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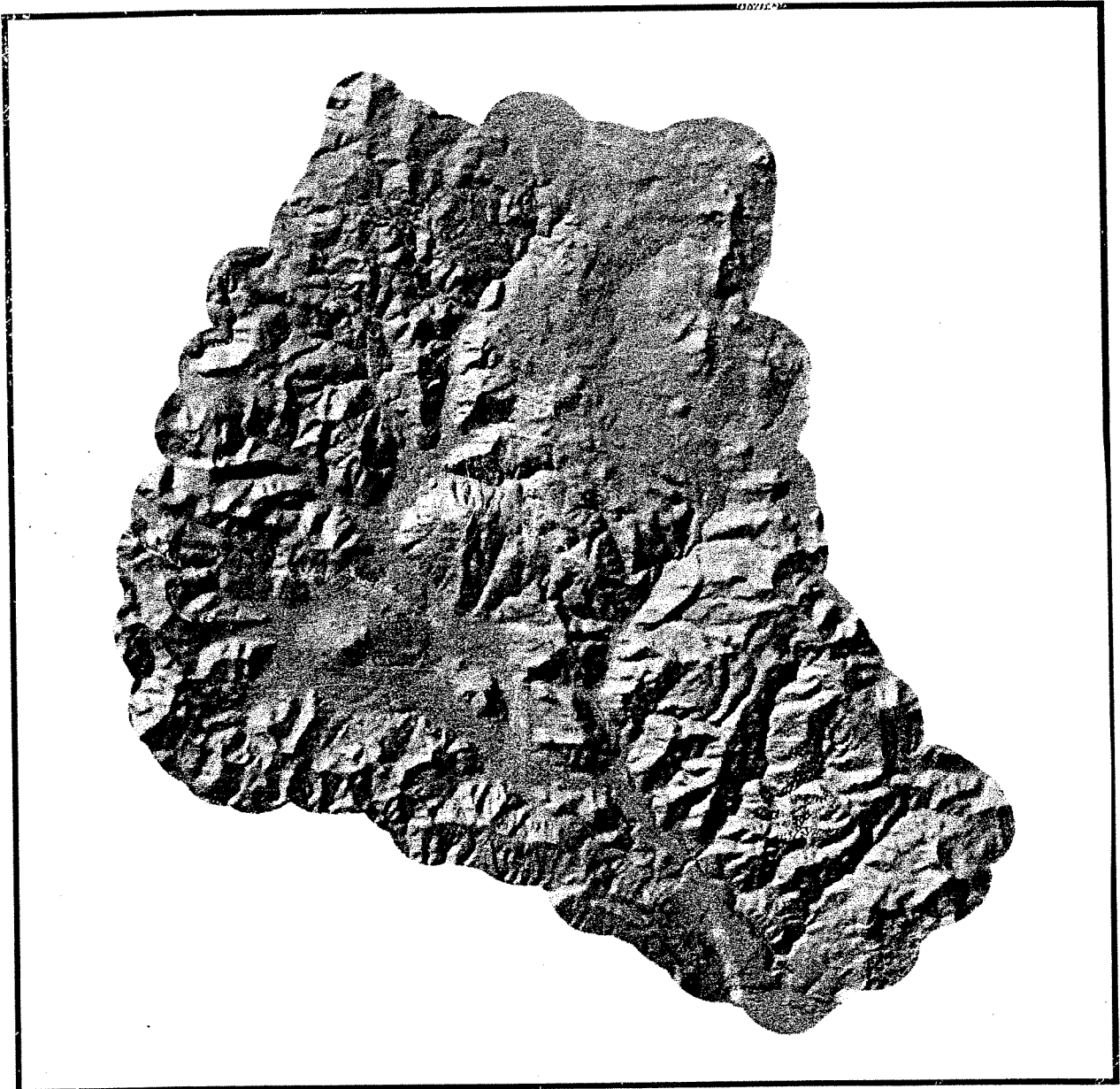
Pacific
Northwest
Region

1996



Wind River Basin Watershed Analysis

Gifford Pinchot National Forest





WIND RIVER BASIN WATERSHED ANALYSIS

Gifford Pinchot National Forest
Wind River Ranger District
South Skills Center

April, 1996

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Special Thanks to Maggie Angobung , Editorial Assistant, Gifford Pinchot National Forest, Vancouver, Washington for assistance in editing and final preparation of the analysis report.

WIND RIVER WATERSHED ANALYSIS

INTRODUCTION

Work on the Wind River Basin Watershed Analysis started in Sept. 1995.

The standard, interagency six step process outlined in "Ecosystems Analysis at the Watershed Scale." Federal Guide for Watershed Analysis, revised August 1995 Version 2.2, Portland, Oregon., was used as a guide for conducting this analysis.

This document is arranged around the six step process. Characterization of the watershed is presented in Chapter I, Issues and Key Questions in Chapter II. Chapter III presents current conditions, reference conditions and synthesis and interpretation.

Recommendations are presented in Chapter IV.

Core Topics established by the Watershed Analysis Guide are addressed and tracked through the six step process.

Maps are located at the beginning of the analysis report and are referenced in the following chapters.

Charts and tables have been incorporated throughout the document and are listed in the table of contents.

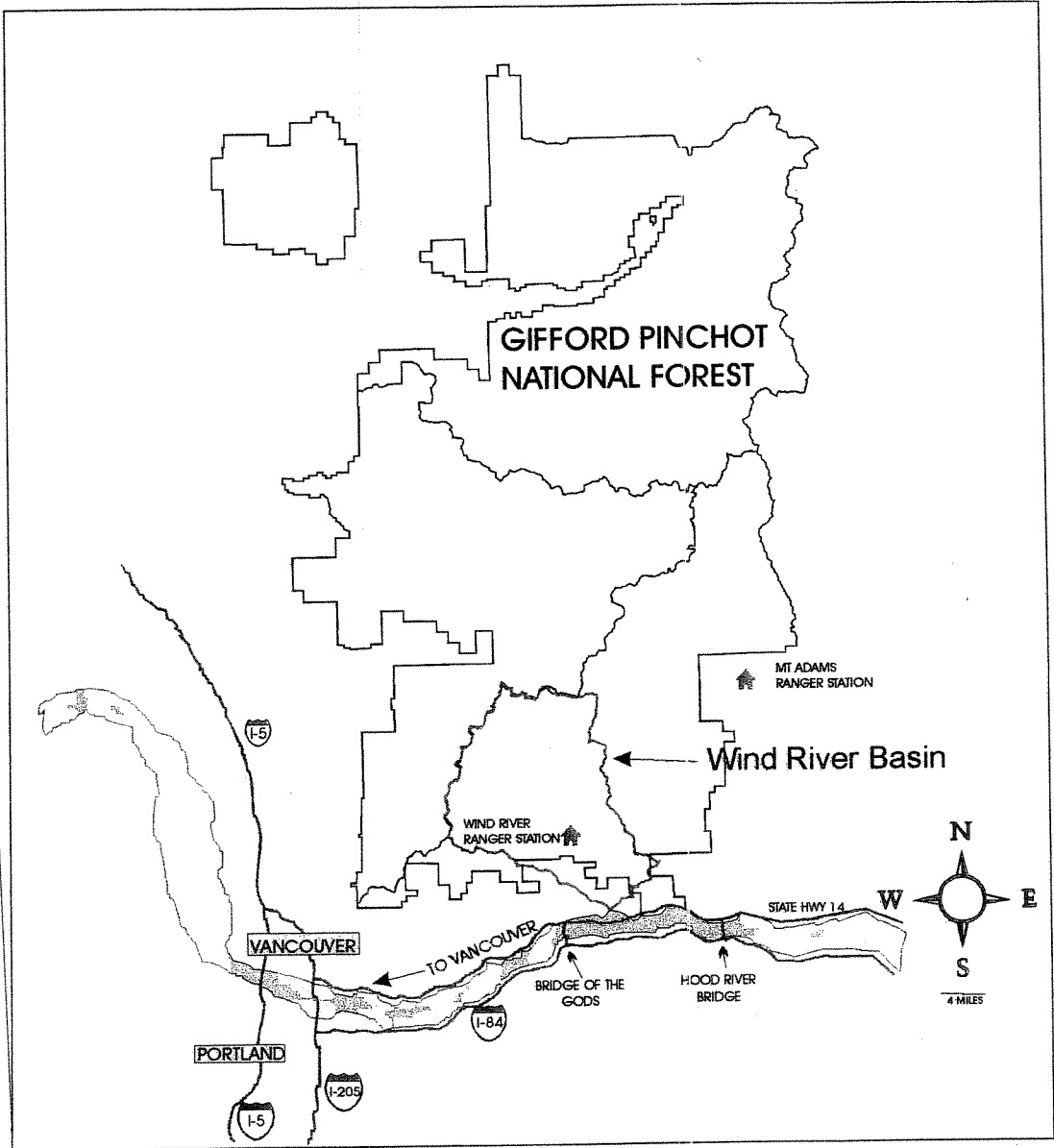
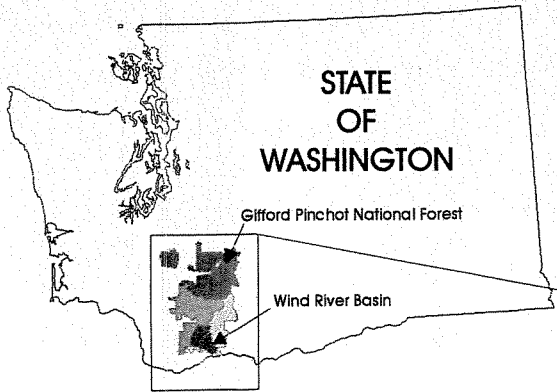
Some larger scale maps used during the analysis process are available for use at the Wind River Range Station. These maps are very expensive to produce; and they are not available for publication.

Other supporting materials used during the process are included as appendices. Because of the length of reports, some portions of the appendices are only available on request.

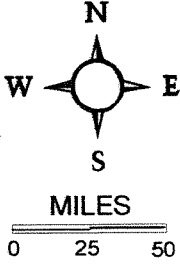
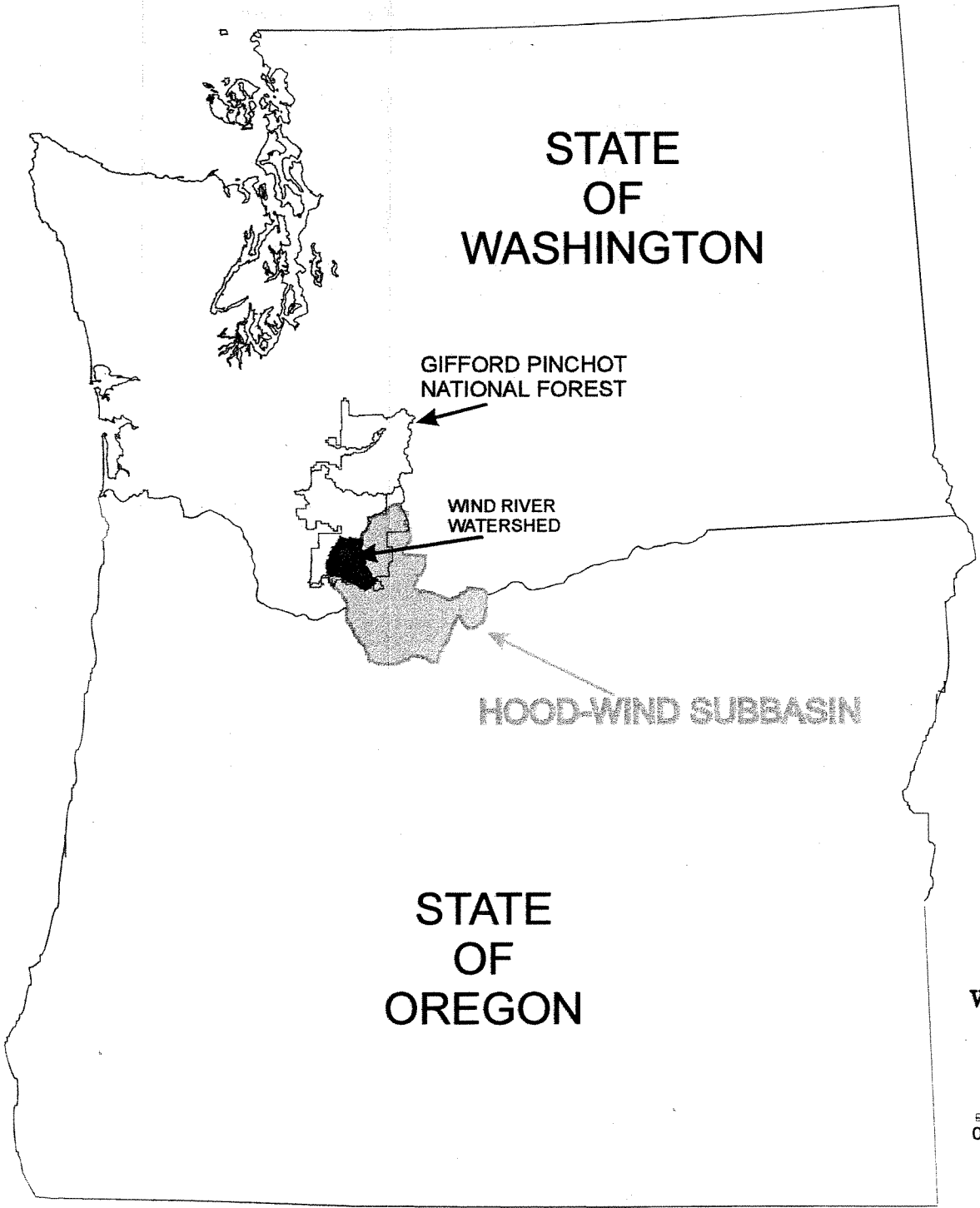
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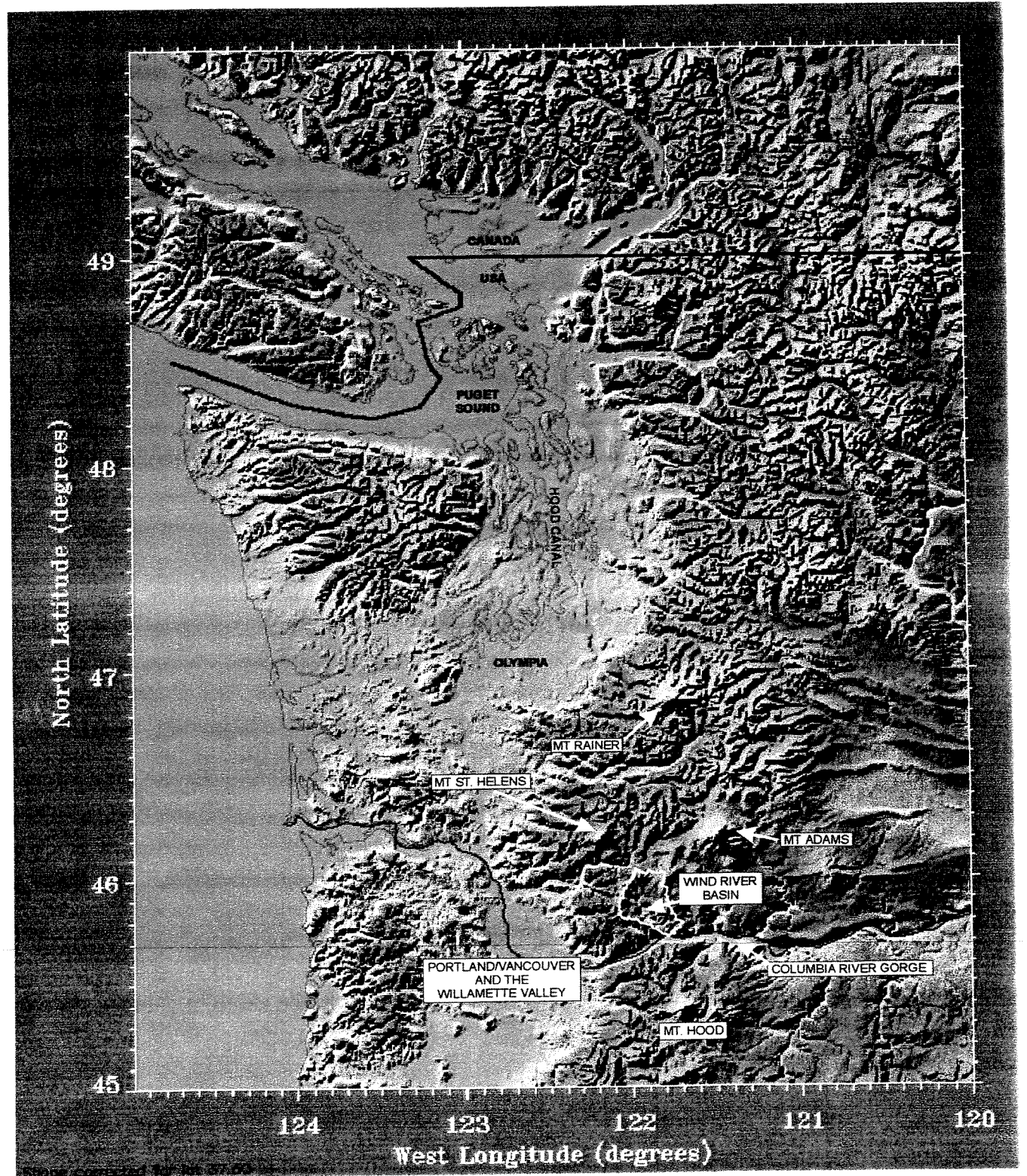
Wind River Basin



