors. The shooting ranges along the south side of 4610 were within 1/3 to 1/2 air miles from popular recreation sites along the Clackamas River and were identified as a special public safety concern. Because of this concern for public safety, a Code of Federal Regulations (CFR) closure to all shooting on Forest Service and BLM land from the junction of Highway 224 and 4610 to the junction of 4610 and 4611 was implemented in 1992.

Garbage dumping and unmanaged OHV use are closely associated with the corridors created by the target shooting. The dumping of household garbage is concentrated in Ladee Flats but occurs throughout the watershed wherever roaded access is available. Household garbage, especially appliances, were used as targets in the shooting ranges. The 1992 shooting

closure was accompanied by an integrated plan to revegetate the shooting ranges, sign the closed area, and emphasize the Ladee Flats area for repeated clean up by the Forest Service, SOLV (Stop Oregon Litter and Vandalism), and local OHV groups. Repeated clean up is still necessary and ongoing in Ladee Flats with greater quantities of trash collected every year.

A consequence of the corridors created by the shooting ranges and spur roads from timber sales has been an increase in unmanaged OHV use. The existing corridors have been expanded by users into numerous unmanaged and unmapped OHV trails. This use is focused on Ladee Flats because the flat grade allows ease of off road access unlike the steeper slopes found elsewhere in the watershed. Wet areas adjacent to 4610 and intersections with spur roads have become devegetated "mud holes" for unmanaged OHV recreation. Most of these user built roads and trails dead end and do not serve as a trail network. This use is not sanctioned by OHV clubs and does not serve the need for a managed OHV trail system.

Target shooting still occurs throughout the watershed. The flat accessible portions of the 4611 road have been reported to show an increase in this activity. The North Fork Rock Pit and an unnamed borrow pit near North Fork Crossing have become informal target ranges with household garbage often used as targets. Indiscriminate shooting and vandalism also occurs in all roaded portions of the watershed.

Garbage dumping is also a pervasive use within the watershed and is due to roaded access, proximity to population centers, and lack of managerial presence. Ladee Flats, timber sale landings, spur roads, the rock pits, and North Fork Crossing are the primary locations for illegal trash dumping but dispersed quantities of litter along the roadsides are also becoming prevalent. In addition, hazardous material (Hazmat) is being found more often in secluded locations including materials used in the manufacture of illegal drugs.

Trails

Four trails ring the perimeter of the watershed or originate within it to access destinations in adjacent watersheds. These trails are the Huxley Lake Trail #521, Corral Springs Trail #507, Fanton Trail #505, and a portion of the Old Baldy Trail #502. Three of these trails, #521, #507, and #505, are the only trails in the Clackamas River drainage designated for motorized use. The trailhead for the Fanton Trail #505 is located on road 4613 and the trail follows the watershed boundary between the North Fork watershed and Eagle Creek watershed for approximately 4.3 miles. The trail is an easy ridgeline grade and is designated for hikers, mountain bikers, and equestrians as well as motorcycles. Use is considered medium. The trail dead ends at the Old Baldy Trail #505 which is part of a trail complex accessing Eagle Creek watershed, Roaring River watershed, and the Salmon Huckleberry Wilderness. The Old Baldy Trail is considered to be more difficult and use is judged medium. Use is limited to hikers, equestrians, and mountain bikers and does not provide a loop opportunity for OHV users.

Both the Huxley Lake Trail #521 and the Corral Springs Trail #507 originate at the former Forest Service campground Lookout Springs. The Huxley Lake Trail follows the rim of the watershed for 1.75 miles. This trail is also accessed from the end of the 4611 road. Both trails provide access into the Roaring River watershed and are consider more difficult. They are also open to hikers, equestrians, mountain bikers, and OHV users. Although valued by OHV users for the legal motorized recreation opportunity, use is consider light and the trails do not provide loop opportunities.

OHV

The popularity of off highway vehicle (OHV) use in the North Fork Clackamas watershed exceeds the 2% of total Forest recreation use estimated in the Mt. Hood Forest Plan. Roaded access and proximity are only two factors which account for this popularity. Other factors include the presence of the only three trails in the Clackamas River drainage designated for

motorized use, the lack of management presence, and flat areas for users to get off road such as Ladee Flats.

The watershed does not meet the needs of all OHV users or of organized OHV clubs. An estimated interconnected network of 50 to 100 miles are necessary for off road bike users while jeeps and 4x4 vehicles are interested in open roads with access to routes in other watersheds. Organized jeep and 4x4 users are also interested in obstacle courses with significant elevation changes. Trail and obstacle courses need to be designated and should provide different levels of challenge and experience. Surfacing, track width, scenery, parking space, and staging areas are other important factors in determining user satisfaction.

Another deterrent to family and organized OHV use in the watershed is the high level of indiscriminate shooting and illegal behavior. The current provision of 6.5 miles of unconnected designated motorized trail does not meet the needs of organized OHV clubs and family users, although it could serve as a foundation for a managed OHV system in the watershed.

Dispersed Camping

Unlike other watersheds in the Clackamas River drainage, dispersed camping is more closely associated with road access than water features and settings. This is because the steep terrain surrounding the river and creeks limits access. Primary campsites are North Fork Crossing and Lookout Springs but every spur road, timber sale landing, and rock pit is used. In addition, camping occurs along roads 4610 and 4611 wherever the road is wide enough for a vehicle to pull over. This type of opportunistic use usually occurs during hunting season in the rest of the drainage but throughout the year in this watershed. Many of the dispersed campsites are also used by homeless people and as underage party sites. Drinking and driving has caused fatal car crashes in the watershed particularly on the hairpin turns on 4610.

Like North Fork Crossing, Lookout Springs is a popular and convenient camping area in close proximity to trails #521 and #507. Lookout Springs Campground was probably built by the Civilian Conservation Corps (CCC) in 1934 but currently no longer possesses sufficient integrity for listing on the National Register of Historic Places according to Forest Service archaeologists. The campground is located on a fairly flat bench approximately 150' from Lookout Springs which is an intermittent spring fed through a drainage pipe in the fill slope of road 4610. The campground was part of a series of five district campgrounds in the North Fork watershed and the Roaring River watershed accessed by the Abbott Road. These campgrounds were abandoned by the Forest Service due to lack of funding and no services are currently provided. Lookout Springs Campground is a popular dispersed site and new campsites created by users are limited only by the extent of available flat ground.

Hunting

Hunting for deer and elk is a popular activity in the watershed with a minor amount of hunting for bear and grouse also occurring. Although the deer and elk populations are not of a significant size to ensure hunter success, proximity to Portland and Estacada make it a popular destination for road based, day use hunting. Poaching is also estimated to be higher than normal for the drainage because of proximity, low management presence, and county road access.

Special Forest Products

The watershed is a popular site for harvesting special forest products like mushrooms, beargrass, vine maple, poles, and firewood although most of that use is now concentrated in the Roaring River watershed. The watershed is also noted for a high level of firewood theft because of county road access and proximity to population centers.

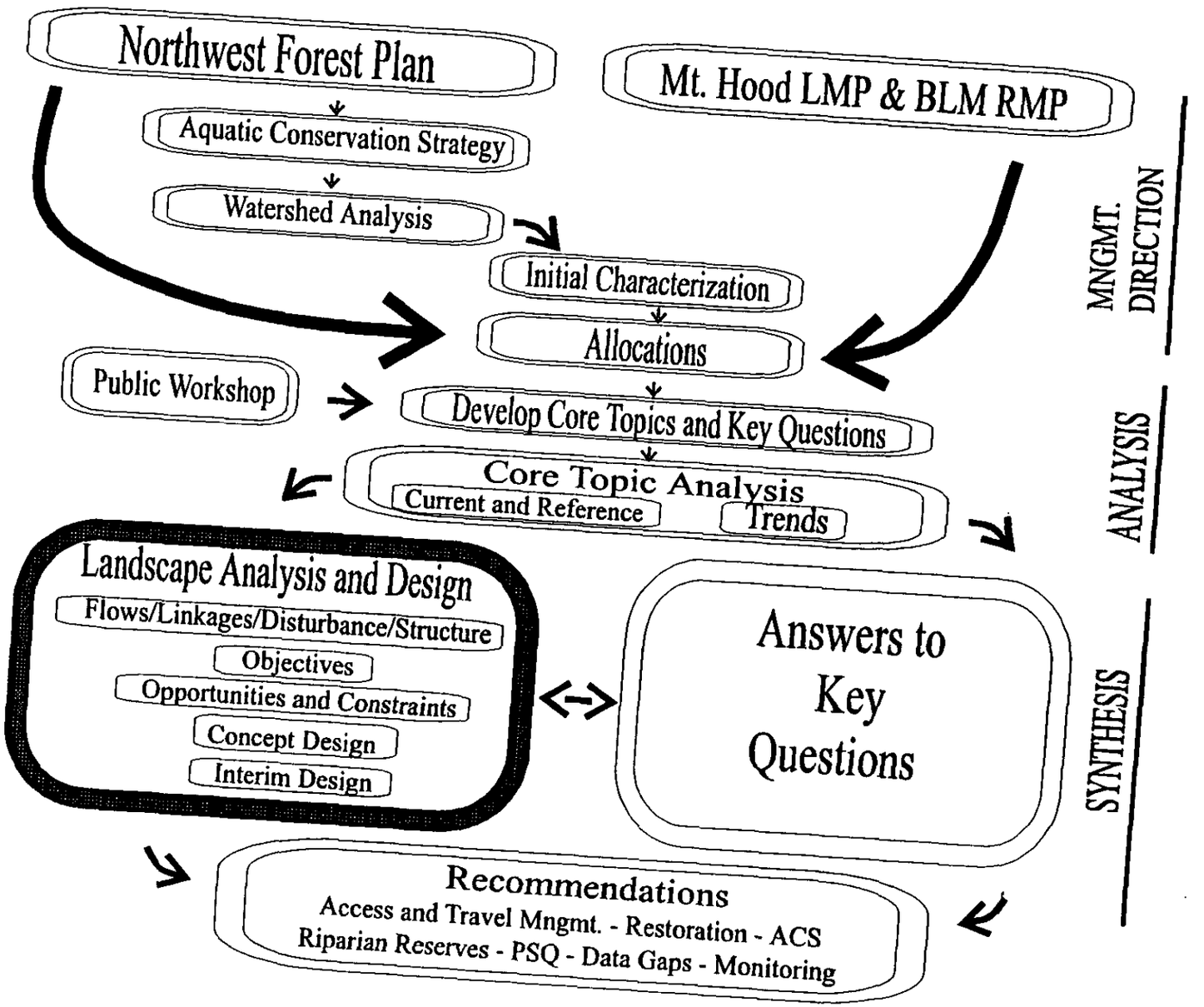
Trends

Recreation use in the watershed and traffic through the watershed to other recreation destinations is expected to increase as the population of Portland and surrounding communities increases. Demand for all recreation activities currently occurring in the watershed: hiking, camping, equestrian use, driving for pleasure, off-highway vehicle use, fishing, hunting, and target shooting; are all projected to rise according to the State Comprehensive Outdoor Recreation Plan (SCORP). With the limited facilities present in the watershed, user conflicts such as between equestrian users and motorized users on trails could rise. Increased hunting and fishing pressure could also lead to lower hunter and angler success and an expansion of OHV use could negatively affect deer and elk herds, also limiting hunter success. Along with increased recreation use, it is expected that the anti-social and/or illegal activities occurring there now will continue to increase.

New Oregon State OHV regulations could increase trail and quad bike use on open roads like 4610 and 4611 which could lead to user conflicts with administrative, commercial, and recreational traffic. Road closures could also limit recreation opportunities for motorized recreation like dispersed camping, hunting, and OHV.

According to SCORP, there is a regional shortage in the supply of primitive and semi-primitive recreation settings and the North Fork watershed could play an important role in the provision of those settings. An increase in the number of users and a more visible management presence could reduce the primitive/semi-primitive qualities of the watershed. Increased timber harvest and road maintenance for logging trucks could also change the character of the recreation setting.

Chapter 3
Landscape Analysis and Design



LANDSCAPE ANALYSIS AND DESIGN

The Landscape Analysis and Design (LAD) process unites forest planning with the principles of landscape ecology and emphasizes the conscious design of vegetation patterns in the landscape based upon management objectives. The premise of the LAD process is that different landscape structures in the watershed can be arranged spatially according to the management direction within the parameters of the watershed's physical and biological potential. Information about the LAD process is described in detail in the publication *Forest Landscape Analysis and Design* by Diaz and Apostol, 1992. The goal of using the LAD process in the North Fork watershed Analysis is to synthesis current management direction from the Northwest Forest Plan, Bureau of Land Management Resource Management Plan, and the Mt. Hood Forest Plan, with the site specific analysis and recommendations from the watershed analysis to form a spatial plan of vegetation patterns and forest structures. In addition, the LAD process was used in the watershed analysis as the synthesis step to coalesce individual resource analysis into a landscape scale understanding of the watershed.

The LAD process for the North Fork watershed began with a comprehensive review of management direction and land allocations and was followed by an analysis of landscape structure, flow phenomena, linkages to the larger landscape, and disturbance regime. This analysis combined with landscape objectives from the existing management direction were used to create an opportunities and constraints map, a conceptual landscape design, and an interim landscape design for the watershed. The designs and plans produced during the LAD process graphically display where future management activities will occur in the watershed and serve as a bridge between analysis and site specific project development.

Landscape Allocations and Design Objectives

Because design is an objective driven process, the establishment of clear landscape objectives for the watershed design is a critical first step of the process. Design objectives for North Fork watershed were derived from the Northwest Forest Plan, Mt. Hood Forest Plan, and the BLM Resource Management Plan.

The next step in the LAD process involved translating the management objectives into vegetation pattern types. Some management directions and land allocations have clear vegetation pattern objectives such as the retention of late seral forest structure in the Riparian Reserves and Owl Activity Centers. Other vegetation pattern objectives had to be developed from the management direction based on watershed specific ecological structures and processes. The following list includes both management direction from the land allocations and the watershed specific vegetation pattern types.

Northwest Forest Plan

Riparian Reserves

Goal: Achieve and maintain riparian and aquatic habitat conditions for the sustained, long-term production of fish, selected wildlife and plant species, and high quality water for the full spectrum of the forest's riparian and aquatic areas. A secondary goal is to provide habitat connection for late-successional species and dispersal habitat for other terrestrial species.

Pattern Type: Late Seral forest structure.

100 Acre Spotted Owl Late Successional Reserve

Goal: Retain one hundred acres of the best northern spotted owl habitat as close to the nest site or owl activity center as possible for all known spotted owl activity centers located on federal lands in Matrix.

Pattern Type: Late seral forest structure.

Matrix (also C 1 Timber Emphasis from Mt. Hood Forest Plan and General Forest from BLM RMP)

Goal: Provide lumber, wood fiber and other products on a regulated basis, based on the capability and suitability of the land. The intent is to retain structural components like 15% green trees, snags, and down woody debris to facilitate species flow. A secondary goal is to function as connectivity between LSR's and provide habitat for a variety of organisms associated with both late successional and younger forests. This is the predominate land allocation within the watershed and is similar to the C1 Timber Emphasis land allocation from the Mt. Hood Forest Plan.

Pattern Type: Two vegetation pattern types were determined for this land allocation, Aggregated and Managed Mosaic which reflect the goal of timber emphasis. The Aggregated pattern is composed of larger patches of early and mid seral habitat ranging from 0-120 years old. Large Aggregated patches would retain structural components like 15% green trees, snags, and down woody debris and would be fitted to the landform.

The Managed Mosaic pattern type includes areas where landform and adjacent allocations make the area too dissected to be in an aggregated pattern. This pattern type also includes the retention of structural components as specified in the Northwest Forest Plan.

The intent of this pattern type is to avoid forest fragmentation in the future, and to create a landscape pattern which more closely approximates the natural disturbance pattern. Aggregated harvest will probably not proceed through the creation of very large openings at any one time. An aggregated patch will more likely have a narrow range of age classes ranging from 0-30 years within the aggregated patch. This concept could be termed an "aggregated young mid seral" strategy rather than an "aggregated early seral"strategy.

Development of the Aggregated and Mosaic pattern would also include the structural components like opening size, forage, and cover, to be compatible with the goals of the inventoried critical and high deer and elk winter range from the Mt. Hood Forest Plan.

Interim Retention of Late Seral

Goal: Remaining late seral refugia which is < 15% of federal lands in the watershed.

Pattern Type: Late Seral Forest Structure

Mt. Hood Forest Plan

C1: Timber Emphasis

See Matrix

Eligible Wild, and Scenic Rivers

Goal: The North Fork Clackamas River is eligible for designation by congress as a Wild and Scenic River. Management activities should be designed to protect the free-flowing nature and outstandingly remarkable values of river until it is designated as a Wild and Scenic River or released from consideration. Until final eligibility determination, management direction includes a 1/4 mile interim boundary on both sides of the river above the average annual high water mark. The Visual Quality Objective (VQO) for the foreground of the river in the Scenic segment is Retention which means the scenery should appear as a predominantly natural landscape where human activities are not evident to casual visitors. In the Recreational segment, the VQO is Partial Retention within the foreground of the river which means evidence of human activities is permissible, but is subordinate to the characteristics of the natural landscape.

Pattern Type: : Managed Late Seral with small perforations, thinning, and irregularly shaped openings

Trail Viewshed.

Goal: All three trails in the watershed are Level 2 Sensitivity Trails and the scenic viewsheds overlay the C1 Timber Emphasis land allocation. Within the 660' near foreground on both sides of the trail, vegetation management must meet the Mt. Hood Forest Plan VQO standard of Partial Retention which means evidence of human activities is permissible but is subordinate to the characteristics of the natural landscape.

Pattern Type: variable canopy and small irregularly shaped perforations. Emphasize a diversity of trees and shrubs species of various sizes and ages, distributed in natural appearing patterns. Natural appearing openings may occur to enhance views to landscape features.

A9 Key Site Riparian Area

Goal: Maintain or enhance habitat and hydrologic conditions of selected riparian areas, notable for their exceptional diversity, high natural quality and key role in providing for the continued production of riparian dependent resource values.

Pattern Type: A9: Late seral forest structure.

B5: Pileated Woodpecker/Pine Marten Habitat Area

Goal: Provide Forest wide mature or Old growth Forest habitat blocks of sufficient quality, quantity and distribution to sustain viable populations of pine marten and Pileated woodpecker. A secondary goal is to maintain a healthy forest condition through a variety of timber management practices.

Pattern Type: Late seral forest structure.

Private Land:

Projected Aggregated harvest pattern of large openings on zoned industrial forest private lands retaining few structural components and narrow riparian buffers..

Landscape Analysis

Landscape Structure

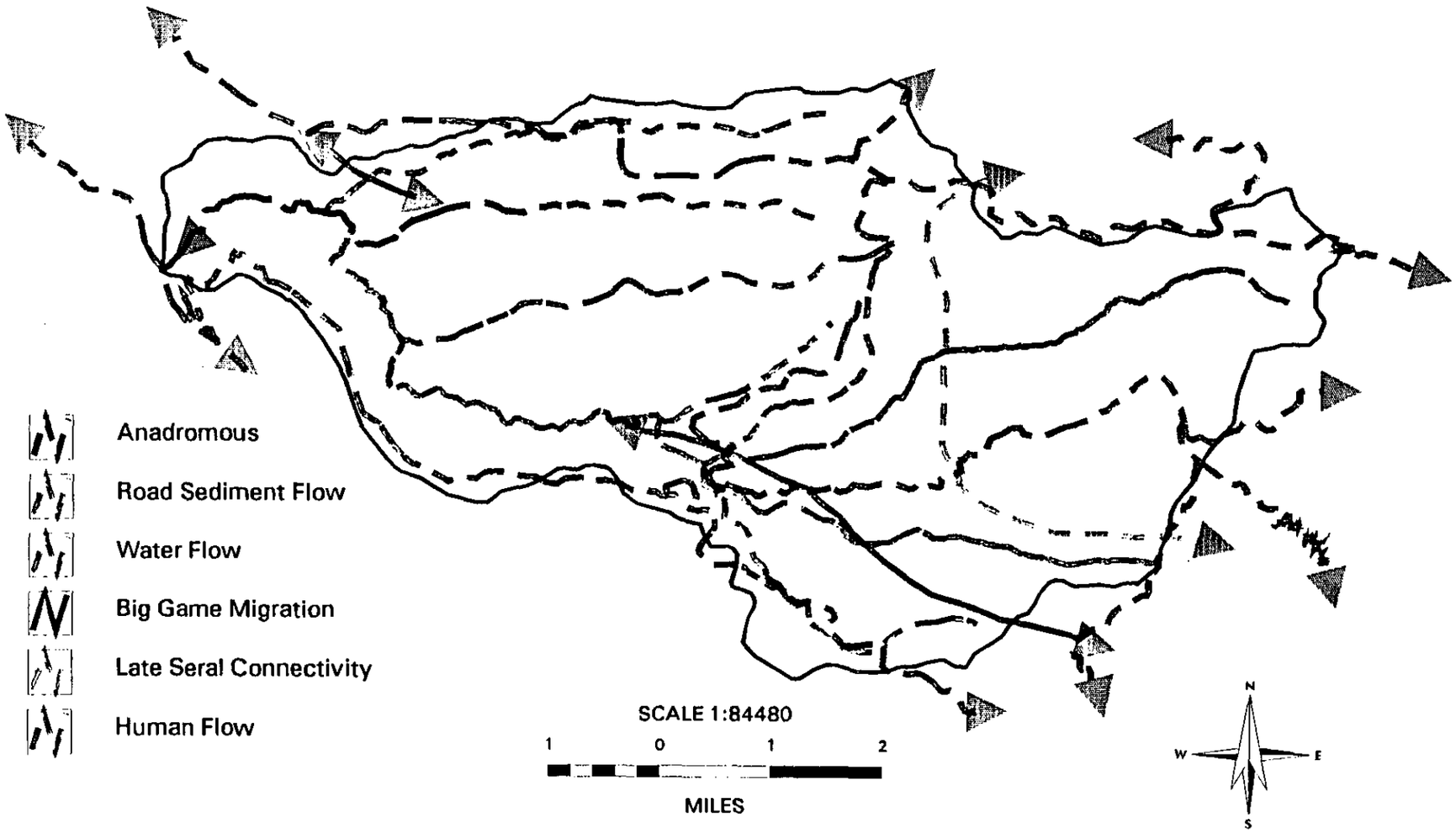
The matrix (landscape ecology definition) within the watershed, based upon the criteria of relative area, connectedness, and control over landscape dynamics, is defined as mature forest. (Map 2-6) The patch types identified within the watershed include hardwood patches, four wet meadows, one aquatic patch, and 163 acres of rock and talus habitat. Currently 10% of the vegetated acres on Federal land in North Fork are in an early seral condition, 79% in mid seral, and 11% in late seral. Fifty -five percent of the watershed is in the western hemlock, series, and 43% is in the Pacific silver fir series. Two percent is in the mountain hemlock zone, on the eastern border of the watershed. The North Fork watershed is largely unfragmented mid seral habitat with an area of fragmented late seral forest.

Flows and Linkages

Because of the low amount of late seral habitat in the watershed, the timber emphasis management allocation, and the watershed's linkage to contiguous Late-Successional Reserves (LSR), flows and connectivity for late seral species are located primarily within the existing stands of late seral forest for the present and in the Riparian Reserves in the future. (Map 3-1) No future need for additional late seral connectivity was identified. The flow of anadromous fish, particularly the late run coho salmon, is blocked 2.4 miles up the lower North Fork River by a waterfall. Sediment from roads was also identified as a flow and approximately 21 miles of the 112 miles of road in the watershed have the potential of delivering sediment to streams. Deer and elk herds are an important flow phenomena in the watershed and move seasonally from the Roaring River watershed into the North Fork watershed. An additional herd moves seasonally from private land in Eagle Creek watershed to private land

North Fork Clackamas River Watershed

Flows and Linkages



MAP 3-1

in the North Fork. The roads 4610, 4611, 4612, 4613, and 4614 were also included in the analysis as the primary travel routes for people.

Disturbance Pattern

Fire, historically, was the dominant landscape pattern forming disturbance in the watershed and the current mid-seral structure is a result of fires and logging during the early part of this century. (Map 2-12) The fire ecology classification for this watershed is "warm, moist western hemlock and Pacific silver fir" and is subject to stand replacement fires with a fire frequency of 50-300+ years. *Phellinus weirii* is found in both aggregated patterns with distinct centers and in diffuse patterns with hard to detect centers. (Map 2-13) The Ladee Flats area is considered an area of concern for *P. weirii* due to the frequency of centers and the large size of pockets (10 acres). Wind has been only a minor disturbance in the past but could increase in the future as young stands grow older and become more susceptible to windthrow. Bark beetle activity has been concentrated in the *P. weirii* pockets in association with windthrow and disturbance and has been considered minor.

Opportunities and Constraints

The Opportunities and Constraints map (Map 3-2) is a compilation of the landscape objectives located spatially in the watershed. The overlapping and nested polygons identify areas of compatible and conflicting management objectives. Opportunities and Constraints mapped in the North Fork watershed include:

* Landform stability concerns: High landslide potential was identified on four landform types: RR/SS, IR/SS, WR/SS, and Quaternary Landslide Deposits. These landform units have the potential to constrain the size of timber harvest openings.

* Remnant late seral stands: The Northwest Forest Plan requires that all remaining late-successional stands be retained in fifth field watershed in which 15% or less of the federal land is comprised of late-successional forest.

* Geologic contacts: Near contacts between WRSS/, IRSS, WRSS/Quaternary Landslide Deposits, RRSS/WRSS, RRSS/WRMS, and IRMS/WRMS.

* Northfork River viewshed: The 1/4 mile interim boundary marks the viewshed boundary but does not necessarily respond to the slope break of the river corridor or site specific changes in landform.

* Aggregate Recovery Potential (ARP) concerns: In general, ARP is not currently a major concern in this watershed. The Bee Creek subwatershed has the lowest ARP values in the watershed but only a small portion is located on federal land.