HOOD-WIND SUBBASIN



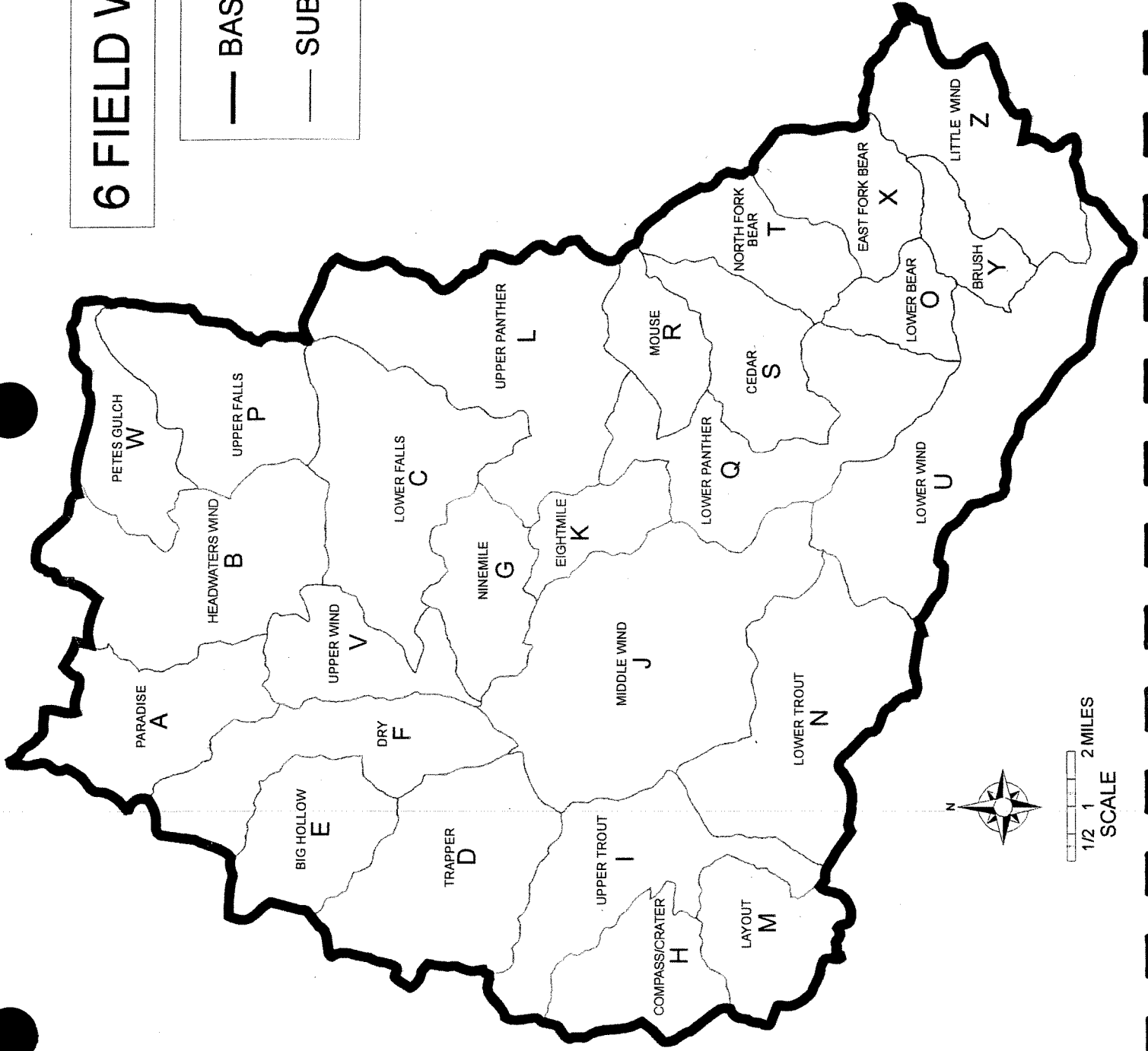
TOPOGRAPHIC RELIEF



6 FIELD WATERSHEDS

— BASIN BOUNDARY

— SUB-BASIN BOUNDARY



GIFFORD PINCHOT FOREST PLAN ALLOCATIONS AND NATIONAL SCENIC AREA LAND USE DESIGNATIONS

NSA LAND USE DESIGNATIONS	
	SMA OPEN SPACE
	SMA GEN FOREST
	GMA GEN FOREST
	GMA RESIDENTIAL
	GMA COM REC
	GMA OPEN SPACE
	HOME VALLEY URBAN AREA
	CARSON URBAN AREA

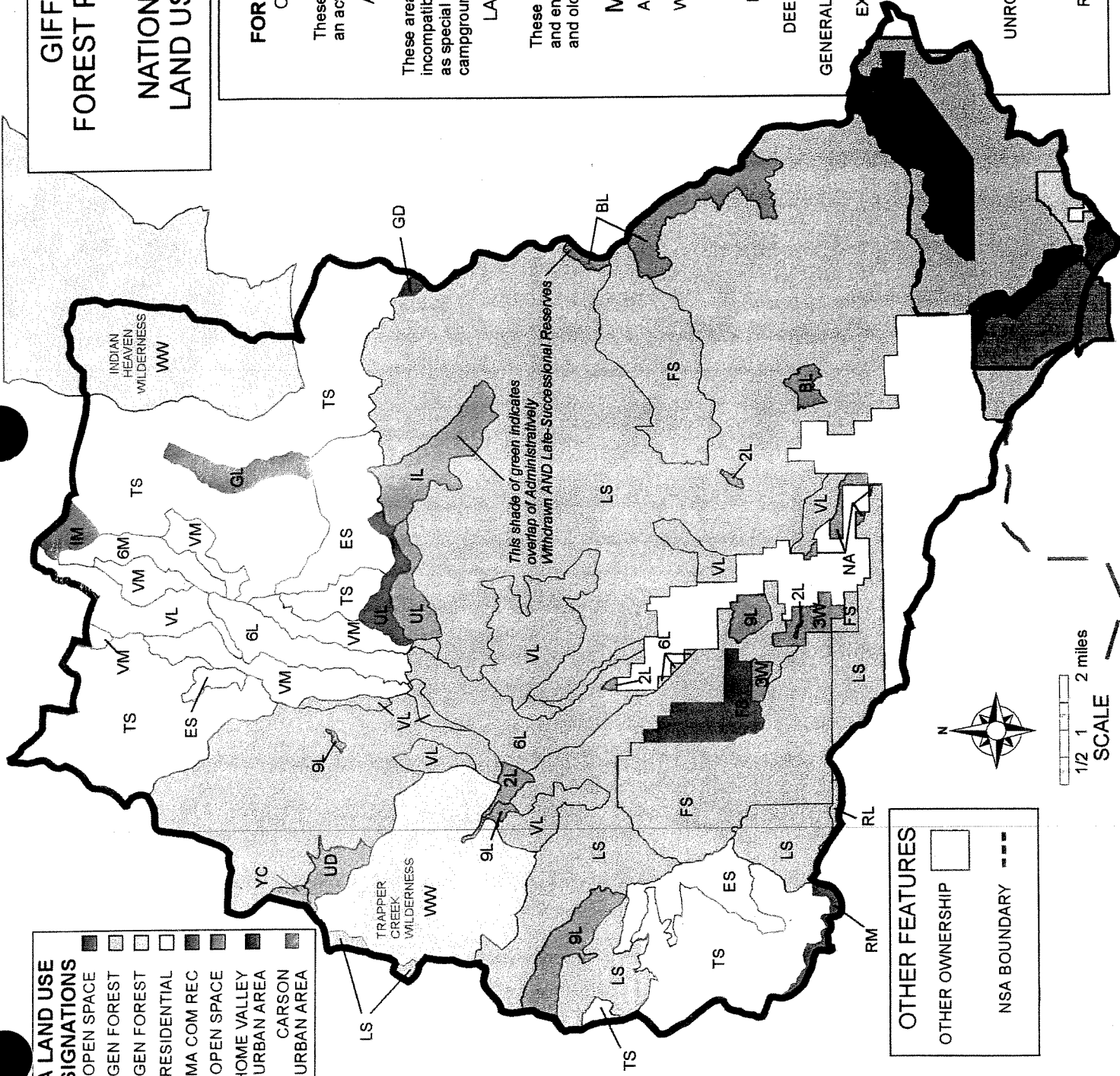
GIFFORD PINCHOT FOREST PLAN ALLOCATIONS	
	CONGRESSIONALLY RESERVED
	ADMINISTRATIVELY WITHDRAWN
	LATE-SUCCESSIONAL RESERVES

These lands have been reserved by an act of Congress for a specific purpose.

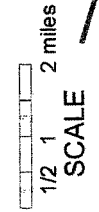
These areas feature resource values that are incompatible with scheduled timber harvest, such as special habitats, unusual natural features, campgrounds, and unroaded recreation areas.

These reserves are designated to protect and enhance conditions of late-successional and old-growth forest ecosystems.

MANAGEMENT AREAS	
ADMINISTRATIVE SITES	2L,3W
WILD & SCENIC RIVERS	NA,6L,6M
SPECIAL INTEREST	9L,BL,GD,GL
ROADED RECREATION	RL,RM
DEER/ELK WINTER RANGE	ES
GENERAL LATE SUCCESSIONAL	LS
EXPERIMENTAL FOREST	FS
WILDERNESS	VV
WILDLIFE SPECIAL	IL,IM
GENERAL FOREST	TS
UNROADED REC W/O HARV	UL,UD
VISUAL EMPHASIS	VL,VM
RESEARCH NAT AREAS	YC,FB



OTHER FEATURES	
	OTHER OWNERSHIP
	NSA BOUNDARY



RIPARIAN RESERVES

RIPARIAN RESERVES

Streams and wetlands are buffered as follows:

Fish bearing streams - two potential site trees.

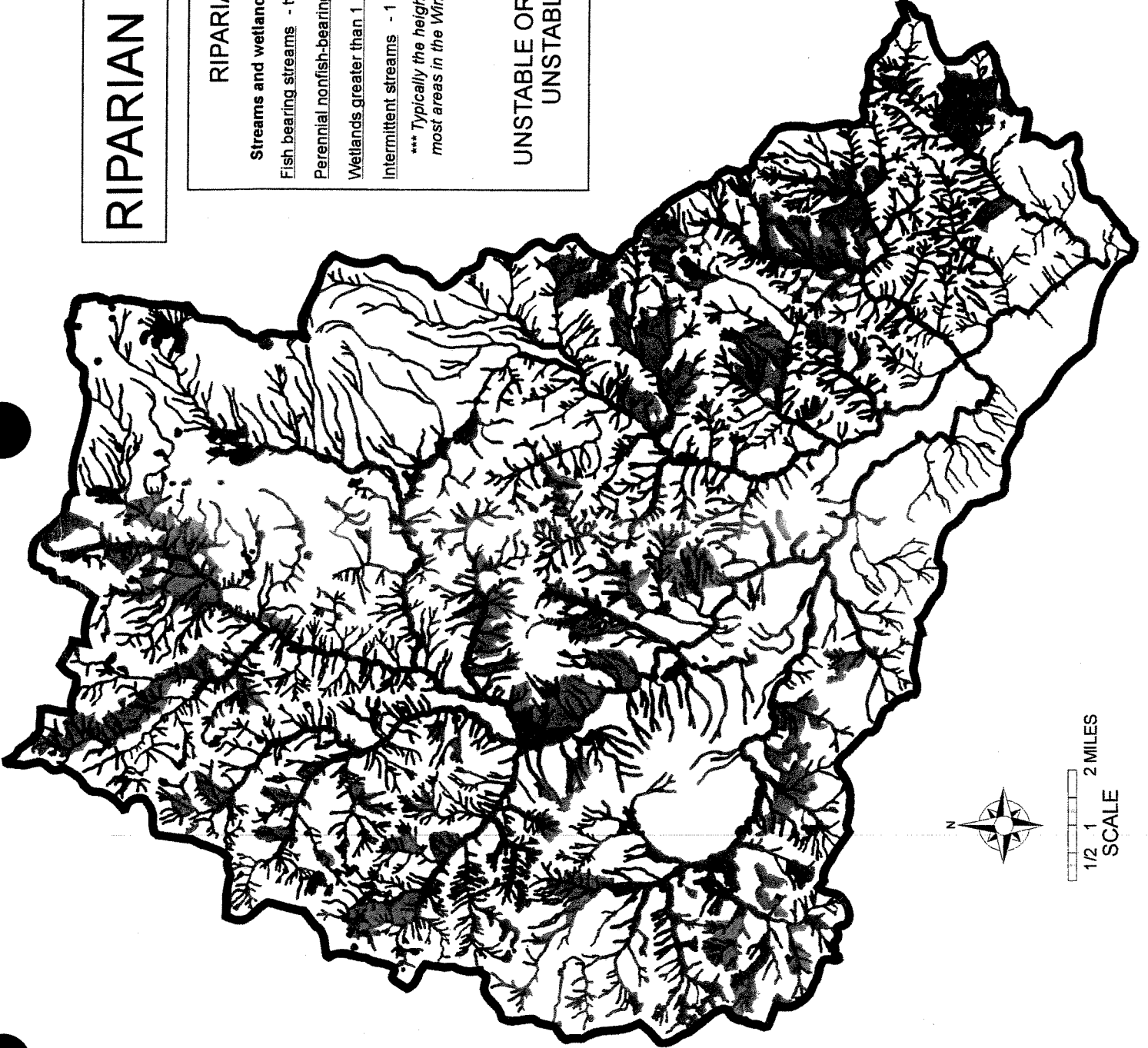
Perennial nonfish-bearing streams - 1 potential site tree

Wetlands greater than 1 acre - 1 potential site tree.

Intermittent streams - 1 potential site tree.