* Ladee Flats: The presence of localized pockets of *Phellinus weirii* and high levels of unmanaged OHV use could affect the size and placement of openings and selection of logging systems.

* High sediment production roads: important information for developing the Access and Travel Management Plan (ATM).

* 100 acre owl activity center: Requires the retention of late seral forest and overlaps with the existing 11% late seral forest to be retained in the watershed.

* Special areas/ dispersed campground: North Fork Crossing and Lookout Springs dispersed campgrounds receive a high level of recreation use.

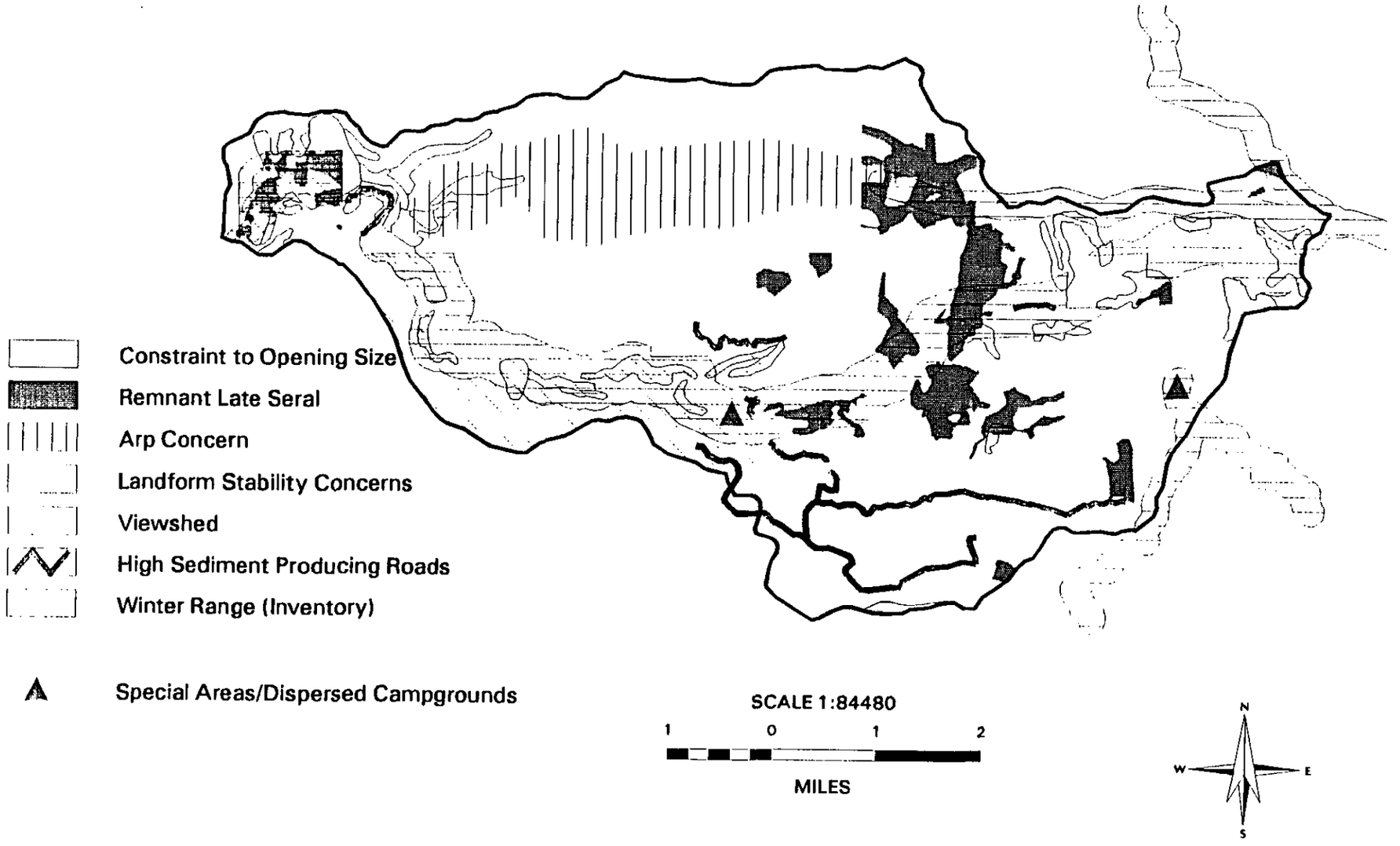
* Inventoried critical and high deer and elk winter range: structural components like opening size, forage, and cover, must be compatible with the winter habitat needs of big game. Also has implications for the ATM by directing seasonal closures.

Conceptual Landscape Design

The Conceptual Landscape Design (Map 3-3 and Table 3-1) graphically displays the vegetation patterns desired under the existing management direction found

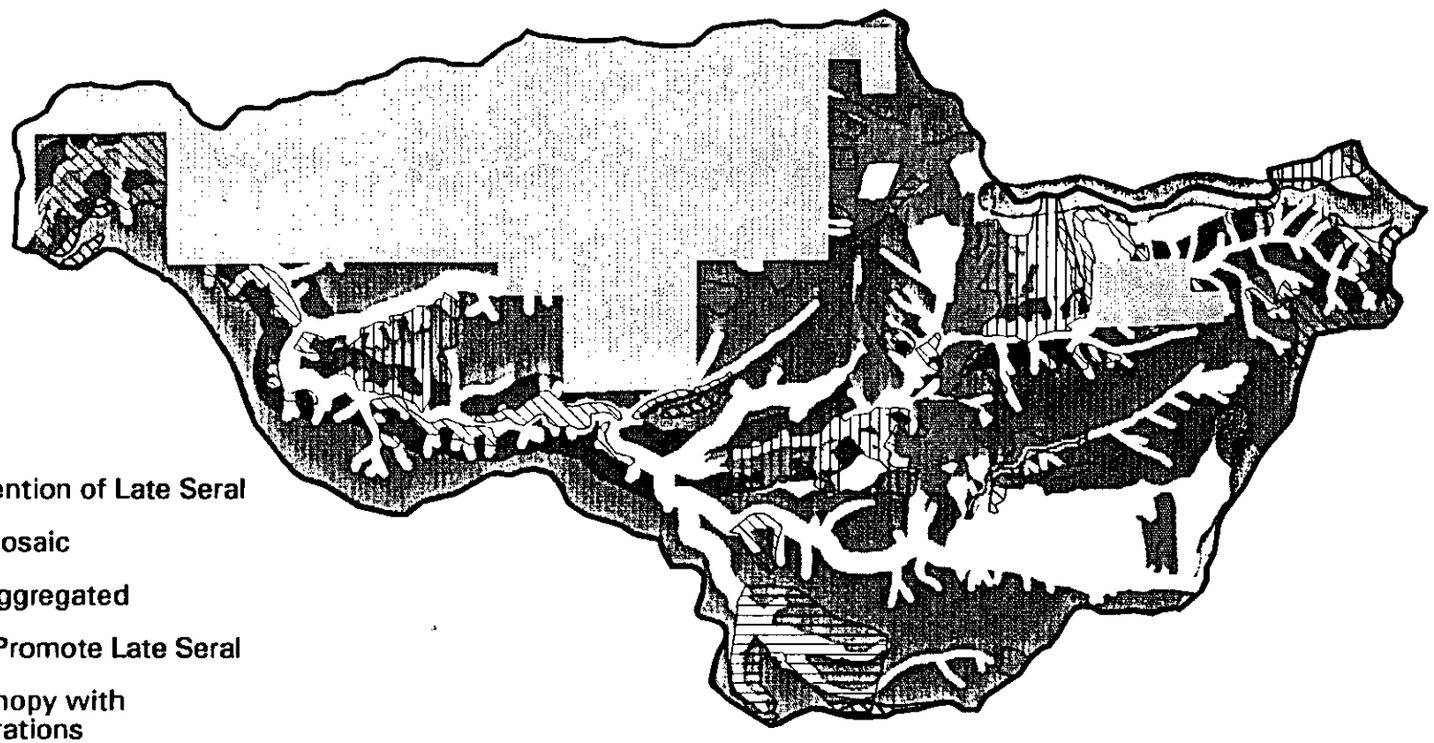
North Fork Clackamas River Watershed

Opportunities and Constraints



MAP 3-2

North Fork Clackamas River Watershed
Concept Design



- Aggregated
- Interim Retention of Late Seral
- Managed Mosaic
- Projected Aggregated
- Retain and Promote Late Seral
- Variable Canopy with Small Perforations
- Managed Late Seral with Small Perforations
- Potentially Unstable Areas
- Keysite Riparian
- Marten/Woodpecker Areas

SCALE 1:84480

1 0 1 2

MILES

N W E S

MAP 3-3

Table 3-1 Conceptual Landscape Design Key

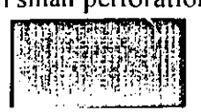
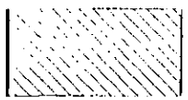
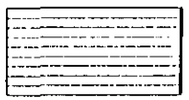
Pattern Type	Objectives	Includes	Management Direction
Retain and promote late seral forest. 	* Aquatic habitat protection. * Late Seral terrestrial connectivity.	* Riparian Reserves. * 100 acre Owl Activity Center.	* Thin plantations and natural stands to accelerate production of large trees. * Reduce risk from fire, insects, and disease. * Release young conifers in Riparian * Reserves.
Interim retention of late seral forest. 	* Late seral refugia.	* Remaining late seral refugia. (currently 11% of federal land in the watershed)	* Retain existing late seral stands until at least 15% of stands in Riparian Reserves reach late seral structure.
Managed late seral with small perforations. 	* Scenery resource management.	* North Fork River viewshed.	* Thin for late seral structure with small irregularly shaped openings.
Pine Marten/Pileated Woodpecker Areas. 	* Pine marten and pileated. woodpecker habitat. * Late successional habitat connectivity.	* B 5 land allocations.	* See recommendations.
Variable canopy with small perforations. 	* Scenery resource management.	* Trail viewsheds.	* Create small perforations, thinning, irregular shaped openings, clumps, and shelterwoods. * Emphasize species and structural diversity.

Table 3-1 Conceptual Landscape Design Key

Pattren Type	Objectives	Includes	Management Direction
Aggregated 	* Timber production. * Deer and elk forage.	* Matrix. * C1, timber emphasis. * General Forest (BLM).	* Create large patches of early and mid seral habitat ranging from 0 - 120 years old. * Retain structural components like 15% green trees, snags, and down woody debris. * Develop narrow range of age classes ranging from 0-30 years old within patch. * Fit patches to landform.
Managed Mosaic 	* Timber production. * Deer and elk forage.	* Matrix. * C1, Timber Emphasis. * Where landform and adjacent allocations make the area too dissected to be in an aggregated pattern.	* Same as Aggregated Pattern Type but smaller patches because of adjacent allocations and landform.
Projected Aggregated 	* Timber production.	* Private forestland.	* Large patches of early and mid seral habitat but without the structural components required under ROD. * 100' riparian buffers on anadromous fish bearing streams. * 50' buffers on all other streams.
Potentially Unstable Areas 	* Aquatic habitat protection. * Landform stability. * Timber production.	* Steep slopes on weak, intermediate, and resistant rock types. * Quaternary landslides deposit.	* Opening site determined after field verification. * Include field verified unstable areas in Riparian Reserves.
Keysite Riparian 	* Aquatic habitat protection.	* A 9 land allocation.	* See recommendations.

in the Northwest Forest Plan, the Mt. Hood Forest Plan, and the BLM Resource Manage Plan. The Conceptual Landscape Design provides information specific to each pattern type, its management objectives, and recommended activities. It is important to note the difference in treatment between federal and privately owned land in the Conceptual Design. For Federal lands, the design represents the conscious, spatial arrangement of vegetation patterns according to current management direction. The pattern displayed on lands under private ownership is only a graphic projection of forest land managed under state law.

The design reflects the timber emphasis objective through the vegetation patterns of Aggregated and Managed Mosaic. Late seral forest structure is located in the Riparian Reserves and the existing blocks of late seral forest that are to be retained on an interim basis until the mid seral stand in the Riparian Reserves achieve late seral structure. The viewsheds, although not a land allocation, are displayed as Managed Late Seral for the river and Variable Canopy with Small Perforations for the trail viewsheds. The B5 Pileated Woodpecker/Pine Marten Habitat Areas and the A9 Key Site Riparian Area are recommended to be deleted through a Forest Plan Amendment by this watershed analysis and are illustrated as a "ghost allocation" pending management decisions. The LSR network in the Northwest Forest Plan is considered to be adequate to meet the needs of the pileated woodpeckers and pine martens and these areas are not considered to be necessary for late seral forest connectivity. One of the two A9 areas is completely encompassed by the Riparian Reserve network. The other, much larger Key Site Riparian area, in the Winslow subwatershed was determined to be predominantly dry, nonriparian habitat.

Interim Landscape Design

The Interim Landscape Design (Map 3-4 and Table 3-2) serves as a guide for the transition toward the Conceptual Landscape Design through the scheduling of silvicultural activities. It is derived from the Conceptual Landscape Design, the seral stage map, and a landform analysis. The Interim Landscape Design serves as a reality check through comparison the existing landscape condition with the Conceptual Landscape Design. Also, by refining the Conceptual Design into smaller "design cells", the Interim Landscape Design can guide future management activities by delineating logical and reasonable units for planning. Some of the design cells reflect a single vegetation pattern type like Aggregated on a uniform landform such as a long, broad ridge. Other design cells encompass several pattern types which will need planning coordination.

Development of the Interim Landscape Design was especially important for the North Fork watershed because of the dominant presence of mid-seral stands which will need thinning to promote growth and windfirmness before development of the Aggregated and Managed Mosaic patterns. The Interim Landscape Design identifies short term, watershed specific concerns like disease, production of special forest products, reshaping existing geometric clearcut units, and recreation uses like unmanaged OHV on Ladee Flats.

From the Conceptual Landscape Design and the Interim Landscape Design, an ATM plan was developed to meet the needs of administrative, commercial, and recreational needs of the watershed.

Recommendations

* Implement the Conceptual and Interim Landscape Design developed through the LAD process.

* Adjust interim boundary of the North Fork River viewshed to reflect landform during project planning.

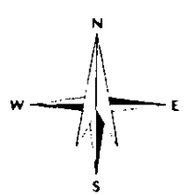
* Landform with areas of potential instability need field verification by geomorphologist during project planning.

* Withdraw the A9 and B5 land allocations in the North Fork watershed through a Forest Plan Amendment.

North Fork Clackamas River Watershed
Interim Concept Design

Pattern Type

Retain Late Seral		Existing Early Seral
		Existing Mid Seral
		Existing Late Seral
Interim Late Seral		
Managed Late Seral With Small Perforations		Early Seral
		Mid Seral
Variable Canopy With Small Perforations		Early Seral
		Mid Seral
Aggregated and Managed Mosaic		Mid Seral
		Early Seral
		Potential to Reshape Mid Seral Units
		LaDee Flat
		Older Mid Seral
		Special Forest Products
Projected Aggregated Private Retain & Improve Meadow Habitat		



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MILES

MAP 3-4

Table 3-2 Interim Landscape Design Key

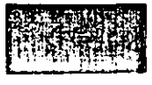
Pattern Type	Objectives	Includes	Management Direction
Retain and promote late seral forest. Existing early seral  Existing mid seral  Existing late seral 	* Aquatic habitat protection. * Late Seral terrestrial connectivity.	* Riparian Reserves. * 100 acre Owl Activity Center.	* Thin plantations and natural stands to accelerate production of large trees. * Reduce risk from fire, insects, and disease. * Release young conifers in Riparian * Reserves.
Interim retention of late seral forest. 	• * Late seral refugia.	* Remaining late seral refugia. (currently 11% of federal land in the watershed)	* Retain existing late seral stands until at least 15% of stands in Riparian Reserves reach late seral structure.
Managed late seral with small perforations. Existing early seral  Existing mid seral 	* Scenery resource management.	* North Fork River viewshed.	* Thin for late seral structure with small irregularly shaped openings.

Table 3-2 Interim Landscape Design Key

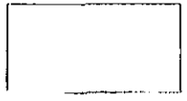
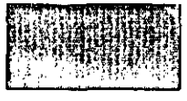
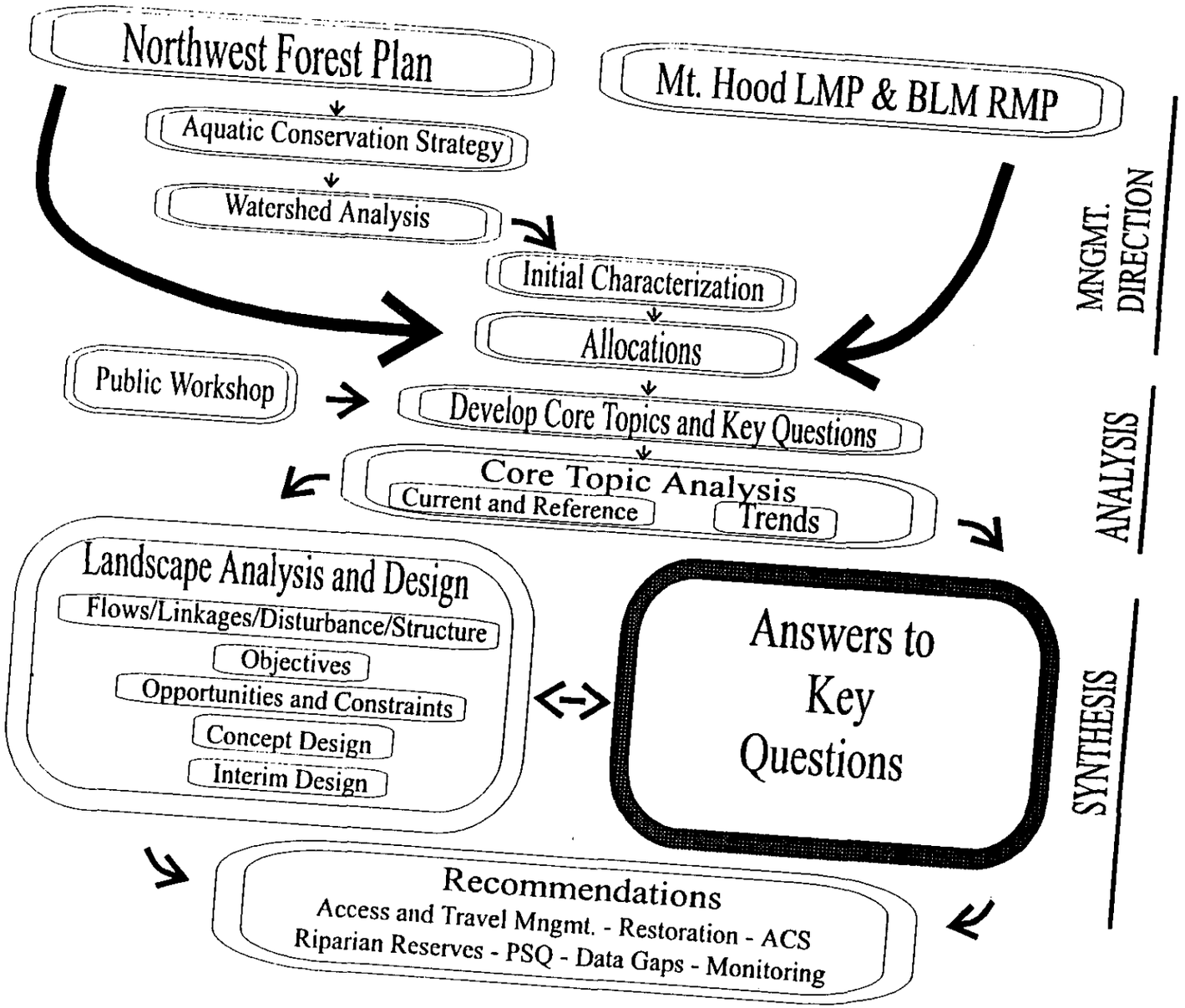
Pattern Type	Objectives	Includes	Management Direction
Aggregated and Managed Mosaic Design Cells  Existing early seral  Existing mid seral	* Timber production. * Deer and elk forage.	* Matrix. * C1, timber emphasis. * General Forest (BLM).	* Create large patches of early and mid seral habitat ranging from 0 - 120 years old. * Retain structural components like 15% green trees, snags, and down woody debris. * Develop narrow range of age classes ranging from 0-30 years old within patch. * Fit patches to landform.
 Design cell with potential to reshape mid seral units	Scenic resource management.		* Potential to reshape mid seral stands adjacent to existing early seral units(10'-15'tall).
 Ladee Flat Design cell	* Forest health.		* Thin for tree growth. * Harvest Phellinus pockets. * Design placement of thinning, openings, and skid roads to minimize OHV access. * Revegetate disturbed areas immediately after disturbance. * Restore impacted wetlands.
 Older mid seral design cell	* Forest health		* "Older mid seral " stands in fragmented condition. * Thin lightly for growth.
 Mid seral design cell with special forest products emphasis.	* Continued special forest products emphasis.		* Opportunity for salvage. * Thin for growth and windfirmness in plantations. * Opportunity for special forest products harvest of pole and firewood.

Table 3-2 Interim Landscape Design Key

Pattern Type	Objectives	Includes	Management Direction
Variable canopy with small perforations. Existing early seral  Existing mid seral 	* Scenery resource management.	* Trail viewsheds.	* Create small perforations, thinning, irregular shaped openings, clumps, and shelterwoods. * Emphasize species and structural diversity.
Projected Aggregated 	* Timber production.	* Private forestland.	* Large patches of early and mid seral habitat but without the structural components required under ROD. * 100' riparian buffers on anadromous fish bearing streams. * 50' buffers on all other streams.
Retain and Improve Meadow Habitat 	* Retain special habitats.	* See map.	* Explore options to reduce exotic plant species in meadow habitats. (Burn if necessary and/or possible)

Chapter 4
Key Questions



KEY QUESTIONS

Aquatic

How does the current and past condition of riparian areas effect the sediment regime of the watershed?

After thorough analysis it was determined that sedimentation in North Fork watershed is not a key management concern, as was originally believed. Historically sediment delivery into streams has usually occurred following large scale fire and floods, but today roads and timber harvest can also contribute sediment into the North Fork watershed. Landforms within the watershed are relatively stable in comparison to other watersheds within the Clackamas River subbasin. Map 3-3 illustrates the unstable landforms of concern located in the Riparian Reserve. Sediment delivery from management activities can be avoided in this watershed as most of the unstable and potentially unstable lands have been included within the Riparian Reserves or will be identified and field verified on a site specific basis.

Most of the North Fork watershed is vegetated with relatively few canopy openings. The ARP values confirm this because all the subwatersheds are currently above the Mt Hood Forest Plan standards

"After thorough analysis it was determined that sedimentation in North Fork watershed is not a key management concern, as was originally believed."

(Table 2-5).

The North Fork is a watershed recovering from extensive stand replacement fires of the early and mid 1900's. The intensity of the fires, coupled with salvage logging afterwards left very little remnant structures (trees, down wood) in the existing Riparian Reserves. Today Riparian Reserves are mainly composed of mid seral (Map 2-4). The Riparian Reserves are lacking large woody debris in the stream with little recruitment potential within adjacent mid seral stands for approximately 30 years until the stands reach late seral conditions. All surveyed streams within the watershed-North Fork, Bedford, Boyer and Winslow; are below the Mt. Hood Forest Plan standards for large wood (Fig. 2-2). This can result in the reduction of aquatic habitat quality and affect the natural stream channel functions such as pool formation, regulation of bedload movement, and nutrient routing. Recommendations in certain reaches to add wood structures to the stream could provide for the short term recruitment and function of large wood during the interim until riparian stands progress to late seral. Long term recruitment of large wood in the Riparian Reserves could be accomplished by thinning to promote late seral structure, thinning hardwoods to release conifers, and by the planting of redcedar.

Roads within the watershed have the potential to deliver sediment into the streams. The sediment model is used to assess potential high sediment production areas. The model looked at certain characteristics of roads such as surface, distance from streams, number of stream crossings, and landform type. Small stretches of road within the Boyer and Winslow subwatersheds located in the Riparian Reserves were identified as high potential sediment concerns Map 2-3. Whiskey Creek is another area of potential concern. The ATM map (3-5) identifies roads within the watershed that are priorities for closure, maintenance, and restoration opportunities.

The North Fork watershed is not a major sediment producer compared to other watersheds, but the streams do have high sediment composition. It is a watershed in recovery with localized sediment concerns. The flood of 1996 was estimated to be a 100 year event in the Clackamas drainage. Damage to the watershed from landslides and debris flows were

minimal compared to other watersheds within the Clackamas River subbasin. Damage to areas within the private holdings is not known.

Looking into the future, sediment delivery into streams on federal lands should decrease with the implementation of the Aquatic Conservation Strategy and the designation of Riparian Reserves including unstable lands. The lower subwatersheds of Fall and Bee Creeks, which are predominantly in private ownership, may experience increases in sediment if the demands for wood products increases; timber harvest and associated road building may increase. These subwatersheds may also experience a growth in residential development further increasing sediment delivery due to vegetation clearing within riparian areas. These increases in sediment delivery could degrade fish habitat by embedding spawning gravels with silt, and increasing deposition limiting pool depth.

Field verification has shown that the A9 Key Site Riparian land allocation located within the Winslow subwatershed may be recommended to be dropped during the Mt. Hood Forest Plan amendment process. It was determined the majority of the allocation was predominantly dry nonriparian habitat. The portion affecting the aquatic resources is protected within the Riparian Reserves.

Recommendations

* Fish habitat restoration should concentrate on increasing instream LWD through short and long term recruitment. This is accomplished through placement of instream structures, through silvicultural thinnings to promote late seral structure, thinning of hardwoods to release conifers, and the planting of redcedar within Riparian Reserves.

* Roads within the North Fork watershed need to be managed to reduce the sediment effects and increased stream channel network on riparian and aquatic habitat functions, with emphasis on roads adjacent to Boyer, Winslow, and Whiskey Creeks.