*** Typically the height of a potential site tree for most areas in the Wind River Basin is 156 feet.

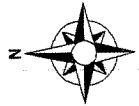
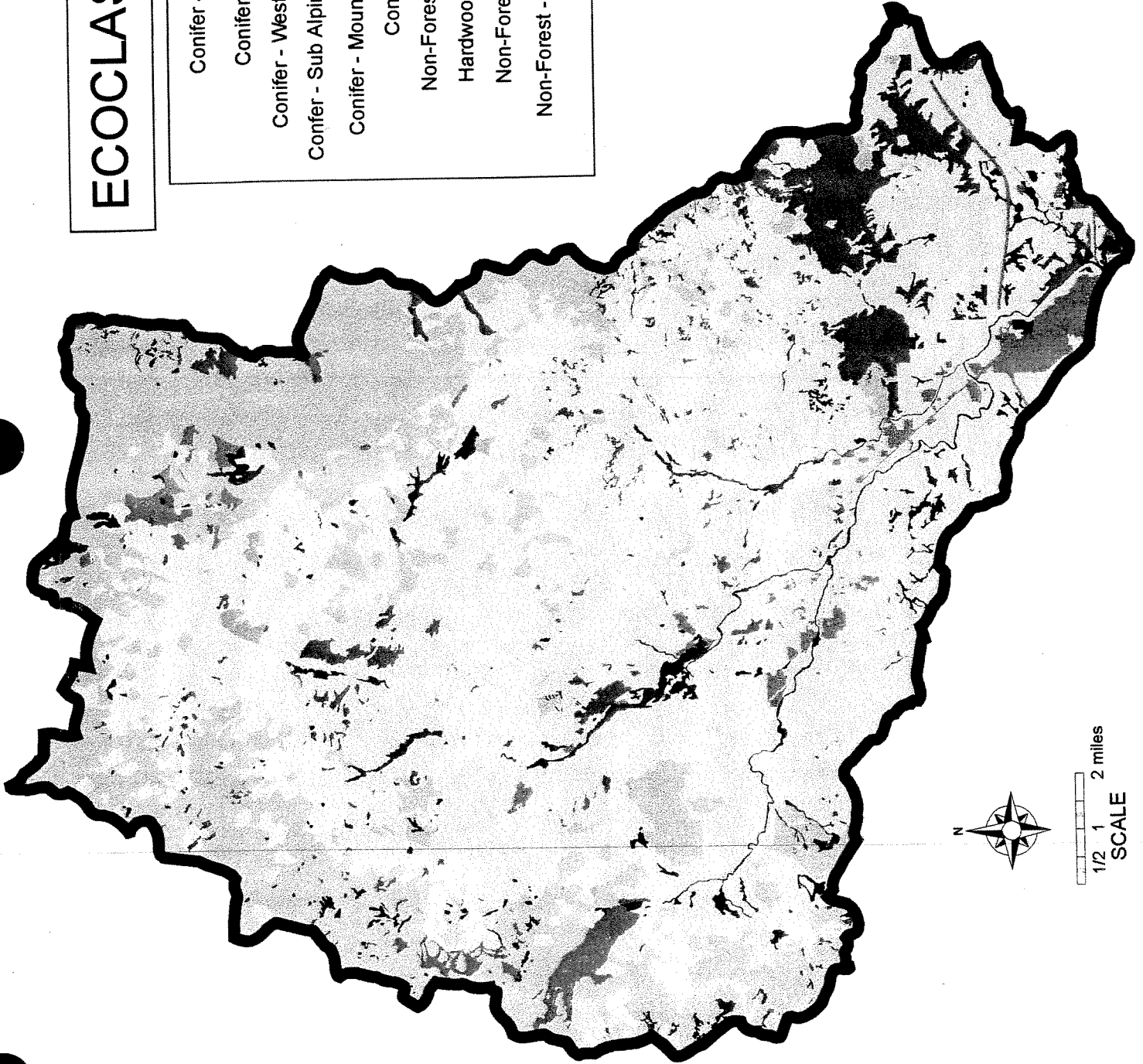
UNSTABLE OR POTENTIALLY UNSTABLE SOILS



1/2 1 2 MILES
SCALE

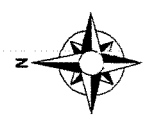
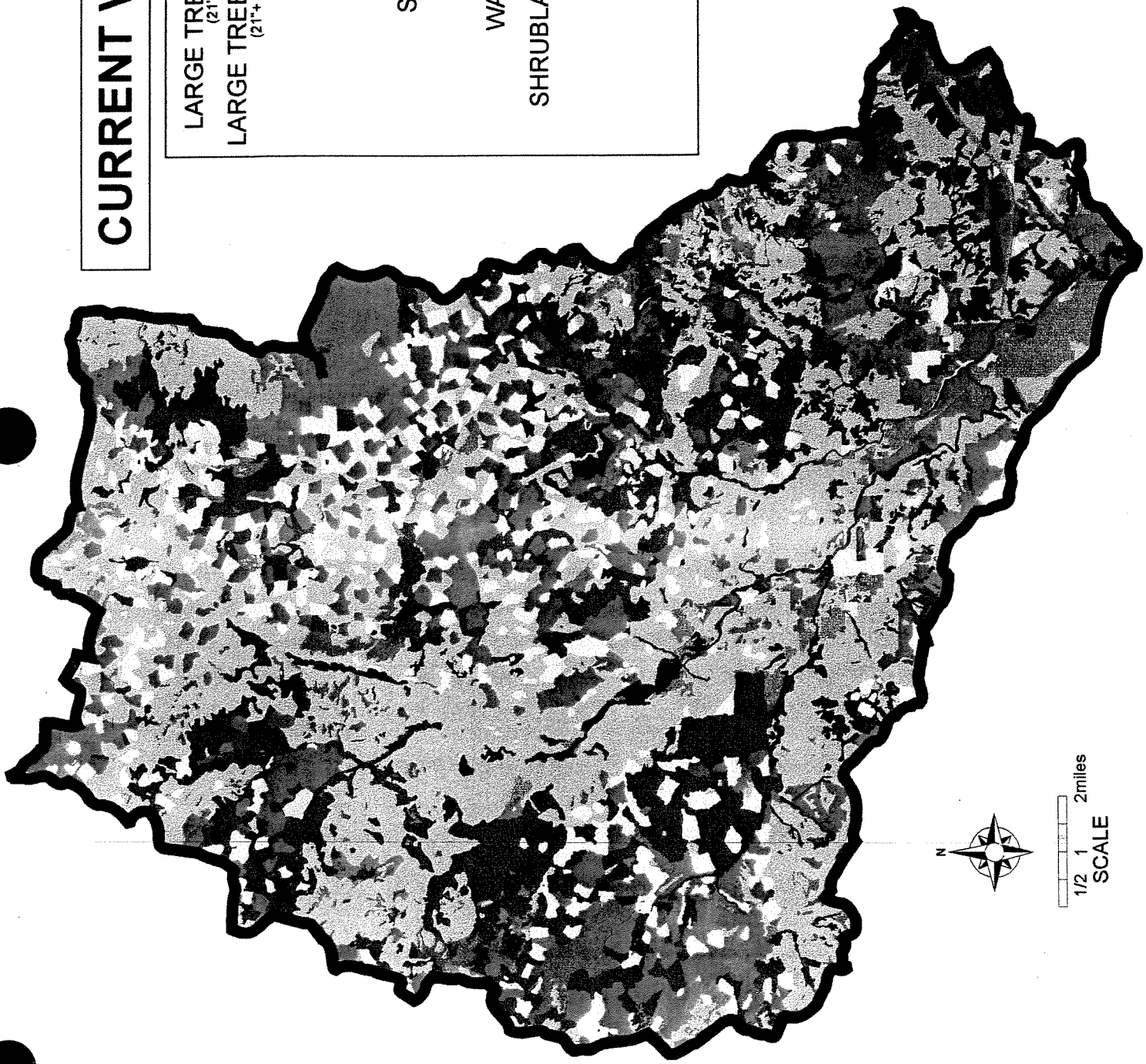
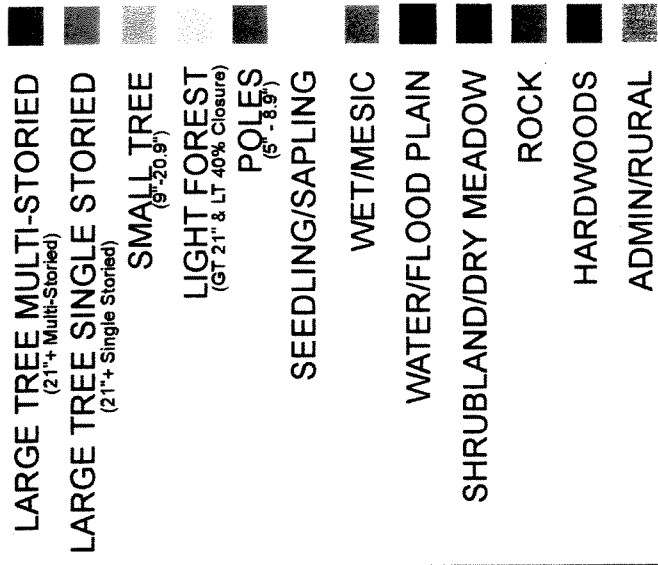
ECOCLASS ZONES

- Conifer - Douglas Fir
- Conifer - Red Cedar
- Conifer - Western Hemlock
- Conifer - Sub Alpine Fir/Spruce
- Conifer - Mountain Hemlock
- Conifer - True Fir
- Non-Forest - Wet/Moist
- Hardwood - Red Alder
- Non-Forest - Dry/Rock
- Non-Forest - Admin/Urban

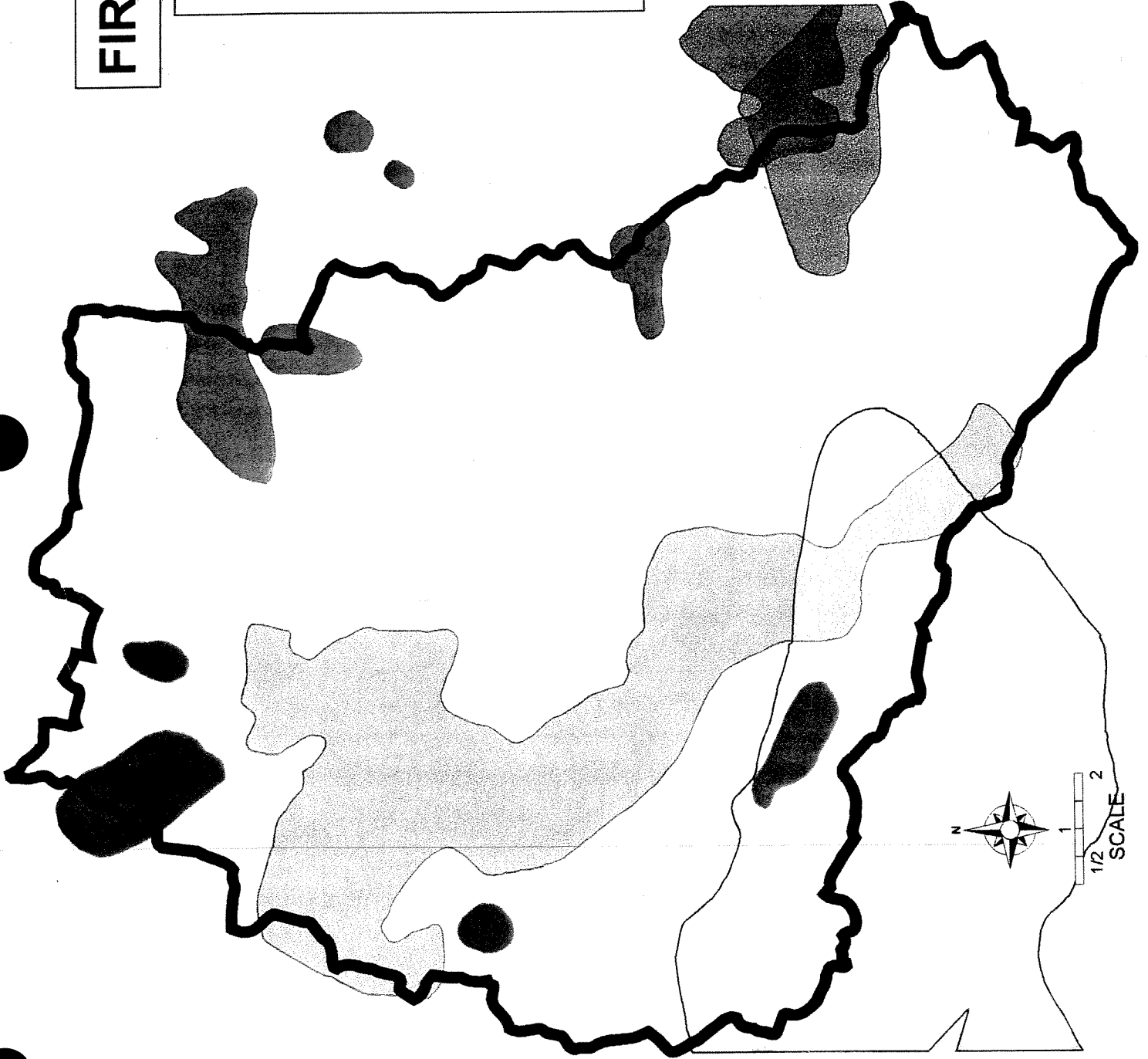
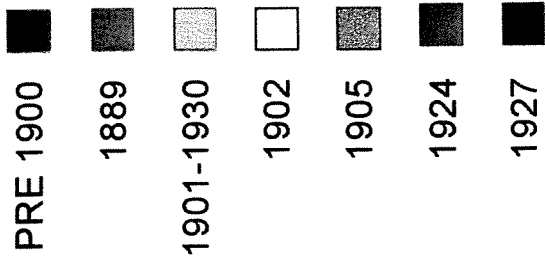