* Delete A9 Key Site Riparian land allocation within the Winslow subwatershed. Habitat is predominantly dry nonriparian. The portion affecting aquatic resources is protected within Riparian Reserves.

Terrestrial

What are the ecological and management implications of a watershed with a timber production emphasis and a predominance of mid seral habitat?

Extensive stand replacement fires in the North Fork Clackamas River watershed in the early 1900's have resulted in a landscape largely dominated by even-age, mid seral forest. Currently, 77% of the watershed is mid seral, 8% is late, and 15% is early seral. The primary ecological and management related implications examined were late-successional species and habitat; effect on big game habitat; effect on snag-dependant species; hydrologic recovery; insects, disease, and windthrow; and management implications associated with the desired future conditions for the watershed.

"The desired future condition for this area is to have extensive stands of trees at various stages of development, arranged in a mosaic pattern, with an even distribution of age classes between 0 and 120 years."

Most of the federal land in the North Fork watershed is in the "C1 Timber Emphasis" (Mt. Hood Forest Plan) or "General Forest" (BLM RMP) allocations. The desired future condition for this area is to have extensive stands of trees at various stages of development, arranged in a mosaic pattern, with an even distribution of age classes between 0 and 120 years.

Most of the federal land outside of Riparian Reserves in the North Fork watershed is Matrix land under the Northwest Forest Plan. There are no Late-Successional Reserves (LSR) in North Fork, except for one 100 acre LSR for the only spotted owl location, a resident single. There are no administratively withdrawn areas in North Fork, except for two A9 Keysite Riparian allocations. One of these areas is completely encompassed by Riparian Reserve network. The other, much larger Keysite Riparian Area, was determined to be predominantly dry, non-riparian habitat.

Late-Successional Species and Habitat

Late-Successional Habitat

Late seral habitat, defined as stands dominated by trees at least 21" in diameter, currently makes up 11% of the federal lands within the watershed. The majority of these stands originated in the late 1800's or early 1900's. Most are larger second growth stands that have not yet developed the characteristics that typically make up an "old-growth" forest.

The Northwest Forest Plan requires that all remaining late-successional stands (equivalent to late seral for this analysis) be retained in fifth field watersheds in which 15% or less of the federal land is comprised of late-successional forest. Therefore, all existing late seral habitat on federal lands in the North Fork watershed should be retained until the Riparian Reserve system reaches the point where it can function as dispersal habitat for late-successional associated species. The intent is to provide refugia for species associated with this habitat type, in particular those with limited dispersal capabilities. Given the predominant land allocations in the drainage (Matrix, C1 Timber Emphasis, General Forest), multiple entries for management are emphasized and it is unlikely that Matrix land will contain late seral habitat in the future. Future late seral habitat will primarily be found in Riparian Reserves (32% of the federal land within the watershed), a system which currently is in a predominantly mid seral condition.

Connectivity

The Northwest Forest Plan developed a strategy of a network of reserve areas to meet the needs of late-

successional forest species. Connectivity of late-successional habitat, as addressed in the strategy, can be broken into three major categories:

* LSR's (Late-Successional Reserves): intended to be large, contiguous blocks of habitat that can sustain populations or subpopulations of most late-successional associated species. The intervening matrix does not need to be late-successional habitat but must provide for the needs of dispersing individuals.

* Riparian Reserves: provide connectivity for less mobile species unlikely to survive outside late-successional forests even during dispersal.

* Isolated small blocks of late-successional habitat in the matrix for species to move between LSR's and for refugia for sessile species.

There is no LSR in the North Fork watershed, except for one 100 acre owl LSR. The watershed is largely surrounded by the LSR network in the Lower Clackamas watershed, Roaring River, and the Salmon-Huckleberry Wilderness. North Fork's role in the Northwest Forest Plan's connectivity strategy is in the Riparian Reserves and the small retention blocks (11% of the watershed) of existing late seral habitat.

The Mt. Hood Forest Plan identified areas allocated for pileated woodpecker and pine marten habitat (B5 allocation). The LSR network in the Northwest Forest Plan is considered adequate to met the needs of these species. The role of these allocations in late-successional forest connectivity still needs to be considered. The North Fork watershed is largely surrounded by LSR's. The LSR network, coupled with the Riparian Reserve system, is considered adequate for long-term late-successional connectivity. Over the short term, all existing late-successional stands in the North Fork watershed will be retained. There are four B5 allocations in the watershed, they are not considered to be necessary for late-successional forest connectivity and it is recommended that they be dropped through the Forest Plan amendment process.

Species Associated with Late-Successional Habitat

Northern Spotted Owl

Considering connectivity, land allocations, and the predominance of mid seral habitat within the watershed, it seems that North Fork's role subbasinwide, is not to provide for suitable owl habitat, but rather to optimize the dispersal potential of the watershed.

Dispersal habitat, habitat used for roosting, foraging, and protection, currently comprises 12,815 acres in the watershed. In the future, dispersal habitat will be important as a means of connectivity between other habitat types, primarily the suitable habitat which surrounds the watershed.

Survey and Manage (C3) Species

Plants

There is currently very little habitat for late-successional species in the North Fork watershed. The existing habitat will be retained over the short term, until the Riparian Reserve system reaches a late-successional condition. Information on the occurrence of these species is lacking, especially for nonvascular plants. Surveys should be conducted for C3 species before harvest of late-successional stands. Of these species, two vascular plants, *Corydalis aquae-gelidae* and *Allotropa virgata,* have documented sightings. *C. aquae-gelidae* is found growing in or near flowing water. The Riparian Reserve system should be adequate to meet the needs of this species.

Larch Mountain Salamander

Currently little habitat (breeding or dispersal) exists for the Larch mountain salamander. As the mid seral stands of the watershed are treated (thinned), some

areas will experience, over time, a trend toward the late seral conditions preferred by this species. However, other habitat components are necessary to meet the requirements of this salamander and it is unlikely that those conditions can be met in the watershed.

Red Tree Vole

Primary habitat, as defined in the Current Conditions, is absent from the drainage at this time. It is unlikely that Primary habitat conditions will evolve, due to the watershed's land allocations (Matrix, C1 Timber Emphasis, General Forest), the proposed conceptual design, and the overall role of the watershed (timber emphasis). However, Secondary and Marginal habitat, as described in the Current Condition, does exist in the watershed and is likely to remain stable or slightly increase. Still, it is unlikely that red tree voles would persist in this drainage.

Big Game Habitat

Of the four primary components that make up big game habitat (forage, hiding, thermal, and optimal cover), optimal cover is most lacking in the watershed. Optimal cover includes approximately 8% of the watershed, in the existing late seral stands. As the Riparian Reserves grow into late seral stands they will provide big game with important optimal cover, as the remainder of the watershed is likely to continue in a mid or early seral condition. As designated crucial and high value winter range, optimal cover plays a critical role in the thermoregulation of big game.

The Interim Design Map (Map 3-4) shows that over the next 20 years, big game foraging opportunities will mainly come from thinning of mid seral stands and the creation of small openings, primarily in pockets of *Phellinus weirii*. The Concept Design (Map 3-3) illustrates that aggregate and mosaic patterns will also contribute to the forage potential in created openings, although not all of the forage will be optimal. Additional opportunities may exist on private lands and in reshaping existing harvest units or in creating small irregular shaped openings in the trail viewsheds and river corridors.

Considering the importance of both of the above mentioned habitat components, it is crucial that each of them be retained and/or enhanced at every given opportunity as failure to do so may result in decreased health or mortality of big game.

Hiding and Thermal cover make up 33% and 45% of the watershed, respectively. As the mid seral conditions are treated and the Riparian Reserves mature, it is likely that these two components will be present, and sufficiently abundant, within the watershed.

Snag Dependant Species

There are more remnant snags (those remaining after the widespread stand replacement fire events) in the eastern portion of the watershed than in the western portion. Many of the snags remaining after the fires of 1929 and 1939 in the western portion of the watershed were harvested by the Civilian Conservation Corps. While there are snags in the eastern portion, the majority are in an advanced state of decay.

The large amount of mid seral habitat in the watershed means that there is a temporal gap or "snag lag" in the watershed, when remnant snags from the fires are in an advanced state of decay and the stands originating from the fires are still too young for snag production. This could continue for approximately 30 years, until some of the existing mid seral stands have trees large enough to meet the desirable diameter sizes for large snags.

Riparian

See the discussion in the Aquatic Key Question for the ecological impacts of the large amount of mid seral in riparian areas.

Hydrologic Recovery

The large stand replacement fires in the watershed did not leave much remaining late seral forest. Some of the late seral forest that survived the fires have since been harvested. Some of the earlier harvest units are already in a hydrologically recovered condition. ARP analysis shows that all of the subwatersheds in the North Fork watershed are currently above the Mt. Hood Forest Plan standard of 65% hydrologic recovery.

The Interim Design (Map 3-4) shows that over the next 20 years timber harvest in the watershed will primarily be thinning of mid seral stands. Following the ARP standards over the long term could effect how the Concept Design (Map 3-3) is implemented. ARP effects the way that aggregation harvest would proceed, due to the limitations on acreages of openings at any one time in a given area.

Future decisions will have to focus on whether to follow the ARP standards. The standards tend to disperse harvest among subwatersheds rather than concentrating the openings, as was seen under the natural disturbance pattern. An aggregation strategy could focus on aggregating future, harvest created mid seral stands in order to minimize the effect on hydrologic recovery (see Chapter 4, Landscape Analysis and Design for more information). ARP requirements could potentially effect the timing and distribution of the creation of openings.

Insects, Disease and Windthrow

Most of the uniform mid seral stands in the watershed have grown under dense stand conditions. Windthrow may be a concern in the future. An important objective for second growth stands in the North Fork watershed is to manage for windfirmness, as mid seral stands grow older and more susceptible to wind damage. Thinning and harvest unit design could help decrease this risk.

The large tracts of uniform Douglas-fir stands in the watershed create a potential risk for bark beetle infestation. Potential risk resulting from the creation of bark beetle habitat through a combination of windthrow, *Phellinus weirii* pockets, and creation of wildlife structures should be monitored.

Management Implications

Much of North Fork watershed is essentially even-aged. One management implication of this is that over the short term you have a large proportion of the watershed which has not yet reached mean annual increment, and therefore would not be regeneration harvested under the Mt. Hood Forest Plan . At the watershed scale, the area does not provide for the even distribution of age classes between 0-120 years which is the desired future condition for the C1 allocation described in the Mt. Hood LMP. This desired future condition may be achieved when looking at a scale larger than a watershed.

"Much of North Fork watershed is essentially even-aged."

Another management implication is that the large amount of thinning of mid seral stands, as shown in the Interim Design (Map 3-4), would mean multiple entries. There are potential concerns for soil compaction. Much of the watershed would be skyline harvested. Most of the tractor harvest, and therefore the potential compaction concerns, would be in the flatter Ladee Flats area. This is an area of deeper soils with less concern of compaction than on other soil types.

Probable Sale Quantity (PSQ)

Timber commodity output in the North Fork watershed is expected to continue for the next 3-4 decades primarily by thinning and other intermediate harvest of mid seral stands. The average long-term PSQ for the

watershed is estimated at a volume of two million board feet (MMBF) per year. This translates to approximately 400 acres of thinning per year. This appears feasible given the current and desired future conditions of the watershed.

Recommendations

* Implement the Interim and Concept Designs as described in Chapter 4.

* Remove the four B5 Pileated Woodpecker/ Pine Marten Habitat areas in the watershed through a Forest Plan amendment. These areas are not considered to be necessary for late-successional forest connectivity.

* Provide a variety of wildlife structures (snags, down woody debris) of various decomposition classes over time. Evaluate the risk of epidemic bark beetle levels.

* The watershed is currently lacking large diameter snags. There appears to be an adequate number of small snags. Thin mid seral stands to promote tree growth for long term future large snag recruitment. Over the short term, create smaller diameter snags only when they are determined to be lacking on a site specific basis.

* The watershed is currently lacking down woody debris of all sizes and decomposition classes. Girdle standing trees to create down woody debris in areas throughout the watershed.

* Thin second growth stands and young plantations to develop windfirmness, to accelerate development of large diameter trees for wildlife structures, and to maintain health and growth of stands.

* Develop silvicultural prescriptions for creating wildlife structures which consider the developmental stage of the stand, the diameter size of the existing stand, the function that wildlife structures would provide to various species, high stress environmental conditions, and the risk to the existing stand based on factors conducive to Douglas-fir bark beetle.

Social

What are the future implications and impacts of urban and rural use, such as off highway vehicle use, target shooting, garbage dumping, and dispersed recreation on the physical, biological, and social resources in high use areas of the watershed?

Future impacts from the social uses of the watershed can be evaluated from the existing pattern of social use and current impacts from users on the biological and physical characteristics of the watershed. It is also important to evaluate how the current use pattern affects both the potential use and users of the watershed's resources.

Off Highway Vehicle (OHV)

Motorized recreation is a prevalent use within the North Fork watershed and currently has localized effects upon the soil and hydrologic resources. Compaction, erosion, and sedimentation have been identified as a result of unmanaged OHV use on "non-system user created roads", skid trails, and closed roads throughout the watershed. The use and effects, however, are concentrated along road 4610 on Ladee Flats because of the ease of off road access, unlike the steeper slopes found in the rest of the watershed. This use has caused a localized increase in tree mortality and loss of forest productivity.

Although the North Fork watershed is not a major sediment producer compared to other watersheds, unmanaged OHV use and high sediment production roads have had an effect on aquatic habitat through sedimentation, compaction, and loss of riparian vegetation. Because of the flat terrain with few riparian areas found on Ladee Flats, sedimentation in the streams and river from unmanaged OHV use is not a significant problem. Unmanaged OHV use, such as driving through the small unmapped wetlands in the Ladee area has, however, resulted in the loss of these wetland habitats.

"The North Fork watershed provides an important setting for a motorized recreation experience which fosters self-challenge, skill development, and independence and which is in limited supply in the Clackamas River drainage."

Unmanaged OHV use, particularly off road bikes, in the wet areas on the 4612-120 road were also identified as a potential sedimentation problem for Bedford Creek. Dispersed camping at North Fork Crossing is also another site for localized compaction, sedimentation, and loss of riparian vegetation in the North Fork River. Unmanaged off road bike use is also eroding and undermining the fill slope of road 4613 at the campground.

In addition to effects on aquatic habitat, unmanaged OHV use has effects on terrestrial species. Harassment of deer and elk is the largest potential impact to wildlife throughout the watershed from motorized recreation. Ladee Flats is again the focus of concern both because of the high level of unmanaged OHV use there as well as the area's role as an inventoried Crucial Winter Range for deer and elk. Other concerns include the localized effects of unmanaged OHV use on special wetlands and meadows in the Boyer Creek subwatershed and Ladee Flats which can compromise habitat for sensitive plant species. Harassment of the resident single northern spotted owl does not appear to be a problem because the 100 acre owl Late Seral Reserve is in a steep, unroaded section of the watershed.

Perhaps the largest impact of unmanaged OHV use in the watershed is on current and potential recreationists. The North Fork watershed provides an important setting for a motorized recreation experience which fosters self-challenge, skill development, and

independence and which is in limited supply in the Clackamas River drainage. The unmanaged OHV use on Ladee Flats has, however, resulted in negative effects on the scenery from devegetation, exposed bare soil, and mudholes, and has discouraged organized OHV club and family use in the watershed. Unmanaged OHV use also has the potential to damage Heritage Resources on off-road sites, Heritage Resource roads, at Lookout Springs, and in the borrow pit archaeological site. Public safety and conflicts between motorized and nonmotorized use are also potential effects from unmanaged OHV use in the watershed.

Target Shooting

Like OHV use, target shooting offers a recreation experience of self challenge, skill development, and independence. Also like unmanaged OHV, many of the impacts of unmanaged target shooting affect the other users of the watershed. Public safety is the main concern for recreation users, special forest product harvesters, and agency personnel. Unmanaged and indiscriminate shooting also has a negative effect on the recreation experience of other users and can encourage anti-social behavior. In general, unmanaged shooting has a negative effect on the character of the watershed by promoting a lawless quality and discouraging other users. Organized OHV clubs, for example, have been deterred from using the watershed by the pervasive unmanaged target shooting.

Unmanaged target shooting also contributes to wildlife harassment of many species throughout the entire watershed. Scenery is affected, with localized tree mortality from unmanaged shooting along road 4610 and its spurs. Because the target of unmanaged shooting is frequently household garbage like batteries and refrigerators, concentrated garbage sites along road 4610, at the junction of 4613 and 4614, across from North Fork Crossing, North Fork Pit and the borrow pits, can create localized toxic contamination.

Dispersed Camping

Because most dispersed camping in the watershed does not occur in the riparian areas, effects to the Riparian Reserves are not as serious a concern as in other watersheds in the Clackamas River drainage. The largest site with the most potential for resource damage to aquatic resources is North Fork Crossing. Other sites located along 4610-150, 4612, 4611, and the homeless camp on BLM land near the river also have potential for resource damage in the riparian areas.

The elements of dispersed camping which have a negative effect on recreation use of the watershed includes homeless camps, theft, and assaults (particularly at North Fork Crossing), underage drinking, driving under the influence of alcohol and drugs, and lack of sanitation. These elements all contribute to an anti-social atmosphere which can limit the types of recreation users and the quality of the recreation experience in the watershed.

Garbage Dumping

Garbage dumping occurs along all system and non-system roads, timber sale landings, and rock pits in the watershed, but is concentrated in Ladee Flats. The effects of garbage dumping are primarily localized contaminated soils but it has the potential for widespread effect if toxic materials contaminate the river or creeks. The greatest concern is hazardous material (HAZMAT) which is usually dumped away from main roads and can contaminate soil and water.

Garbage dumping also has a negative effect on the scenery, the image of the National Forest, and on the quality of the experience of recreation users. It is a public safety hazard for all users of the watershed and can serve to encourage even more anti-social behavior. It is also expensive and dangerous to remove.

Recommendations

Recommendations for social and recreation use of the watershed focus on the promotion of positive social behavior as well as the protection of the physical and biological resources.

OHV

* Develop a managed OHV Use Plan for the watershed. Develop plan within 1 year to meet state funding deadlines.

* Implement an area closure which limits all OHV use to designated roads and trails using a "green dot system".

* Focus on existing roads and trails in the OHV Use Plan.

* Implement a Code of Federal Regulations (CFR) closure for OHV use in crucial and high "inventoried winter range" off of mainline roads from December to March.

* Consider trail connections between existing roads and soft closure roads.

* Analyze effects of allowing OHV use on soft closure roads by identifying resources at risk, potential sedimentation, success of access controls, effects to riparian vegetation, and damage control measures.

* Avoid new roads and motorized trails in Riparian Reserves.

* Any new roads or motorized trails within the Riparian Reserves must meet ACS objectives.

* Include motorized trails in road density calculations.

* Include North Fork Crossing and Lookout Springs dispersed campground in managed OHV plan.

Potential Concerns for concentrated OHV use areas

* Steep slopes

* High sediment production roads

* Potentially unstable landforms

* Whiskey Creek subwatershed where sediment has been identified as a problem

* Heritage Resource Sites

* Known calving/fawning areas

Target Shooting

* Implement an Area Closure for all but hunting related shooting in the watershed.

Dispersed Camping

* Increase law enforcement to deal with illegal activities.

* Provide toilets in high use sites like North Fork Crossing and Lookout Springs.

* Consider permit only camping at North Fork Crossing and Lookout Springs.

* Promote organized recreation use through "adopt a site" partnerships with groups like OHV clubs.

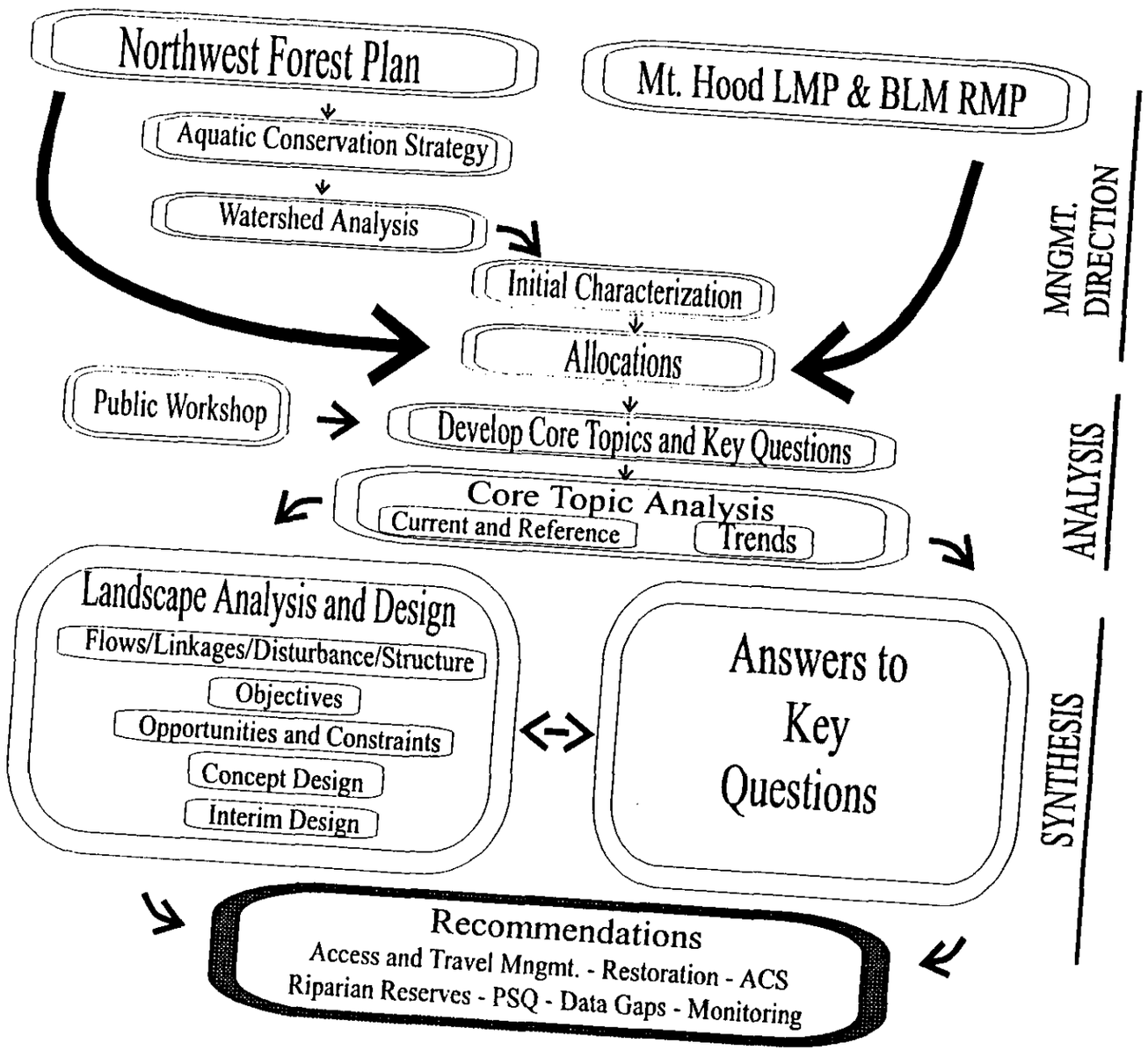
Garbage Dumping

* Continue aggressive cleanup measures.

* Increase management presence.

* Emphasize public information.

Chapter 5
Recommendations



RECOMMENDATIONS SUMMARY

Aquatic

* Avoid new roads. Any new roads or motorized trails within the Riparian Reserves must meet Aquatic Conservation Strategy objectives.

* Delete A9 Key Site Riparian land allocation within the Winslow subwatershed. Habitat is predominantly dry nonriparian. The portion affecting aquatic resources is protected within the Riparian Reserves.

* Fish habitat restoration should concentrate on increasing instream LWD through short and long term recruitment throughout the watershed. This is accomplished through placement of instream structures, through silvicultural thinnings to promote late seral structure and thinning of hardwoods to release conifers and the planting of western redcedar within Riparian Reserves.

* Manage roads within the North Fork watershed to reduce the sediment effects and increased stream channel network on riparian and aquatic habitat functions, with emphasis on roads adjacent to Boyer, Winslow, and Whiskey Creeks.

* Manage dispersed recreation sites within the watershed, with emphasis on North Fork Crossing, to insure compliance with the Aquatic Conservation Strategy.

Terrestrial

* Implement the Interim and Concept Designs as described in Chapter 3.

* Remove the four B5 Pileated Woodpecker/ Pine Marten Habitat areas in the watershed through a Forest Plan amendment. These areas are not considered to be necessary for late-successional forest connectivity.

* Provide a variety of wildlife structures (snags, down woody debris) of various decomposition classes over time. Evaluate the risk of epidemic bark beetle levels.

* The watershed is currently lacking large diameter snags. There appears to currently be an adequate number of small snags. Thin mid seral stands to promote tree growth for long-term future large snag recruitment. Over the short term, create smaller diameter snags only when they are determined to be lacking on a site specific basis.

* The watershed is currently lacking down woody debris of all sizes and decomposition classes. Girdle standing trees to create down woody debris in areas throughout the watershed.

* Thin second growth stands and young plantations to develop windfirmness, to accelerate development of large diameter trees for wildlife structures, and to maintain health and growth of stands.

* Develop silvicultural prescriptions for creating wildlife structures which considers the developmental stage of the stand, the diameter size of the existing stand, the function that wildlife structures would provide to various species, high stress environmental conditions, and the risk to the existing stand based on factors conducive to Douglas-fir bark beetle.

* Adjust interim boundary of the North Fork River viewshed to reflect landform during project planning.

* Landform with areas of potential instability need field verification by geomorphologist during project planning.

Social

Recommendations for social and recreation use of the watershed focus on the promotion of positive social behavior as well as the protection of the physical and biological resources.

OHV

* Develop a managed OHV Use Plan for the watershed. Develop plan within 1 year to meet state funding deadlines.

* Implement an Area closure which limits all OHV use to designated roads and trails using a "green dot system"

* Focus on existing roads and trails in the OHV Use Plan.