1/2 1 2 miles
SCALE

CURRENT VEGETATION



FIRE HISTORY

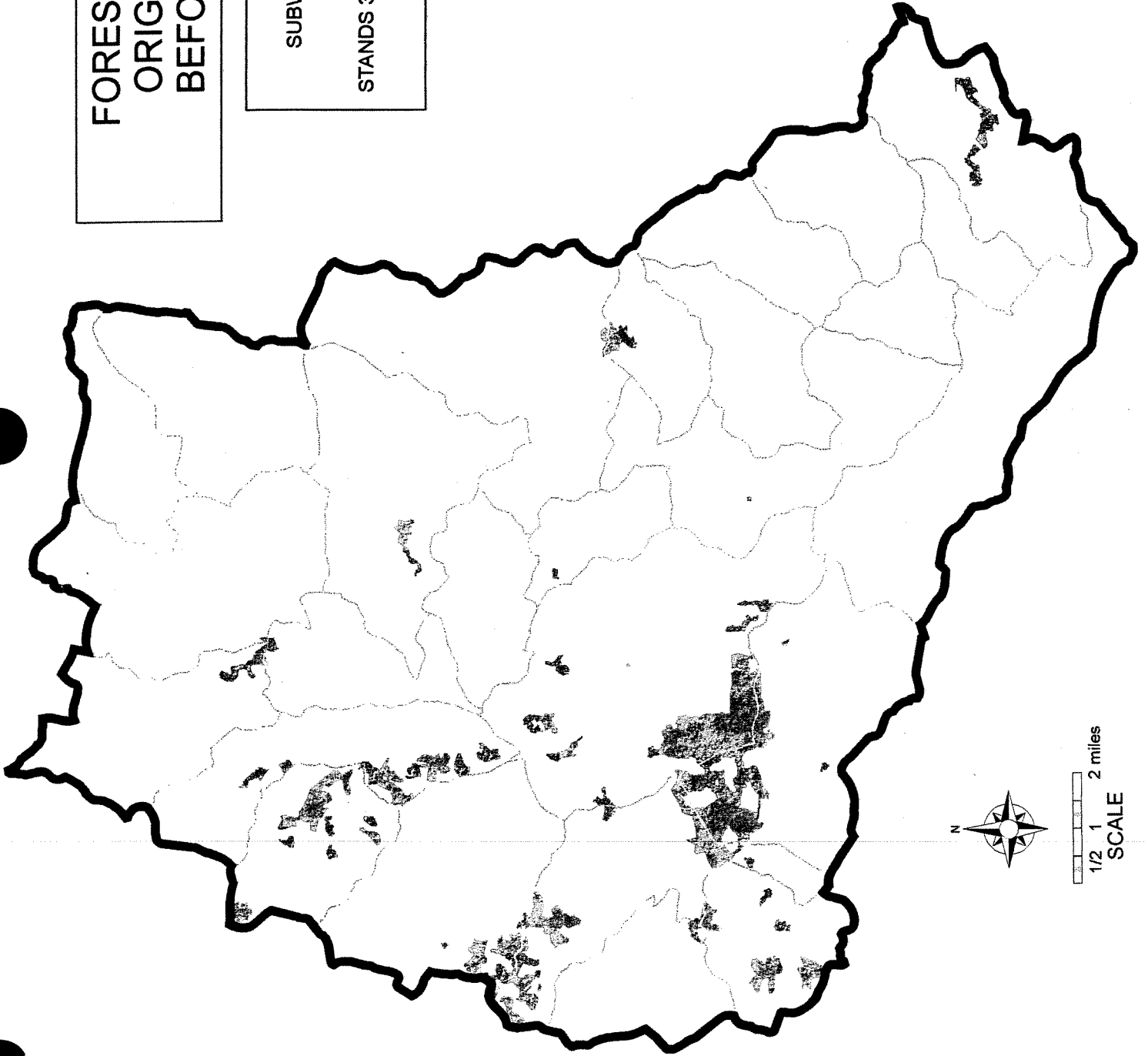


MAP 9

FOREST STANDS
ORIGINATING
BEFORE 1696

SUBWATERSHEDS






STANDS 300+ YEARS OLD

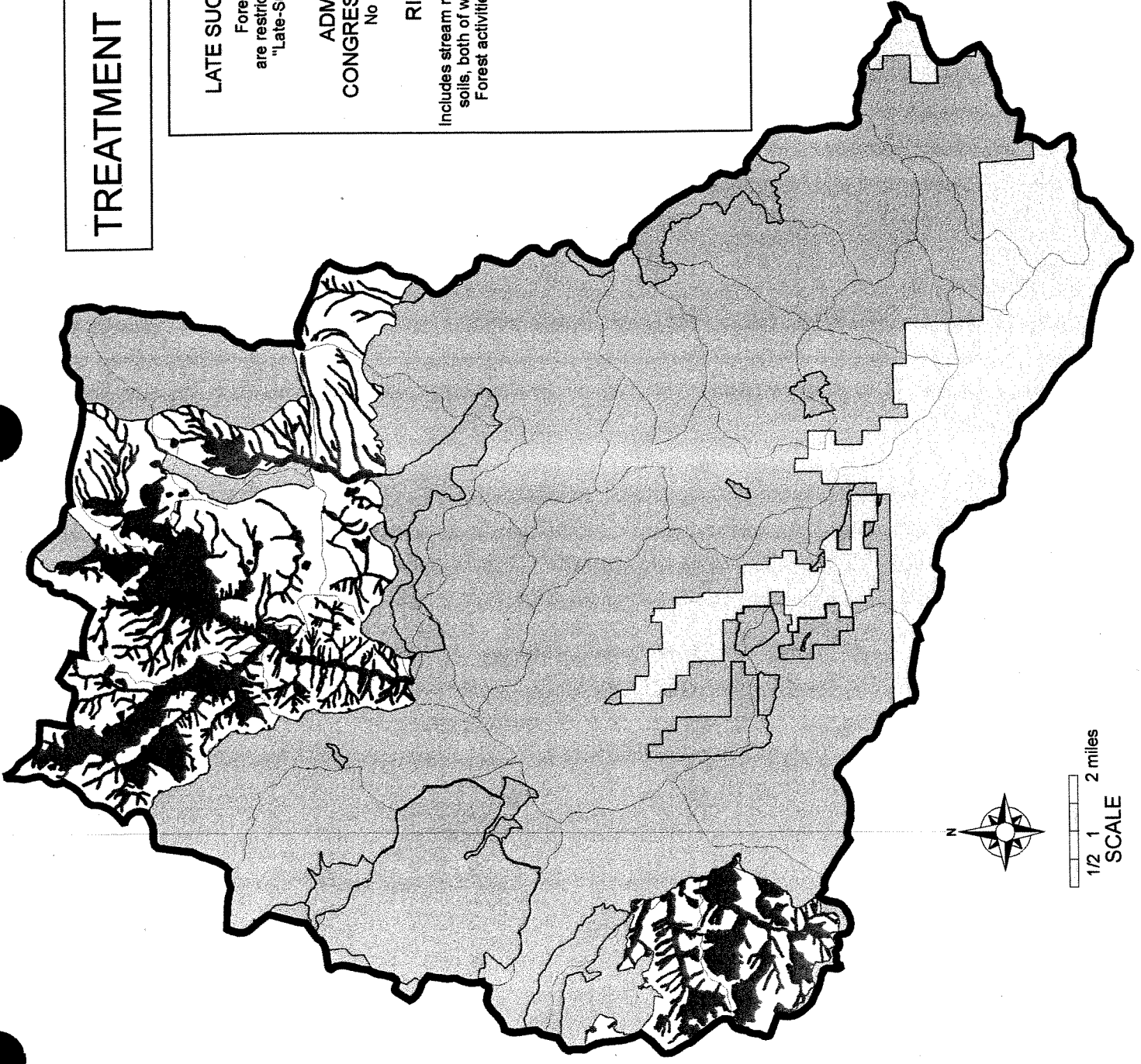


1/2 1 2 miles
SCALE

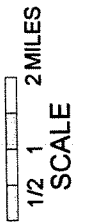
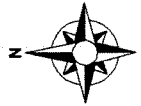
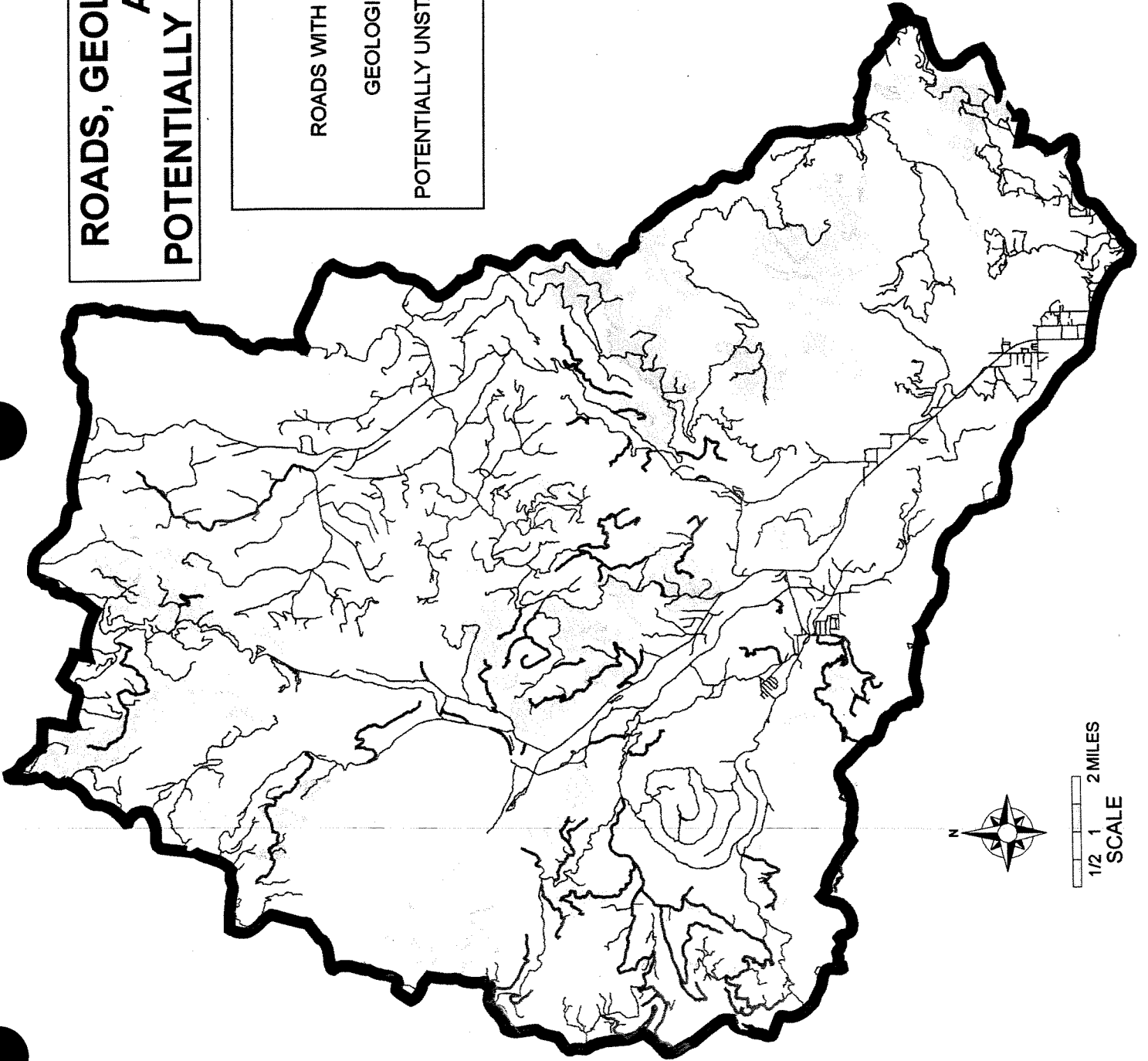
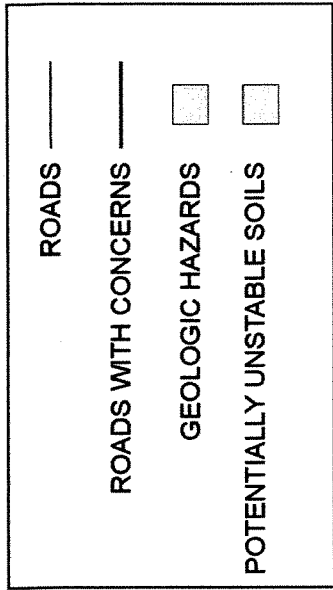
MAP 10

TREATMENT OPPORTUNITIES

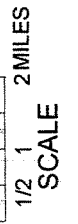
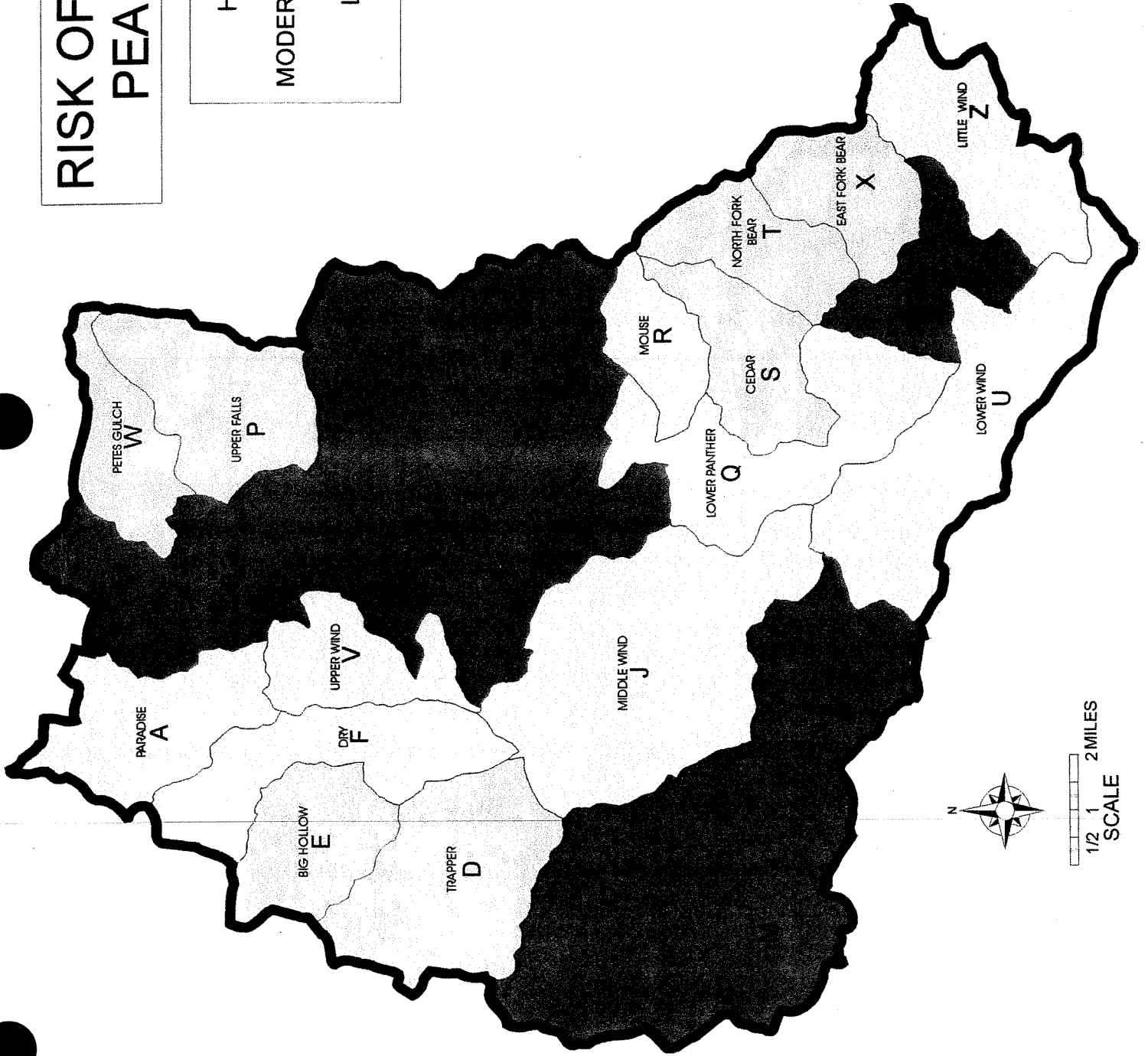
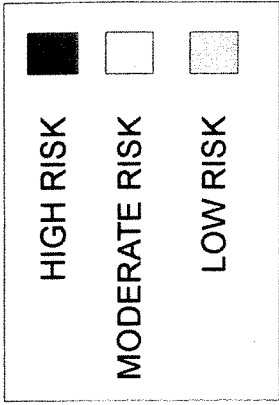
-  **LATE SUCCESSIONAL RESERVES**
Forest management activities are restricted to those that will enhance "Late-Successional" characteristics.
-  **ADMINISTRATIVELY OR CONGRESSIONALLY WITHDRAWN**
No timber harvest permitted.
-  **RIPARIAN RESERVES**
Includes stream reserves and unstable/potentially unstable soils, both of which are dependant on field verification. Forest activities must be consistent with the Aquatic Conservation Strategy.
-  **MATRIX**
-  **OTHER OWNERSHIP**