* Implement a CFR closure for OHV use in crucial and high "inventoried winter range" off of mainline roads from December to March.

* Consider trail connections between existing roads and soft closure roads. Analyze effects of allowing OHV use on soft closure roads by identifying resources at risk, potential sedimentation, success of access controls, effects to riparian vegetation, and damage control measures.

* Allow no new roads or motorized trails through Riparian Reserves.

* Include motorized trails in road density calculations.

* Include North Fork Crossing and Lookout Springs dispersed campground in managed OHV plan.

* Consider the following potential concerns for concentrated OHV use when developing an OHV Use Plan:

  - Steep slopes
  - High sediment production roads
  - Potentially unstable landforms
  - Whiskey Creek subwatershed, where sediment has been identified as a problem
  - Heritage Resource Sites
  - Known calving/fawning areas.

Target Shooting

* Implement an Area Closure for all but hunting related shooting in the watershed.

Dispersed Camping

* Increase law enforcement for illegal activities.

* Provide toilets in high use sites like North Fork Crossing and Lookout Springs.

* Consider permit only camping at North Fork Crossing and Lookout Springs. Promote organized recreation use through "adopt a site" partnerships with groups like OHV clubs.

Garbage Dumping

* Continue aggressive cleanup measures.

* Increase management presence.

* Emphasize public information.

ACCESS AND TRAVEL MANAGEMENT

Access and Travel Management (ATM) objectives were determined by identifying access needs for the public and various forest management activities like fire, timber, and recreation (Map 3-5). Objectives of the ATM help focus priorities for maintenance and funding and identifying restoration opportunities. The goal of the ATM plan for North Fork of the Clackamas River is to reduce the effects on sediment delivery and deer/elk disturbance while facilitating administrative, commodity and recreational uses on federal lands.

Roads identified to stay on the Forest Road system are not necessarily recommended for year-round access. Restricted access and use is currently imposed on certain roads, primarily by gates or berms. Additional restrictions may be identified at the project level and are not recommended here. Roads that are not identified as being needed for access objectives become opportunities for restoration and potential road decommissioning. This determination will be considered at the project level.

Roads to Keep Open

The roads listed in Table 5-1 are mainline roads which access the matrix lands and have provided traditional and recreational uses. These roads would have priority for maintenance.

Table 5-1. Roads to keep open.

ROAD	COMMENTS
4610	High priority for maintenance from Hwy. 224 to 4613 jct.
4611	
4612	
4613	High priority for maintenance
4614	High priority for maintenance
4615	

Roads to Keep But Not Maintain; Available for Closure

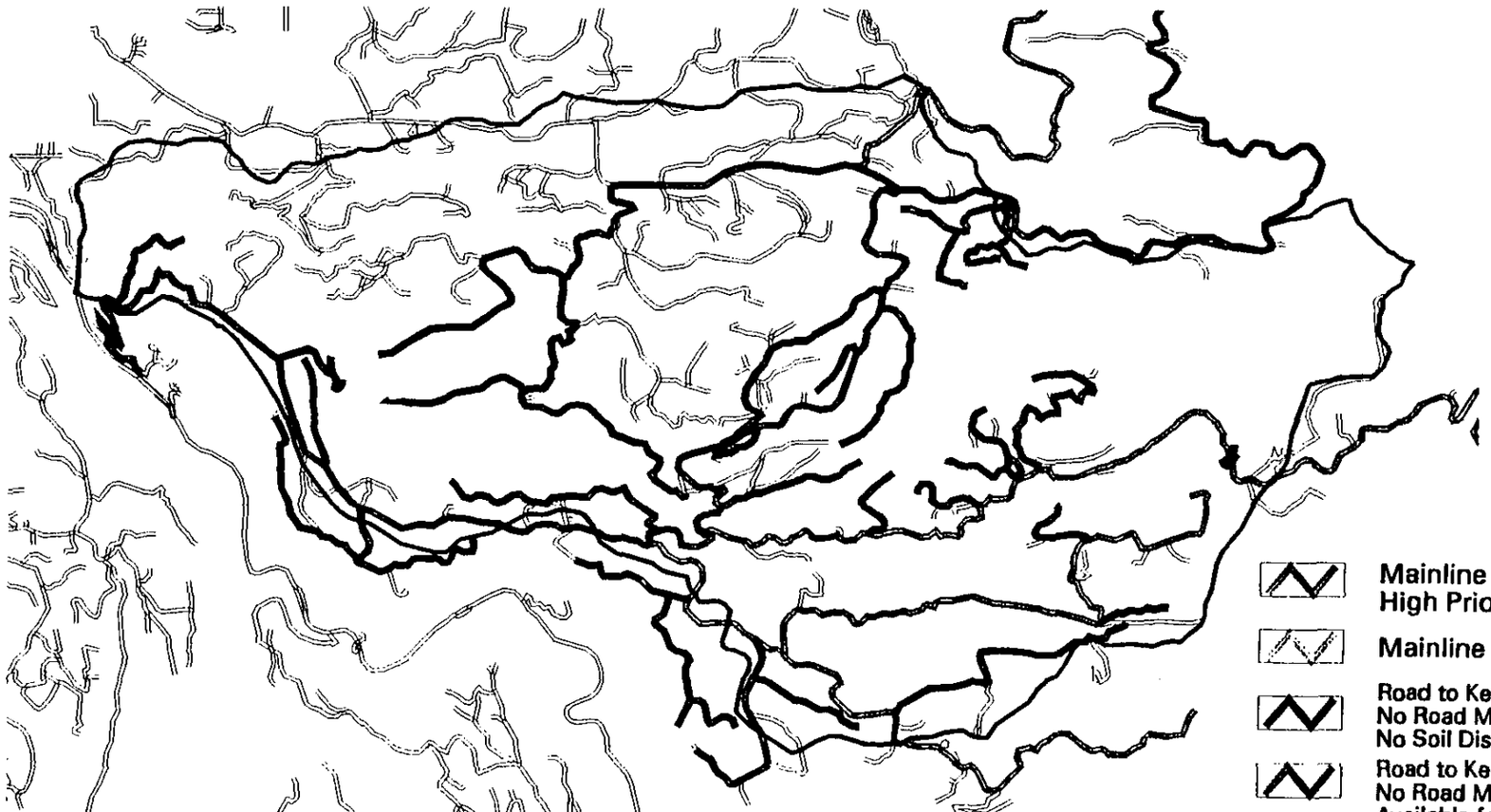
Table 5-2 shows roads needed for forest management activities, primarily for timber needs. They are available for closure, however, maintain roadbed and maintain or pull culverts. Some roads are already closed as shown in Comments column.

Table 5-2. Roads to keep but not maintain.

ROAD	COMMENTS	ROAD	COMMENTS
4610 - 023		4613 - 120	Gated; no oblit. to Whiskey Crk.
- 027			
- 112			
- 113	Gated	- 130	No oblit.north of 017 jct.
- 115	Guardrail		
- 116		- 140	
- 120		- 150	
- 130		- 170	
- 140		- 200	No oblit. on
- 150	Gated at jct.; Can oblit. Last ½ mile	/012	first part
4611 - 120	Bermed	4614 - 120	
- 121	Guardrail	- 122	
- 125		- 124	
- 130	Bermed	- 130	
- 132	Guardrail	- 140	
- 140		- 150	Can oblit. Last 1/4 mi.
		- 160	
4612 - 140			
- 141	Bermed		

North Fork Clackamas River Watershed

Access Travel Management



Mainline Road
High Priority Maintenance

Mainline Road

Road to Keep
No Road Maintenance
No Soil Disturbance

Road to Keep
No Road Maintenance
Available for Closure

SCALE 1:84480

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MAP 5-1

Table 5-2, cont. The following roads have heritage resource values. Do not disturb roadbed. Closure may be limited depending on site.

ROAD	COMMENTS
4610 - 011 - 012 - 019 - 040 - 160	
4612 - 130	Currently bermed; no obliteration on first 600 feet

Road Closures Covered by Signed NEPA Documentation

Table 5-3 shows road closures covered by NEPA documentation written within the last five years and closures under currently active timber sales in which the timber sale contract will close the road. In some cases there are no funds designated to perform the work. This is indicated in the table as well as the source of funding when available. Generally, NEPA documents are good for 3 to 5 years. After this time, and if the project has not been implemented, new scoping and documentation should be done.

Table 5-3. Road closures covered by signed NEPA documentation.

Bedford EA *	Lower North Fork and Bedford Creek Subwatersheds
4610 - 011	Purchaser funded; close only
- 012	Purchaser funded; close only
- 013	No funds; close only
- 015	Purch. fund. closed outside of unit; KV funds oblit. w/in unit
- 017	
- 018	No funds
- 019	No funds; possible heritage resource concern
- 020	No funds
- 112	Purchaser funded
- 113	Purchaser funded; Gated
4611 - 120	No funds
4613 - 016	No funds
- 017	No funds
- 018	No funds
- 019	No funds
- 020	No funds
- 021	No funds
- 022	No funds
- 023	No funds
- 130	No funds
- 150	KV funded under firewood sale, close only
- 160	No funds
4614 - 122	Purchaser funded
- 124	Purchaser funded

*Bedford Planning Area size: 4334 acres
Winter range road densities with purchaser, KV, and existing closures: 1.93 mi/sq mile
Summer range road densities with purchaser, KV, and existing closures: 1.50 mi/sq mile

Yober EA	Boyer subdrainage
4612 - 141	Purchaser funded; close only
- 147	Purchaser funded; newly constructed portion only
- 151	Purchaser funded

Yober Planning Area size = 2607 acres
Winter range road densities with purchaser, KV, and existing closures: 1.6 mi/sq mile
Summer range road densities with purchaser, KV, and existing closures: 1.8 mi/sq mile

Table 5-3, cont.

Boyer Restoration EA	Boyer Subdrainage; all closures are KV funded through the Yoda timber sale (Yober EA)
4610 - 031 - 032 - 170	
4611 - 140	Only the portion in planning area
4612 - 120 - 130 - 135 - 140 - 145 - 147 - 149 - 153	Close only No obliteration first 600 feet Close only End portion Existing portion

Thrasher Timber Sale	Winslow and Lower North Fork Clackamas River watersheds
4610 - 021	
4611 - 120 - 121 - 132 - 135 - 147	Currently bermed Guardrail present Guardrail present Guardrail present Currently bermed

Other Road Densities by Subwatersheds (Federal lands only)

Fall Creek (504 acres) - 6.02 mi/sq mile
Bee Creek (71 acres) - 3.68 mi/sq mile
Upper North Fork Clackamas River (4647 acres) - 1.44 mi/sq mile
Winslow Creek (1313 acres) - 1.84 mi/sq mile

Priorities for Road Closure or Decommissioning

The following roads are considered to be of a high priority for road closure or decommissioning.

* Roads accessing Deer/Elk Crucial and High Value Winter habitat during winter months.
* Roads with high sediment delivery potential (generally roads which parallel and are within 300 feet of streams).
* Roads in Riparian Reserves.

Roads with Concerns

The roads listed in Table 5-4 were identified with concerns based on GIS mapping. These road concerns should be field verified and recommendations developed to mitigate concerns through closure and/or road repair and maintenance, etc.

Table 5-4. Roads with Concerns

Roads with sediment concerns	
4610 - 021 - 150	End portion of road
4611 - 140	
4612 - 011 - 130	
4613	Near North Fork Crossing
Roads with Deer/Elk Winter Range concerns	
- Crucial Value Winter Range	
4610	And spurs on Ladee Flats to the 4613 jct.
4613	From 4610 to 4613-170
4614 - 120 - 122 - 124	
- High Value Winter Range	
4610 - 021	
4613 - 200/012	

Table 5-5. Restoration Projects.

OBJECTIVE (Why)	PROJECT	WHERE
Barbed wire fencing from old range allotment could impede wildlife travel and is a public safety concern	Remove barbed wire fencing.	Ladee Flats, Boyer Creek subwatershed
Long term: Promote late seral structure in Riparian Reserves for future large woody debris and terrestrial connectivity.	Thin early and mid seral stands in Riparian Reserves. Conifer release in hardwood stands, Plant western redcedar.	Throughout watershed
Short term: Large woody debris and pool habitat is lacking in streams due to mid seral conditions throughout the watershed.	Introduce wood into streams with the largest pieces available.	Throughout watershed
There are many dying trees in North Fork Crossing Campground due to user impacts. There is erosion and compaction in the Riparian Reserve.	Plant trees and ground cover; a mix of species.	North Fork Crossing Campground
Small wetlands are impacted by unmanaged off-highway-vehicle (OHV) use.	Block access, Rehabilitate wetlands.	Ladee Flats
There are known high priority roads needing restoration due to sediment concerns within Riparian Reserves. (See Access and Travel Management section.)	Pave, obliterate, and create sediment ponds on portions of the 4611 road, which produces a high quantity of sediment (the road parallels a stream); the 4611140 road which has sediment and water running down it; and the 4612130 road.	4611, 4611140, and 4612130 roads
With a large amount of mid seral snags, the watershed is currently lacking large snags and down woody debris, especially in the western portion.	Over the long term thin stands to promote late seral structure for future snag recruitment.	Western portion of the watershed outside of dispersed camping areas and road corridors.
The watershed is lacking large snags. It is believed there are currently adequate numbers of small snags (this needs to be monitored). The watershed is also lacking in down woody debris.	Girdle trees to create snag habitat for species that use smaller snags and for down woody debris recruitment.	Throughout watershed
The watershed is lacking deer and elk forage (according to Mt. Hood Forest Plan standards) due to small amount of early seral.	Create openings and design harvest units to promote forage.	Throughout watershed
There is a noxious weed infestation in the Boyer Creek meadow.	Burn meadows and revegetate with native species.	Boyer Creek meadow
There are unvegetated compacted user roads due to unmanaged OHV use.	Rip and revegetate roads and restore hydrologic function.	Ladee Flats

AQUATIC CONSERVATION STRATEGY

The Aquatic Conservation Strategy (ACS) as described in the ROD was developed to restore and maintain ecosystem health at both the watershed and landscape scales. This would protect the habitat for fish and other riparian dependent species and resources and restore currently degraded habitats. The four components of the strategy (Riparian Reserves, key watersheds, watershed analysis, and watershed restoration) provide the land management agencies the tools to maintain and restore productivity and resiliency of riparian and aquatic ecosystems.