ROADS, GEOLOGIC HAZARDS AND POTENTIALLY UNSTABLE SOILS



RISK OF INCREASED PEAK FLOWS



BENEFICIAL USES

SUBWATERSHEDS □

PERENNIAL STREAMS

ANADROMOUS FISH BEARING —

RESIDENT FISH BEARING —

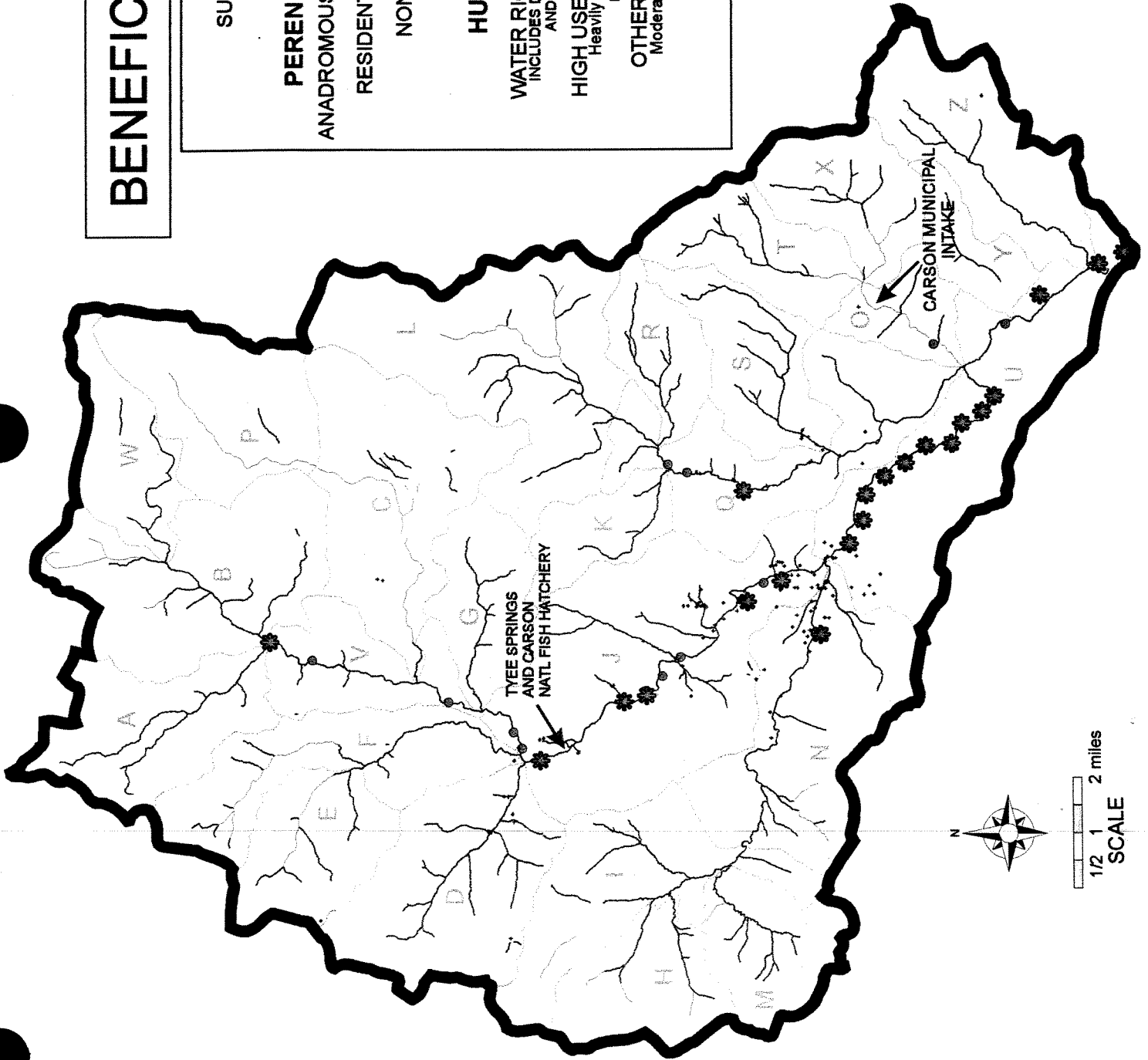
NON-FISH BEARING —

HUMAN USES

WATER RIGHT LOCATIONS
INCLUDES DOMESTIC SOURCES
AND OTHER USES

HIGH USE RECREATIONAL
Heavily used for in-water
recreation

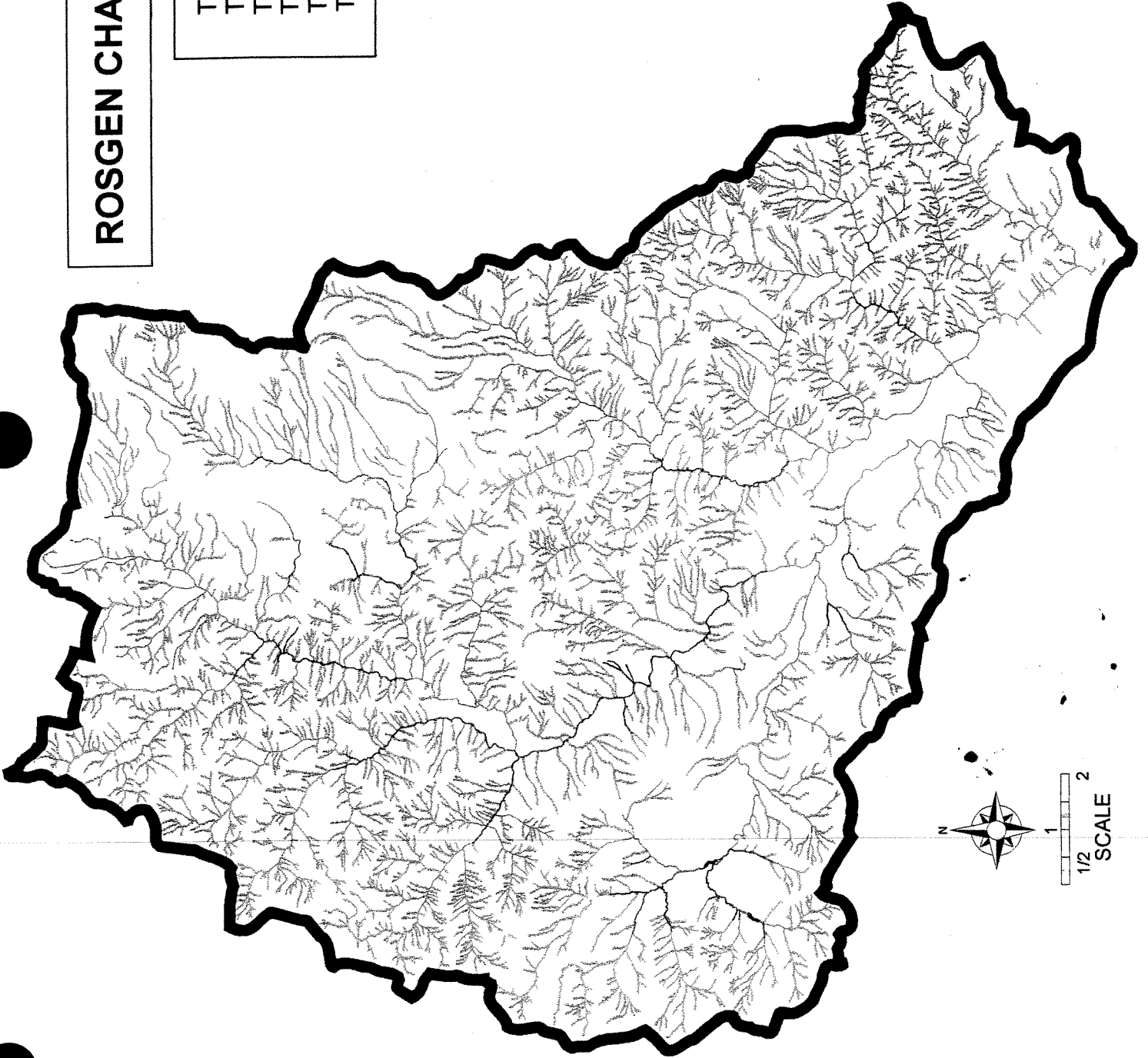
OTHER RECREATIONAL
Moderately used for in-water
recreation



1/2 1 2 miles
SCALE

ROSGEN CHANNEL TYPES

TYPE A
TYPE B
TYPE C
TYPE D
TYPE E
TYPE F



1
1/2 2
SCALE

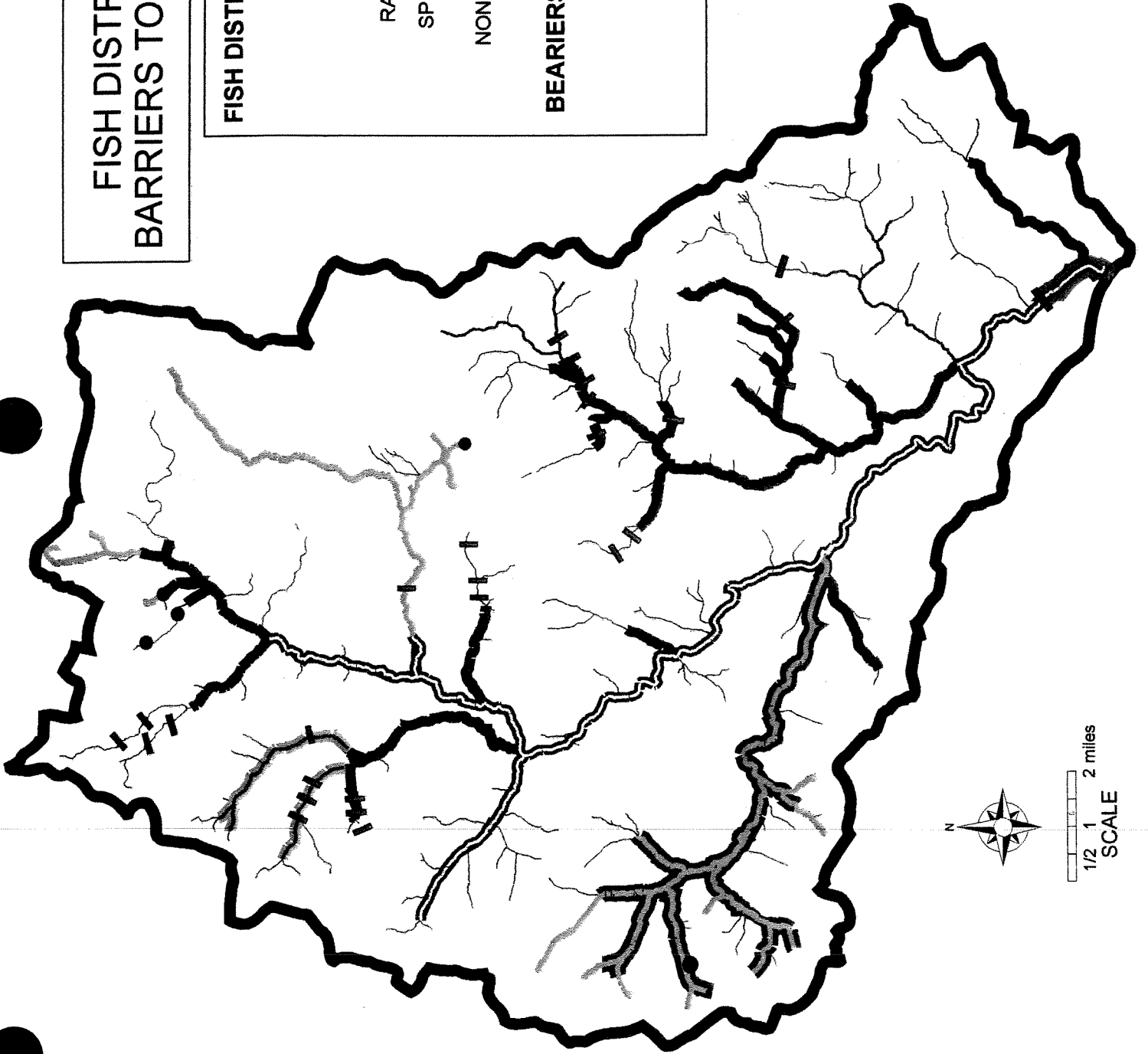
FISH DISTRIBUTION AND BARRIERS TO FISH MIGRATION

FISH DISTRIBUTION BY SPECIES

- FALL CHINOOK
- STEELHEAD
- BROOK TROUT
- RAINBOW TROUT
- SPRING CHINOOK
- PERENNIAL
- NON-FISH BEARING

BEARRIERS TO FISH MIGRATION

- WATER FALLS
- CULVERTS



1/2 1 2 miles
SCALE

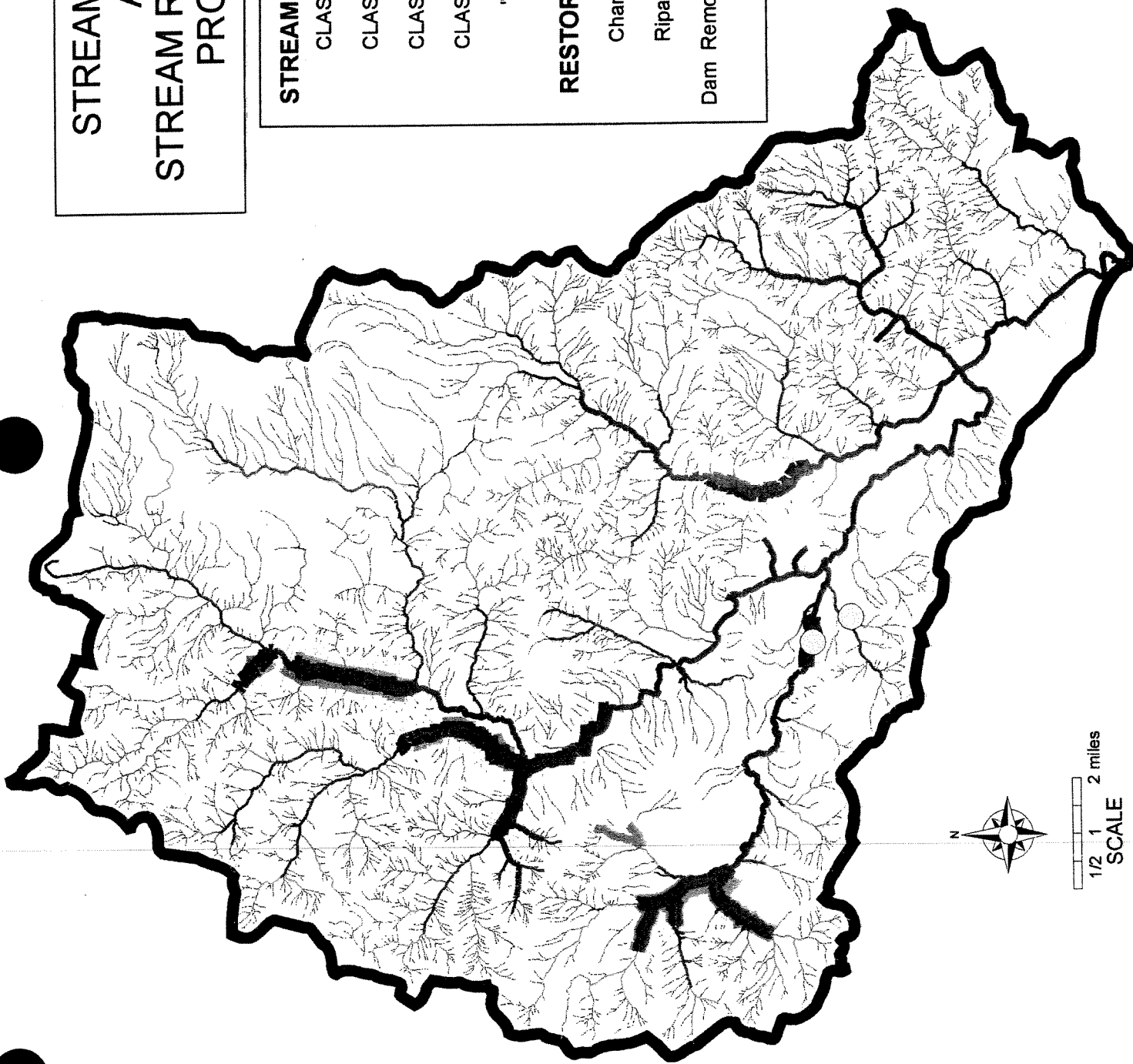
STREAM CLASSES AND STREAM RESTORATION PROJECTS

STREAM CLASSIFICATIONS

- CLASS 1 STREAM ———
- CLASS 2 STREAM ———
- CLASS 3 STREAM ———
- CLASS 4 STREAM - - - - -
- "E" CHANNEL ———

RESTORATION PROJECTS

- Channel Restoration ———
- Riparian Restoration ———
- Dam Removal/Modification ○




1/2 1 2 miles
SCALE

CLOSED-FOREST COVER DISTRIBUTION by 1/4 TOWNSHIP

An indicator of connectivity across the watershed for late-successional related species.

≥ 11 inches DBH
 and
 ≥ 40% canopy cover

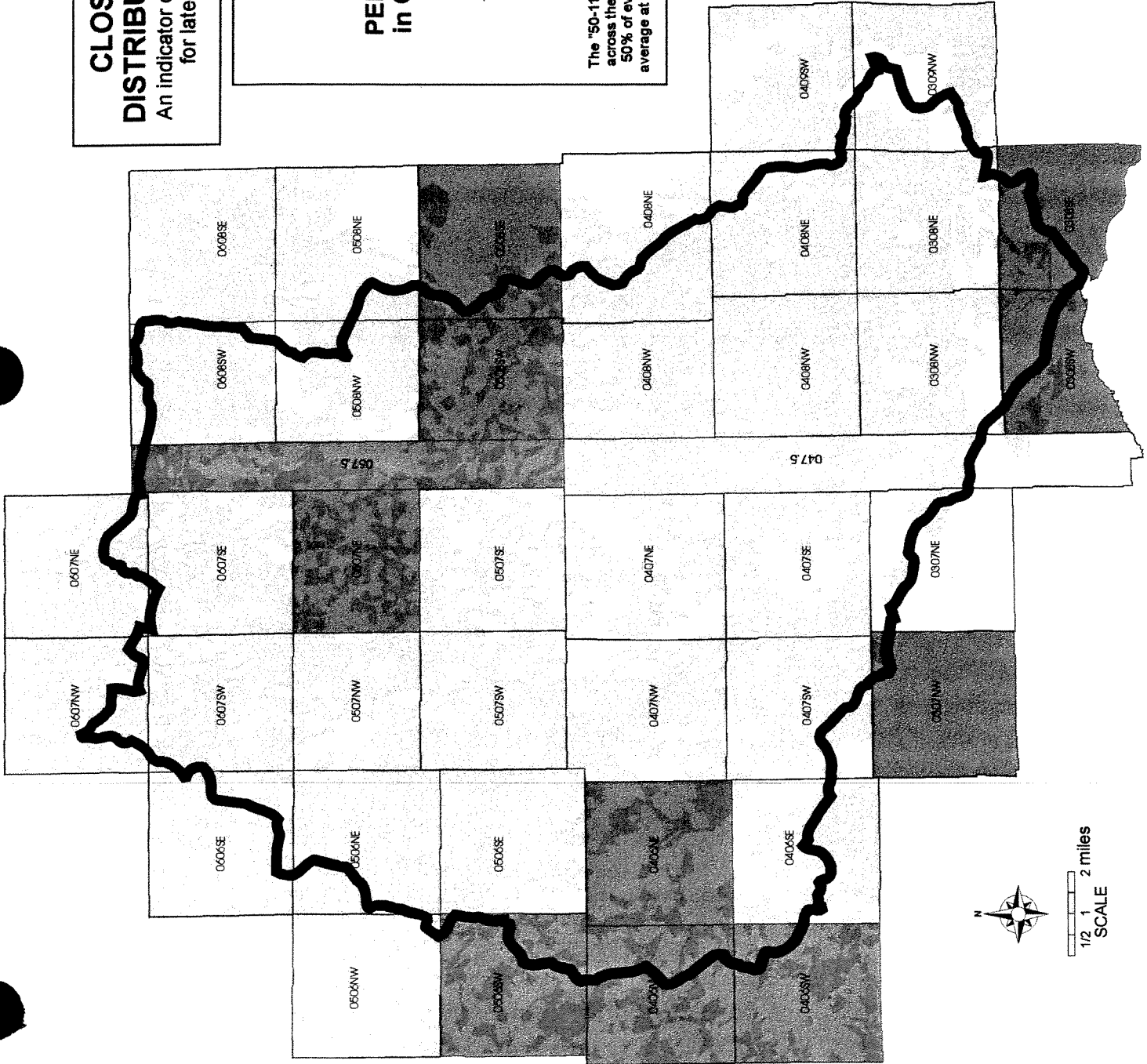
PERCENT OF 1/4 TOWNSHIP in CLOSED-FOREST COVER

≥50%  MEETS THRESHOLD LEVEL

24-49%  BELOW THRESHOLD LEVEL

THRESHOLD LEVEL

The "50-11-40" rule is used to evaluate landscape connectivity across the watershed. This threshold of 50-11-40 is met when 50% of every 1/4 township has forest stand conditions which average at least 11 inches dbh AND at least 40% canopy cover.



1/2 1 2 miles
 SCALE

SUBWATERSHEDS WITH MULTIPLE WILDLIFE HABITAT CONCERNS

OWL HABITAT

Also an indicator of the quality of habitat for other late-successional related species.

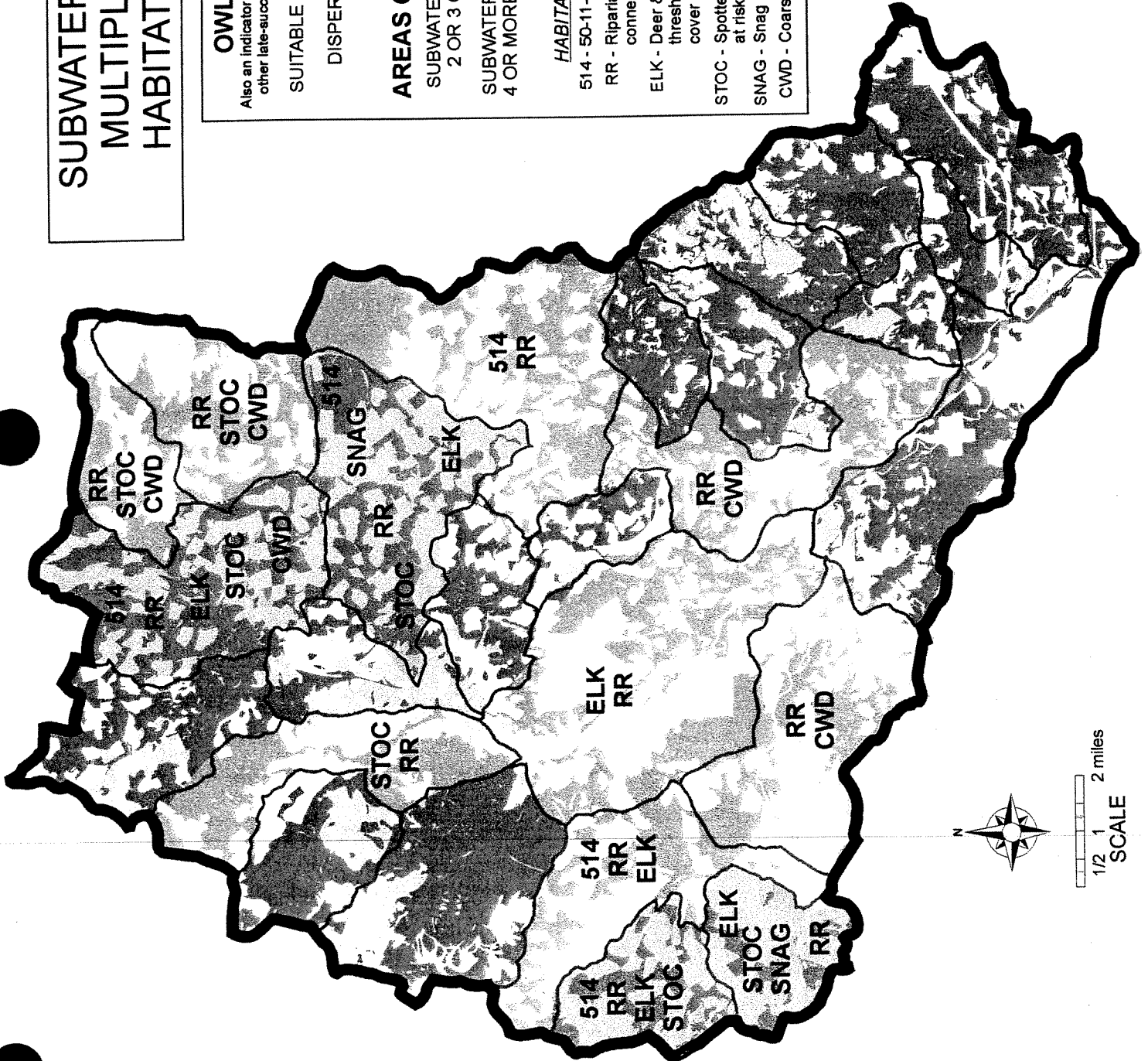
- SUITABLE OWL HABITAT
- DISPERSAL HABITAT

AREAS OF CONCERN

- SUBWATERSHED WITH 2 OR 3 CONCERNS
- SUBWATERSHED WITH 4 OR MORE CONCERNS

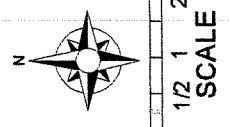
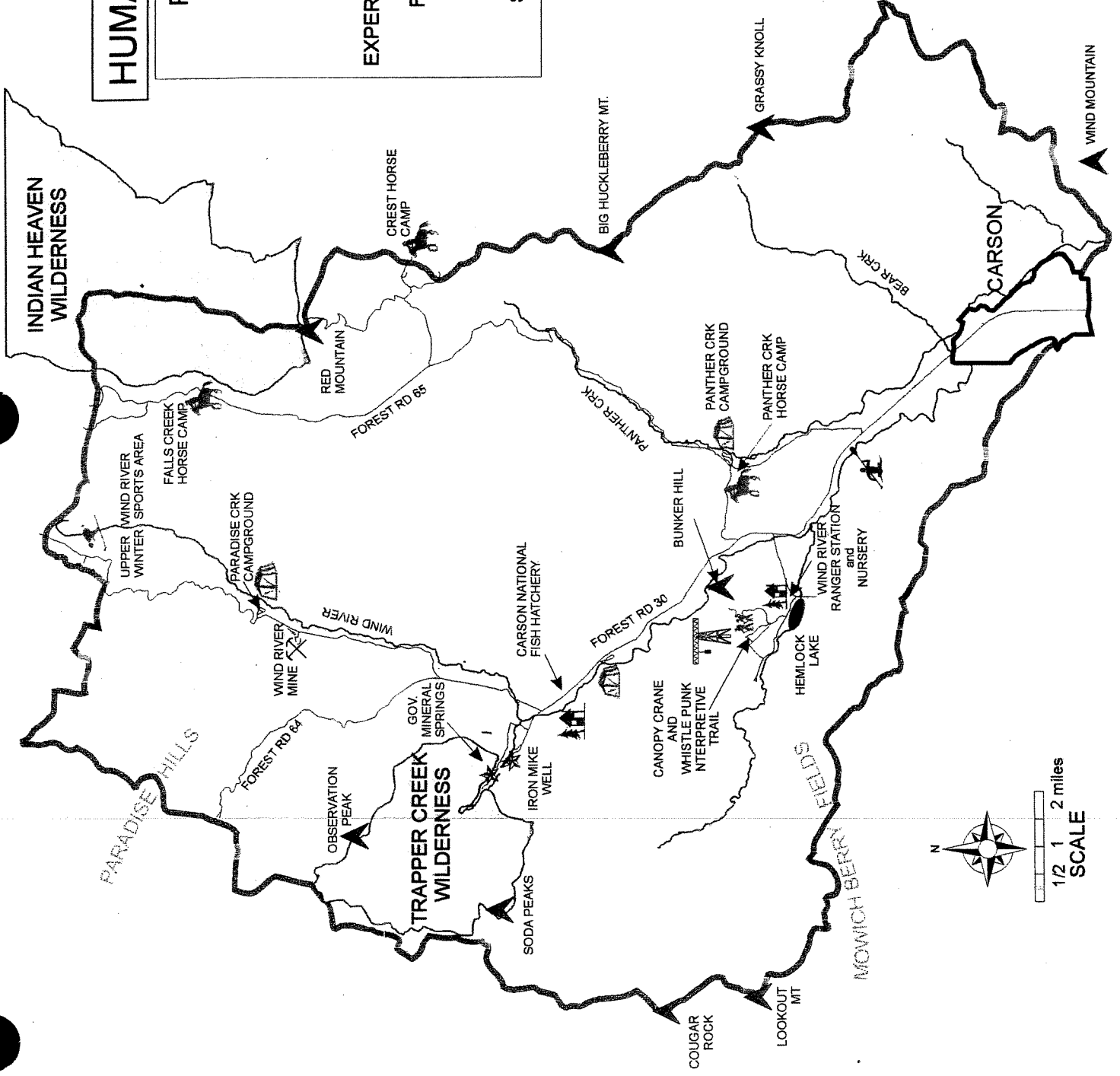
HABITAT CONCERNS

- 514 - 50-11-40 below threshold.
- RR - Riparian reserve breaks in connectivity.
- ELK - Deer & Elk winter range below thresholds: optimal cover, cover distributions, road density.
- STOC - Spotted Owl threshold levels at risk.
- SNAG - Snag habitat limited.
- CWD - Coarse woody debris deficient.



HUMAN USES MAP

POINTS OF INTEREST	
▲	MT. PEAK
🐎	HORSE CAMP
🏕️	CAMPGROUND
🚣	EXPERT ONLY KAYAKING
🏠	FEDERAL FACILITY
—	MAJOR RD
—	STREAM FEATURE



WIND WATERSHED ANALYSIS

CHAPTER I

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CHAPTER I

CHARACTERIZATION

This chapter identifies the dominant physical, biological and human processes or features of the watershed that affect ecosystem function and conditions. General location of the watershed, ownership pattern and major land allocations are presented graphically; see Maps I-1, 2, 3, and 5.

Management objectives constraints and standards and guidelines for National Forest Lands may be found in the following documents:

- **Record of Decision (ROD)** for Amendment to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. (USDA USDI 1994)
- **“Land and Resource Management Plan”** for the Gifford Pinchot National Forest. (GP Forest Plan) Originally published in 1990, with amendments .
- **The Management Plan for the Columbia River Gorge National Scenic Area**, Columbia River Gorge Commission, USDA Forest Service, September 1992.

Management objectives, standards and guidelines specific to core topics are cited where appropriate in this report.

This chapter is generally organized to follow the core topics:

- Erosion Processes
- Hydrology
- Vegetation
- Stream Channels
- Water Quality
- Species and Habitats, Aquatic & Terrestrial
- Human Uses: *Heritage Resources & Recreation*

INTRODUCTION

Location and setting : The Wind River watershed is located in Southwestern Washington along the Western Cascades, with its headwaters originating on the Wind River Ranger District, in the Gifford Pinchot National Forest. It begins at McClellan Meadows approximately 20 miles North of the town of Carson, WA. The basin is oriented northwest to southeast with elevations ranging from 80 feet to 3,900 feet. It is a 5th order stream, about 31 miles long, draining 225 mi² or 139,580 acres, entering the Bonneville pool of the Columbia River at river mile 154.5.