The following recommendations would accelerate the rate of recovery of aquatic and riparian processes to meet the intent of the Aquatic Conservation Strategy.

Recommendations

* Fish habitat restoration should concentrate on increasing instream LWD through short and long term recruitment. This is accomplished through placement of instream structures, through silvicultural thinnings to promote late seral structure, thinning of hardwoods to release conifers, and the planting of redcedar within Riparian Reserves.

* Roads within the North Fork watershed need to be managed to reduce the sediment effects and increased stream channel network on riparian and aquatic habitat functions, with emphasis on roads adjacent to Boyer, Winslow, and Whiskey Creeks.

* Manage dispersed recreation sites within the watershed such as North Fork Crossing to insure compliance with the Aquatic Conservation Strategy.

* Any new roads or motorized trails within the Riparian Reserves must meet ACS objectives.

RIPARIAN RESERVES

The Northwest Forest Plan designates Riparian Reserves at the margins of all standing and flowing water, intermittent stream channels and ephemeral ponds, and wetlands. Unstable and potentially unstable areas effecting riparian and aquatic habitat function are also included in Riparian Reserves. Riparian Reserves generally parallel the stream network but also include other areas necessary for maintaining hydrologic, geomorphic, and ecological processes. The Northwest Forest plan established criteria for delineating interim Riparian Reserve boundaries for five categories of streams or water bodies. Application of these criteria for the North Fork Clackamas River watershed are presented in Table 5-2 and shown in Map 2-4. The Northwest Forest Plan further directs that critical hillslope, riparian, and channel processes be identified through watershed analysis in order to ensure maintenance and restoration of riparian and aquatic functions.

Riparian Reserve widths displayed in Table 5-2 are based on estimated site potential tree heights. Site potential tree heights were estimated using riparian plot information, and were stratified by forest series

Table 5-6. Riparian Reserve Estimated Widths

	WESTERN HEMLOCK SERIES	PACIFIC SILVER FIR AND MOUNTAIN HEMLOCK SERIES
Fish Bearing Streams	420 feet slope distance from edge of channel	320 feet slope distance from edge of channel
Non-Fish Bearing Perennial Streams	210 feet slope distance from edge of channel	160 feet slope distance from edge of channel
Constructed Ponds, reservoirs, and wetlands greater than 1 acre	210 feet slope distance from the edge of the wetland or maximum pool elevation	160 feet slope distance from the edge of the wetland or maximum pool elevation
Lakes and Natural Ponds	The body of water plus 420 feet slope distance	The body of water plus 420 feet slope distance
Intermittent Streams	210 feet slope distance from edge of channel	160 feet slope distance from edge of channel
Wetlands less than 1 acre	The wetland and associated riparian vegetation	The wetland and associated riparian vegetation
Unstable and potentially unstable areas	See text	See text

(western hemlock, Pacific silver fir, mountain hemlock). Estimated site potential tree height for the western hemlock series is 210 feet, and 160 feet for the Pacific silver fir and mountain hemlock series. Riparian Reserve widths, based on site specific site potential tree height, will be refined during project level planning.

Interim Riparian Reserve widths were considered adequate for the North Fork Clackamas River watershed. Riparian Reserve widths were not decreased for the following reasons:

* Most of the Riparian Reserves do not currently meet Aquatic Conservation Strategy objectives, because they are in a mid seral condition.

* There is currently very little late seral habitat in the watershed and most of the watershed is Matrix land. The Riparian Reserve network will provide most of the late seral habitat in the watershed in the future. The Riparian Reserves will play an important role in providing habitat for late-successional associated species (C-3) and dispersal habitat for other terrestrial species.

* A large portion of the riparian areas in the North Fork Clackamas River watershed are in private ownership, which require smaller riparian buffers (100 feet on fish-bearing streams). Riparian Reserves on Federal lands could provide good available habitat for both aquatic and terrestrial species.

Unstable and Potentially Unstable Areas

Unstable lands can occur on the landscape in positions removed from riparian ecosystems and still have an effect on aquatic conditions. Mass movement events deliver large wood, sediment, and nutrients to aquatic systems. The intent of developing Riparian Reserves for unstable and potentially unstable areas is to ensure that the rate and distribution of sediment delivery does not alter stream channel forming processes or impair aquatic ecosystem functions.

No mapped unstable or potentially unstable areas were identified to include in the North Fork Clackamas River Riparian Reserve system. The following geologic conditions were identified as inherently unstable, meriting special attention during project planning and field investigations (see Chapter 2, Aquatic Section, Erosion Processes for further information). The presence of these conditions does not automatically mean that an area is unstable and, therefore, these areas were not included in the mapped Riparian Reserve system. These areas need to be investigated carefully during project level planning, and added to the Riparian Reserve system when appropriate.

* Contacts between weak and resistant rock. Changes in permeability at these contacts often result in springs or shallow groundwater tables. Altering the groundwater conditions in these areas can trigger debris slides and debris flows. Important contacts include the following:

  - Contacts between resistant rock and weak rock on steep to moderate slopes (RRSS-WRSS contacts and RRSS-WRMS contacts).

  - Contacts between the upper and lower members of the Sardine Formation on steep and moderate slopes (IRSS-WRSS contacts and IRMS-WRMS contacts).

* Along the margins of dikes and sills. The heat associated with dike and sill emplacement tends to alter and weaken the adjacent rock making it more prone to mass wasting.

* Along stream banks within the RRSS, IRSS, WRSS, and Qls landforms. Slumps, debris slides, and streambank failures may occur next to downcutting or laterally-cutting streams.

* On slopes with gradients in excess of 60% where shallow soils overlie less permeable materials. These conditions are most commonly met on landform types RRSS, IRSS, and WRSS. Areas meeting these

conditions are prone to shallow failures.

* Along the margins of ancient landslides or earthflows. Changes in groundwater levels near these margins often trigger debris slides, debris flows, and slumps.

* On scarps of ancient landslides. These areas are steep, have shallow soils, and are prone to debris slides and debris flows.

* At the headlands of tributaries with steep gradients. Historically, many such areas have experienced debris flows, and those presently filled or filling with colluvium may fail with the slightest provocation. These conditions are most likely to be met within the RRSS, IRSS, and WRSS landform types.

* In the vicinity of fault zones on steep slopes. Increased fracturing and weathering in these areas decreases stability.

PROBABALE SALE QUANTITY

Timber commodity outputs in the North Fork Clackamas River are expected to continue for the next 3-4 decades primarily by thinning and other intermediate harvest of mid seral stands. Harvest is planned to be accomplished within Matrix lands and Riparian Reserves. Management activities will follow the policy direction provided in the Mt. Hood Forest Plan and the Northwest Forest Plan.

The average long term probable sale quantity (PSQ) is estimated at a volume of 2 million board feet per year (MMBF) for this watershed. This translates to about 48 acres of regeneration harvest a year (or about 400 acres of thinning at 5 MBF per acres). This is based on models used to project the PSQ under the Northwest Forest Plan. A large proportion of the PSQ outputs will be from C1-Timber Emphasis land allocation.

After the fourth decade, it is estimated that many of the mid seral stands will have reached the definition of late seral stands and optimal cover. At this point, the quantity of late seral within the watershed would be above the 15% required for retention. Regeneration harvest of late seral stands to provide a variety of age classes from 0 to 120 years could begin.

The North Fork watershed has approximately 13,789 acres of Matrix lands. Mid seral stands, outside of Riparian Reserves, within the matrix comprise about 11,031 acres. If during the first two decades, these stands were entered every 20 years to maintain health and growth of stands, encourage late seral structures, and to provide wood products, then 552 acres/year would be treated (11,031 acres of mid seral/20 years). At 5 MBF/acre during the first entry, this would yield 2.8 MMBF/year. Treating stands on the east side of the watershed would yield a higher quantity, 4.4 MMBF/year at 8 MBF/acre. Treatment of Riparian Reserves would also contribute to the yield during the first entry (1754 acres mid seral/20 years = 88 acres/year at 50% Riparian Reserve treated; 88 acres/year X 5 MBF/acre = 0.4 MMBF/year). The second entry on Matrix lands would occur during decades 3 and 4 and would yield approximately 3.9 MMBF/year (at 7 MBF/acre).

The above calculated PSQ does not take into account other resource constraints that could limit acres actually treated, such as screen 3 or unstable (from Mt. Hood Forest Plan) owl activity centers, visual objectives, hardwood stands, ARP constraints, and understocked *Phellinus weirii* pockets. Nor does it take into account stand conditions not needing treatment such as non-overstocked stands due to previous heavy thins and low site potentials.

DATA GAPS

* What are user demographics and their preferences in North Fork?

* Maps of unmanaged OHV roads in the drainage

* Location and composition of HAZMAT sites in watershed

* North Fork's role in the subbasin in relation to overall distribution of age classes (0-120 yrs)

* Wildlife, anadromous fisheries, and recreation information on private lands within the watershed

* Future management on private lands within the drainage

* More accurate information on availability of deer and elk habitat within the watershed

* Amount of poaching and other illegal activity occurring in the drainage.

* Population estimates of coho and steelhead that utilize the North Fork for spawning and rearing habitat, i.e., spawning surveys, snorkeling and/or smolt trap installation

* The role that North Fork has on juvenile production of coho and steelhead in comparison to the Clackamas subbasin

* The role that the slack water arm of the North Fork has on habitat use of coho and steelhead compared to the free flowing river

* Presence or absence of C3 Survey and Manage plant and animal species in the watershed

* Distribution of species such as lichens and bryophytes.

* Snag and down woody debris information at the watershed level

* Information gaps on sediment delivery on private lands may have contributed to questionable results in the sediment model

* Information on driveways, secondary road locations, and intermittent streams is lacking for private lands in the watershed.

* Stand ages on private land

* Condition of soil resources

* Limited stream location information on private land.

* Spawning information on large scale suckers at the mouth of North Fork Clackamas River and the effect on anadromous fish.

* Monitor displacement effects of target shooting on other watersheds, particularly South Fork and Eagle.

* Determine the effects of OHV use on deer and elk.

* Monitor sediment production from OHV use on roads.

* Determine effectiveness of implemented recommendations on social uses.

* Determine effectiveness of big game forage areas.

* Monitor down wood retention levels post harvest, fuels treatment, and firewood collection.

* Monitor effects of multiple entry thinnings on soil productivity.

* Continue the following baseline trend monitoring of North Fork: stream temperature, macro-invertebrate, Vstar, D50's, riffle stability index, and spawning gravel surveys.

* Determine changes in stream characteristics resulting from the February 1996 storm on North Fork.

* Determine user preferences on river and trail viewsheds.

* Monitor existing wildlife structures (i.e. snags and DWD) three years following logging operations to include subsequent blowdown and logging damaged trees.

* Evaluate the risk of catastrophic bark beetle infestation from the combination of naturally occurring and created bark beetle habitat.

* Monitor thinning effectiveness to determine whether stated goals are being achieved, i.e., large trees, down woody material, etc.

PARTICIPANTS

The following individuals gave their time and effort to make this report possible:

District Ranger: John Berry

Team Leader: Cynthia Froyd, Ecologist

Steward: Jeanne Rice, Silviculturist

Core Team Members: Pat Greene (Landscape Architect), Ron Wanek (GIS Analyst), Sue Helgeson (Fisheries Biologist), Lynne Cady (Wildlife Biologist)

BLM Representative: Randy Gould

Writer/Editor: Ed Buursma

Additional Analysis Input Specialists: Glenda Woodcock (Recreation Planner), Tom DeRoo (Geologist), Tom Rottman (Forester), Carson Hall (Forester), Todd Reinwald (Soil Scientist), Connie Athman (Hydrologist), Gale Masters (Botanist)

Persons Consulted: Glenda Goodwyne, Joyce Johnson, Kristine Marshall, Craig Edberg, Melanie Myers, Cyndi Baker, Mike Malone, Linda DeLa Rosa, Larry Reed, Chris Lynch, Robin Wiley, Cari Kreshak, Merle Seidel, Don Chase

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