Climate: The watershed has a temperate marine climate with cool moist winters and dry summers. Mean annual precipitation averages 110 inches per year most of which occurs in the winter between November and April.

Topography: Topography varies within the watershed; it is steep in NW and lower SE, gentle in NE - McClellan Meadows area, and it is benchy in Trout Creek Flats and middle portions of the Wind River valley.

Land allocations, land management objectives: The upper portion of the basin is situated within the legislated boundary of the Gifford Pinchot National Forest. The river flows through some private lands situated within the forest boundary. The lower portion of the watershed (6.5 river miles) consists of non-federal lands outside the forest boundary. The President's Forest Plan (ROD) categorizes the Wind River Basin as a Tier 1, Key Watershed that provides habitat for anadromous salmonids. Land designations and management categories are summarized in Map 5.

EROSION PROCESSES

The Wind River Watershed has been shaped through 25 million years of volcanic activity and glacial action. Most of the watershed is between 25 and 12 million years old with some younger flows out of Indian Heaven and Trout Creek Hill being dated between 3 million to 350 thousand. The flows out of Trout Creek Hill are the youngest at about 300,000 years old.

The majority of the watershed is in the older volcanoclastic material. These areas are more susceptible to erosion and mass failure due to the weathering of the material to silts and clays.

Glacial activity has had an effect on the landscape especially in the upper regions of the watershed by Indian Heaven. Glaciers have scoured and smoothed the land where they flowed out of Indian Heaven. Outwash and alluvial material from this time period have been eroding down through the Wind River valley. Since the construction of the Bonneville Dam this material has been building up at the mouth of the Wind River. Other material that has been moving into the streams in the lower parts of the valley are flood deposits left from the Bretz floods in Eastern Washington. A good example of this is Sand Hill on the cut off road to Carson. Sediment input has also resulted from large landslides in the watershed such as the slide associated with Wind Mountain.

Sediment delivery from the upper reaches of the watershed make its way slowly downstream during major storm events until it gets just below Stabler. From here down to the mouth of the Wind sediment is in constant transport mode till it settles out at the mouth. Sediment is from surface erosion from roads, mass wasting during storm events and minor amounts from hillslope activities when bare soil is exposed.

Management activity has increased the amount of sedimentation but it is hard to quantify how much as a base level is unknown prior to human intervention. Periods of fire have also increased the amount of sediment movement as vegetation is removed from the landscape.

HYDROLOGY

Because the Wind River lies in the western Cascades, climatic patterns are strongly controlled by marine-influenced air masses that move in off the Pacific Ocean. Summers are warm with infrequent precipitation, and during October through March, 80% of the watershed's moisture is delivered in a combination of rainfall and snow. Streamflows in the watershed range widely from summer low flows to the largest peak flows occurring in the winter. Some streams only flow during high flow events and are dry the remainder of the year (ephemeral streams). Others such as the mainstem of the Wind River increase by an order of magnitude from an average daily flow of less than 250 cubic feet per second (cfs) during low flows of August and September to over 2,000 cfs on an average day in December and January. The largest streamflows typically occur in response to rain-on-snow events, when heavy rains combine with high air temperatures and high winds to cause widespread snowmelt. Low flows are maintained by late season snowmelt and areas of water retention or recharge.

VEGETATION

The Wind River drainage is characterized by large areas of even-aged coniferous forest that vary in age from 65 to 150 years old interspersed with remnants of older forest up to 500 years old and patch clearcuts less than 40 years old. The stand types can be classed into Late-successional, Mid-successional, and Early-successional conditions. Stands below 3500 feet elevation are in the Hemlock plant association. Stands above 3500 feet elevation transition into the Pacific Silver fir zone.

Late-successional stands contain trees over 21 inches in diameter with multiple canopy layers. These areas consist of old growth and remnant older stands. Most stands occur in the Experimental Forest and along the drainage bottoms. Some late-successional stands are found above 3,500 feet elevation in the Silver Fir Zone.

Mid-successional stands contain large trees over 21 inches in diameter but with a single canopy layer and stands of small trees from 9 inches to 21 inches in diameter. These areas generally develop after fires or approximately 30 years after regeneration harvest. These stands are starting to develop the characteristics and attributes of late successional stands (large diameters, layering, species diversity, and woody debris.)

Early-successional stands contain young trees from 0 to 9 inches in diameter. These areas are generally the result of recent regeneration harvest (clearcut) and stands are generally stocked with young tree. Young stands tend to be overstocked and lack diversity in species and tree sizes.

Prior to European settlement (1850) vegetative patterns were mainly influenced by wild fires. After settlement the patterns were influenced by roading activity and timber harvesting. Private lands below the Forest Boundary were logged 1850 and 1900 and many have been logged a second time.

Natural causes of change: fire, wind storms, floods, debris flows, root disease, insect infestation

Human causes of change: human caused fires, timber harvest, road building.

There are nine vegetative zones represented in this watershed (Figure I-1)

TABLE I-1: Vegetative Zones within the Wind River Watershed

Vegetative Zones	Code	Acres	% of Area	Principal Species
Hemlock	(CH)	88,118	61	Western Hemlock, Douglas-Fir
Silver Fir	(CF)	37,937	26	Pacific Silver Fir, Noble Fir
Douglas-Fir	(CD)	4,392	3	Douglas-Fir
Subalpine Fir	(CA)	270	<1	Subalpine Fir
Cedar	(CC)	381	<1	Western Red Cedar, Red Alder
Lodgepole Pine	(CL)	41	<1	Lodgepole Pine, True Firs
Mt. Hemlock	(CM)	719	<1	Mt. Hemlock
Hardwood	(H)	1,712	1	Hardwoods
Other: non-forest		9,957	7	Rocks, Shrubs and Meadows

STREAM CHANNELS

Physical characteristics of stream channels (channel morphology) are a primary factor in determining the quality and quantity of available fish habitat. Rosgen (1985) developed a method of classifying stream channels based on channel characteristics such as gradient, sinuosity, and bankfull or floodprone areas. This type of characterization allows managers to estimate the relative potential for fish production in various stream segments and predict the impacts of land management on basin-wide fish populations. Low gradient, meandering stream segments (generally Rosgen "C" channels) containing substrate types and water velocities that are suitable for spawning and rearing of salmonids during early developmental stages are the most sensitive to disturbances and are key to the maintenance of healthy fish populations.

Because channel morphology is a function of large scale valley formations and geology, certain regions and elevation ranges within a basin are often dominated by a single channel type. The Wind River basin is characterized by three major subbasins (Wind River, Panther Creek and Trout Creek) that follow a pattern of narrow, incised valleys in the lower reaches, followed by a broad, alluviated middle segment and narrow incised valley in the upper reaches and headwaters (see Figure I-2). Rosgen channel types follow this pattern as well. Incised valleys within the basin are dominated by "B" channels in the lower reaches and "A" channels in the headwaters, while "C" channels characterize the flat floored alluvial valleys in the middle.

Both "B" and "C" channel types play major roles at certain stages in the life histories of anadromous salmonids. Within the Wind River basin, "B" channel segments generally contain more flow, cooler water temperatures, and deeper, higher quality pool habitat than the lower gradient reaches. These segments are important as holding areas or migration corridors for adults and smolts, and as low flow refuges for rearing juveniles. Impacts to these reaches of stream have been minimal relative to the sensitive "C" channel reaches because the increased gradient flushes sediment, and the predominant bedrock/boulder bed and bank substrate maintains stability of stream channels and natural pool/riffle patterns.

TABLE I-2: Characteristic of Major Sub-basins

Stream Name	Length of "C" Channels (River Miles)	Elevation Ranges Dominated By "C" Channels	Major Tributaries
Wind River	25	1200-2000'	Trapper, Dry, Ninemile, Falls, Paradise Cks.
Trout Creek	11	1600-2000'	Layout, East Fork Trout, Compass, Crater Cks.
Panther Creek	6	800-1100'	Cedar, Eightmile, Mouse Cks.

The three major sub-basins in the watershed contain "C" channels within upper alluvial valleys that lie predominantly on National Forest land. These reaches hold the primary spawning areas for steelhead in the system. Under natural conditions, the early life stages of juvenile steelhead would take place in "C" channel reaches due to lower stream velocities and diverse habitat formed by woody debris. Due to the flat, accessible nature of the valleys surrounding "C" channel types, the majority of these ecological "hotspots" have been decimated by timber harvest and are in a severely degraded state. In addition to impacts from riparian timber harvest within alluviated valleys, "C" channels are very sensitive to disturbance from upslope management activities in the steeper valleys that are drained by headwater streams. The reduced gradient and resulting lower water velocities make "C" channel reaches a sort of dumping ground for sediment delivered from destabilized areas in the upper watershed. Bed and bank materials are dominated by fines or smaller particle sizes that are susceptible to bank erosion. The removal of large, living rootwads from timber harvest, combined with increased peak flows and sediment loads, results in accelerated channel migration and increased water surface area. Cumulative effects from riparian and basin-wide timber harvest in "C" channels are increased peak flows, poor channel stability and severely increased water temperatures in "C" channel stream reaches.

WATER QUALITY

The Wind River was identified in the Northwest Forest Plan as a Tier I Key Watershed. This designation was given largely because the Wind River supports runs of both native and hatchery-raised anadromous fish. The watershed also has a municipal watershed for the town of Carson, Washington, as well as a number of single domestic water sources. Other beneficial uses of the watershed that drive the need for water quality protection include the many recreational attractions that are focused around water resources, and the resident fish that inhabit most every part of the drainage.

Primary water quality parameters of concern related to these uses include water temperature, turbidity and fecal coliform. State water quality standards have been established for each of these parameters, and are applied to all streams and lakes in the watershed. Currently, water temperatures are known to exceed state standards in several areas in the watershed. Trout Creek, the stream with the highest known temperature in the watershed was identified in the 1994 303(d) list compiled by the State Department of Ecology.

SPECIES and HABITATS

Aquatic

The Wind River is a 5th order stream, about 31 miles long, draining 225 mi² or 139,580 acres. The Wind River enters the Bonneville pool of the Columbia River at river mile 154.5. The basin is oriented northwest to southeast with elevations ranging from 80' to 3,900'. The Wind River watershed is located in southwestern Washington along the Western Cascades. The watershed has a temperate marine climate with cool moist winters and dry summers. Mean annual precipitation averages 110" per year most of which occurs in the winter from November to April. Conductance (a measure of the flow of electrons through water) within the watershed is chronically low due to the relatively high amounts of precipitation and young volcanic soils. Low conductivity in turn limits primary productivity (the production of aquatic vegetation and bacteria) which supplies aquatic organisms such as aquatic insects with food which translates into food for fish. Salmonids such as steelhead have developed an anadromous (live in fresh water for the first year or two of their lives in fresh water, migrate to the ocean until sexual maturity, return to where they were born, mate and repeat the cycle) life history which allows them to achieve their maximum growth potential. Resident fish, such as rainbow trout, will live their entire lives within the stream in which they were born. Fish which have adapted to the resident life strategy, in an environment such as the Wind River, generally will not grow greater than 10" in length, where anadromous fish such as salmon and steelhead can potentially growth to lengths greater than 30".

The most dominant force in the evolution of fish species within the Wind River would probably be the basalt flows and volcanic eruptions which occurred some 340,000 years ago. Shiphard Falls at river mile (rm) 2 which was formed at this time is a series of falls totaling about 40 feet high. The creation of these falls isolated populations of resident fish such as cutthroat trout and blocked migration to the upper watershed for all anadromous fish with the exception of steelhead.

The species of salmonids which occurred below Shiphard Falls before the inundation of Bonneville Dam (1938) were: fall chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch*), coastal cutthroat trout (*Oncorhynchus clarki*), and winter and summer steelhead (*Oncorhynchus mykiss*). The only anadromous salmonid known to negotiate the falls were steelhead. Resident cutthroat were also documented above the falls.

From basically the turn of the century to the present, the Wind River has been stocked with various salmonids ranging from brook trout (*Salvelinus fontinalis*) to sockeye (*Oncorhynchus nerka*). Shiphard falls was laddered in 1958 to permit spring chinook to return to the Carson National Fish Hatchery. The species of salmonids that are known to exist at this time are: fall chinook, spring chinook, summer steelhead (both hatchery and wild), winter steelhead (wild), and brook trout. The race of fall chinook is believed to be a remnant native stock and is contained in the lower river below the falls.

Before the inundation of Bonneville dam (1938), fall chinook, coho, steelhead, and coastal cutthroat were the native salmonids within the lower-Wind River (from the Columbia River to Shiphard Falls; rm 0 - rm 2). Steelhead and cutthroat trout were the native salmonids within the Upper-Wind River and tributaries (from Shiphard Falls to the headwaters; each species occupied approximately 168 and 156 rm respectively).

Populations of cutthroat were identified within Bear Creek (the municipal water source for Carson, Washington) as late as 1989. Electrofishing surveys in 1995 did not produce a single cutthroat. Cutthroat trout may be extinct in the Wind River drainage. Causes for the decline/extinction are believed to be: hybridization with non-native fish, loss of habitat, increased water temperature, sedimentation and over fishing.

Terrestrial

Habitat exists within the Wind river watershed for 25 threatened, endangered, and sensitive animal species.

All animal species documented and suspected to occur within the watershed are grouped into life-history guilds based on how each responds to different amounts and distributions of habitats across the landscape. The only exception to this are the mollusca class of organisms. This document includes neotropical migrant and resident birds. The guilding process will shed light on particular limited special habitats and the species dependent on them.

Special habitats key to many organisms include:

- caves, lava bed, and tubes;
- bridges;
- cliffs;
- talus;
- lava bed;
- wetlands, swamps, ponds, lakes, seeps, rivers, streams, and springs;
- grass meadows;
- Oregon white oak communities;
- old-growth forests.

Special habitat components include:

- unroaded areas;
- snags;
- coarse woody debris.

Numerous reserve land allocations under the 1994 Northwest Forest Plan & Gifford Pinchot Forest Plan, Amendment 11, are distributed throughout the watershed:

- Trapper Creek and Indian Heaven Wildernesses;
- Wind River Research Natural Area;
- Late-Successional Reserve (LSR) covers two-thirds of the watershed;
- unmapped Late-Successional Reserves within Matrix (Matrix is a land allocation designed for timber production);
- geologically special areas include lava beds in Trout and Falls Creeks;
- wildlife special areas include McClellan Meadows and Black Creek Swamp (which is also LSR and elk and deer winter range);
- botanically special areas (Grassy Knoll and Weigle Hill);
- riparian reserves and wetlands (Layout Creek, Coldspring Creek, Planting Creek, Tye Springs, Pete Gulch, Paradise Creek, and Falls Creek).

Additionally, largely unroaded tracts of land in Matrix that currently exist in the watershed.

Biological winter range includes the Wind River and its main tributaries. Resident populations of elk and deer live in Trout Creek and Trapper Creek. The Bear Creek drainage on the east side of the watershed is important black-tailed deer winter range. Before 1994, this drainage was managed specifically for deer winter range. Now under the 1994 President's Plan, it will be managed for late-successional forest related organisms. This change in land management may affect future deer population levels in multiple watersheds and will be evaluated. A 1980s telemetry study found deer radio-collared in Bear Creek winter range spent their summers as far north as Indian Heaven Wilderness and Trout Lake.

Wind River watershed is additionally important as elk and deer biological winter range because of adjacent large areas of early to mid-successional forests on Plum Creek land in the Lower Lewis River watershed and in the northeast edge of the watershed.

Two game management units (GMU) are administered by Washington State Fish and Wildlife in the Wind River watershed: Siouxon (GMU-572) and Wind River (GMU-574). All of Bear Creek drainage lies within the Wind River GMU. The Siouxon GMU is managed primarily for elk with special bull regulations and cow permits. The Wind River GMU is managed for deer with special buck regulations and an either sex elk hunt open to any hunter with no special permit required.

Northern spotted owl critical habitat unit WA-41 (USF&WS) is in the mid and southern parts of the watershed (approximately 2/3 of the watershed). Under the 1994 President's Plan, all of this area except Trapper Creek Wilderness has become LSR. The wilderness is Congressionally Withdrawn Administrative land and serves the same function as LSR. Activity centers for spotted owls are distributed throughout the watershed. The USF&WS's Biological Opinion has agreed to the President's Plan ROD, Alternative 9. It states, "any site specific considerations of critical habitat in the matrix are considered minimal and will be evaluated through watershed analysis and site-specific plans, as appropriate."

HUMAN USES

Heritage Resources

The Wind River Watershed has been used by people over a several thousand year period, for a variety of uses. In the distant past the hunting of large game animals and the quarrying of stone for tools formed the focus of people's activities, while in the more recent past (the last 2000 years) people's efforts centered around the collection of huckleberries, cedar bark, beargrass, and a variety of other plants. During the historic period, people used select portions of the watershed for residential and agricultural purposes, while timber harvest occurred at an early date over a broad area. Selected areas within the watershed were used to provide forage for sheep and cattle. Other known uses include recreational gold mining, hunting, general recreation, and the collection of miscellaneous products such as beargrass, mushrooms, young conifers and assorted other shrubs. There are no ceded lands in the basin.

Recreational Uses and Values

(see Map 20)

Developed Camping Facilities include:

- Panther Creek
- Paradise Creek
- Beaver (CG & Group Camp)

Horse Camps:

- Falls Creek Horse Camp
- Crest Horse Camp
- Panther Creek Horse Camp

Many dispersed camping sites exist along the road systems and are associated with watercourses.

Day-Use Facilities exist at:

- Government Mineral Springs/Iron Mike Picnic Area
- Hemlock Lake, picnic area.
- Whistle punk interpretive trail.

Major off-Forest Recreation sites within the watershed include:

- Hot Springs; St. Martin hotel and various undeveloped hot springs.
- Public boat ramp & parking lot at the mouth of the Wind River.

There are also recreational residences (long-term lease) in the area around Gov't Mineral Springs.

All of Trapper Creek and approximately 1/4 of Indian Heaven Wilderness are within the watershed.

Some activities that occurs on non-wilderness trails are:

- hiking
- horse-riding
- mountain-biking
- motor- biking

Winter Recreation Opportunities:

- The Upper Wind River Winter Rec. Area provides Sno-Parks & groomed ski trails.
- Snowshoeing, winter camping and dispersed snowmobile use occur in some portions of the watershed that are more easily accessed in the wintertime, depending on snow conditions.
- Outfitted Winter Expeditions (Sno-Cat Tours) occur in areas of the watershed by special use permit.

Gathering of Special forest products for commercial and private use includes but is not limited to:

- mushrooms
- huckleberries
- rocks
- driftwood
- conks, etc.

Most of the Wind River is considered eligible for Wild and Scenic River designation.

Some of the ways people enjoy the scenery are driving for pleasure, and visiting viewpoints.

Points of interest include the:

- Wind River Nursery and Arboretum
- The Canopy Crane
- Indian Racetrack.

Special resources include:

- stands of ancient forest
- meadows and other unique vegetative sites
- caves
- lavabeds
- high view point

The Pacific Crest National Scenic Trail runs through the watershed from Indian Heaven Wilderness to the Mowitch Butte area.

Other human use activities that occurs in the watershed are:

- angling
- kayaking
- white water boating
- hunting



WIND WATERSHED ANALYSIS

CHAPTER II

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CHAPTER II

ISSUES AND KEY QUESTIONS

This chapter presents the issues and key questions developed to address values, management objectives and resource conditions within the Wind River watershed. The issues and questions follow the core topics established by the six step process.

EROSION PROCESSES

ISSUE: Mass Wasting

The Wind River Analysis Area has numerous past active and active landslides.. Some of the landslides and debris flows have impacted streams. Shallow failures along stream banks have been an ongoing problem even before the influx of management activities. Human influence over the past 100 years has increased these stream bank failures. In the past, timber has been harvested right up to the stream edges.

KEY QUESTIONS:

1. Is there evidence of, or potential for mass wasting in the watershed?
2. What mass wasting processes are active?
3. How are mass wasting features distributed throughout the landscape?
4. What physical characteristics are mass wasting features associated with?
5. Do landslides deliver sediment to stream channels or other waters?
6. Do forest management activities create or contribute to instability?
7. What areas of the landscape are susceptible to slope instability.

ISSUE: Surface Erosion, Hillslopes

Management activities such as timber harvest and hot burns remove the natural duff. On steep slopes (greater than 50%) exposed surface material is more likely to move. Surface Erosion on hillslopes above streams is of special concern when slopes are left bare (to natural soil).

KEY QUESTIONS:

1. What is the hillslope erosion potential?
2. Are contributing activities present?
3. Is sediment delivered to streams?
4. What areas are sensitive to forest practices?

ISSUE: Surface Erosion, Roads

Surface erosion from roads has been a major contributor to sedimentation to streams in the past. Sediment is most likely to be transported within the first two to three years after road construction.. Re-vegetation of cut and fill slopes reduces the likely hood of sedimentation.. Slope failures on poorly designed, poorly maintained existing roads can continue to contribute sediment to streams. Roads crossing streams and roads in riparian areas are of special concern.

KEY QUESTIONS:

1. What are the roads' erosion potential?
2. Are contributing activities present?
3. Is sediment delivered to streams?
4. What roads are sensitive to forest practices?
5. What is the potential effect of sediment on public resources?
6. What is the baseline sediment level?
7. What are the amounts and types of sediment contributions from forest practices?

ISSUE: Soil Productivity

Background: Law and management policy require conservation of soil productivity on National Forest lands.. This policy establishes that the lands will be managed without significantly impairing the productivity of the soil (land). Soil damage can lead to degraded watershed condition through impairment of hydrologic function and through erosion and sedimentation.

In Region 6 standards and guidelines for soil management for over 20 years (FSM 2520, R6 supplement #50). These are intended to describe significance in terms of degree and extent of the various forms of soil damage which result in impairment of productivity. In addition, the President's Forest Plan further directs us to modify site treatment practices and harvest methods to minimize soil and litter disturbance so that soil fungi, arthropods and other soil organisms are not adversely affected (ROD, pg. C44).

For about the last ten years, soil scientists on the Gifford Pinchot NF have monitored timber sale units to assess compliance with the regional standards. While some of these units have met or exceeded the standards, many have not. In most cases, these are units that have been harvested with ground-based equipment, with and without machine treatment of logging slash. In a few cases, even cable yarded units have come close to or exceeded the standards. Loader logged units have had mixed results. Monitoring results elsewhere in Region 6 have been similar.

KEY QUESTIONS:

1. What is the extent of soil productivity loss due to forest management activities in this watershed?
2. What measures will be applied in future activities to ensure that soil productivity is maintained?
3. What rehabilitative measures will be undertaken to correct existing soil damage?

HYDROLOGY

ISSUE: Stream Flows

Past activities including timber harvest, road construction, and water development projects may have altered hillslope and instream hydrologic processes in the Wind River watershed. In particular, peak streamflows may be increased, and summer low flows may be altered by a combination of water extraction or diversions, timber harvest and roading. Increased peak streamflows can degrade fish habitat, water quality, and water availability for fish culture. Increased peak streamflows may be of particular concern for the Wind River watershed because much of the watershed lies in the elevation band that has a high probability of experiencing rain-on-snow, and because there has been extensive timber harvest and road construction throughout much of the watershed in past years.

KEY QUESTIONS:

1. What are the key processes affecting peak and low flows in the Wind River and its tributaries?
2. Where in the watershed do they occur, and to what degree?
3. What is the historic and current range of peak and low flows in the Wind River and its tributaries?
4. What areas of the watershed are most likely to have experienced changes in peak and low flows?

5. What has been the effect of changes in peak and low flows in the watershed?
6. What are the trends in watershed conditions that influence peak and low flows?
7. Are there projects that would help or hinder recovery of natural peak and low flow regimes?
8. Are there special areas in the watershed that sustain low flows and provide "recharge" of ground surface water?

VEGETATION

ISSUE: Vegetation Management Objectives, Matrix:

Silvicultural objectives for lands within the Matrix are to manage for: 1) commercial yields of forest products; 2) retention of moderate levels of ecologically valuable old-growth attributes such as down logs, and green reserve trees; and 3) early-successional habitat.

KEY QUESTIONS:

1. What are the current vegetative seral stages within the Matrix?
2. What probable sale quantity (PSQ) is appropriate for Matrix?
3. What are criteria for harvest entries into Matrix?
4. What plant species of concern are found within Matrix?
5. How should fire be used in the management of Matrix lands?

ISSUE: Vegetation Management Objectives, Late Seral Reserves:

Silvicultural objectives for lands designated as Late Successional Reserve are to manage for: 1) development of old-growth forest characteristics including snags, down logs, large trees, and canopy gaps that provide for the formation of multiple tree layers and diverse species composition; and 2) the prevention of large-scale disturbances by fire, wind, insects, and diseases that would destroy or limit the sustainability of forest species.

KEY QUESTIONS:

1. What are the current vegetative seral stages within the Late Successional Reserve?
2. What are historical and current disturbance agents?
3. What silvicultural treatments are appropriate to develop the late successional characteristics of young stands?
4. What plant species of concern are found within the Late Successional Reserve?
5. Should fire be used as a management tool in the Late Successional Reserve?

ISSUE: Management of Riparian Reserves:

The watershed contains approximately 11,000 acres of Riparian Reserves within both Matrix and Late Successional Reserve lands that have been impacted or degraded by past management activities. Wetlands are considered part of the riparian reserves.

KEY QUESTIONS:

1. What is the condition of the riparian reserves (including wetlands)?
2. Where are the impacted sites?
3. What stand treatments are acceptable for restoration?

ISSUE: Noxious Weeds, Non-Native Plant Species:

Noxious weeds and non-native plant species have been introduced into the watershed. These species can and do cause a range of negative effects. Many of these species are continuing to expand their range in this watershed and have the potential to eventually displace some native plant and animal communities.

Humans, animals and vehicles traveling on roads and trails may serve as vectors spreading and dispersing seed.

KEY QUESTIONS:

1. What introduced species are present and where?
2. What effect does this introduction have on native Flora and fauna and water quality.
3. What treatment strategy/control measures should be employed to rid the watershed of noxious weeds and unwanted species?
4. What are the socio-economic effects of noxious weeds?

ISSUE: Fire, either through human ignition or through natural ignition, has been one of the major sources of disturbance in the watershed. Natural fire occurrence intervals for this watershed range between 170 and 430 years. Over the past half-century, increased human settlement and fire suppression programs have changed the historical pattern of fire on the landscape.

KEY QUESTIONS:

1. What is the natural role of fire within the watershed?
2. How has the natural role of fire changed over the last 100+ years and what affect has fire had on the array and landscape pattern of plant communities and seral stages within the watershed?
3. What is the current risk of a large fire occurring within the watershed and where is the highest risk?
4. What social and political concerns, including the protection of property and life, will affect fire protection, fire use and fuel treatment programs? Are there feasible measures to deal with these concerns while achieving overall resource concerns in the watershed?

STREAM CHANNELS

ISSUE: Channel Condition

Channel conditions are a reflection of the type of channel, conditions within the riparian area, and upslope condition of the watershed. Streambank stability is a key component of channel condition, and is strongly influenced by the condition of riparian vegetation and amount of large woody debris incorporated in the stream. Timber harvest, splash damming, road construction and other development related activities in the riparian area may have affected channel stability and current channel conditions in the watershed by removing vegetation from the streambanks, removing large wood from the stream channel, and physically disturbing either the streambed or channel banks. The loss of riparian vegetation and large woody debris from the stream can have a large effect on channel structure and response to other disturbances such as high streamflow. Once streams or riparian areas have been destabilized or degraded, recovery can take many years. Fish habitat and water quality are both closely tied with channel condition, and as such can be influenced for long periods in degraded channels.

KEY QUESTIONS:

1. What are the processes that maintain or affect the condition of stream channels in the watershed?
2. How do current conditions affect water quality and fish habitat in the watershed?
3. What are the trends in channel condition and those factors that influence channel conditions?
4. What projects or types of projects will affect channel and riparian conditions and sources of woody debris?
5. What upslope management activities have contributed to the alteration of channels?

ISSUE: Channel Types

Rosgen (1985) created a channel classification system which characterizes streams by morphological characteristics such as gradient, sinuosity, width-depth ratio, bed material, entrenchment and land form. Rosgen "C" and "E" channels are "ecological hotspots" that play a vital role in the maintenance of

healthy fish populations. Low gradients and water velocities in this channel type result in an abundance of spawning gravel for steelhead. In an unaltered condition, "C" channels have a diversity of habitat types including debris complexes, deep pools, and calm backwater areas that are vital to steelhead survival during the early stages of their life history. These channels are very sensitive to disturbance from riparian and upslope management activities that increase peak flow levels, reduce bank stability and stream shade, increase sediment deposition and alter or restrict the natural meander pattern of the stream. Because of the low gradient, loss of shade from riparian timber harvest and reduced channel stability can result in severe increases in water temperature.

KEY QUESTIONS

1. How are stream channels distributed in the watershed?
2. Where in the watershed do "C" and "E" channels occur?
3. What are the existing conditions of all channel types in the watershed?
4. Where have riparian timber harvest and/or channel alterations resulted in degraded channels?
5. Where has degradation of channels resulted in lethal water temperatures for steelhead?
6. Has increased sedimentation in the watershed impacted spawning success for steelhead?
7. What areas are key to the restoration of spawning and rearing habitat for a healthy steelhead population?

WATER QUALITY

ISSUE: Water Quality

The 1994 Northwest Forest Plan identified the Wind River watershed as a Tier I Key watershed due to the presence of anadromous fish in the watershed. Much of the mainstem of the Wind River has also been identified as "Wild and Scenic" based on the outstandingly remarkable fishery and scenic values there. Because of these designations, water quality is an important feature of the Wind River and its tributaries. Beneficial uses in the watershed that rely upon high quality water include the wild and hatchery runs of anadromous fish, resident fish stocks, the Carson National Fish Hatchery, the Bear Creek municipal watershed for the town of Carson, a number of domestic water uses, and the large number of recreational uses of the lakes and streams within the watershed.

KEY QUESTIONS:

1. What are the beneficial uses in the watershed and where do they occur?
2. What are the primary water quality parameters important to maintaining those beneficial uses?
3. What are the processes that affect those parameters of water quality?
4. What are the current conditions of water quality in the watershed?
5. What are the state standards for water quality?
6. What are the trends in water quality or in condition of those factors that affect water quality?
7. What projects may affect water quality?

SPECIES AND HABITATS

Aquatic

ISSUE: Aquatic Environment

Aquatic habitat within the Wind River watershed has been altered by natural disturbances such as floods and human disturbances such as resource extraction. These disturbances influence water quality and the capability of aquatic habitat to support viable populations of aquatic macro-invertebrates and vertebrates.

KEY QUESTIONS:

1. How have altered physical, chemical, and hydrologic processes impacted aquatic organisms?
2. What are the altered physical, chemical, and hydrologic processes?
3. What are the effects of these changes?
4. What are the historic and current fish habitat conditions for the watershed?
5. Where are degraded and impacted sites?
6. What can be done to improve degraded areas?

ISSUE: Aquatic Species and Populations

Native steelhead within the basin have been identified as "stocks at risk"; the winter race steelhead is at a high rate of extinction and summer race steelhead is at a moderate rate of extinction (Nehlsen et. al. 1991).

Trout Creek which has historically produced 45% of the Wind River's adult steelhead escapement (the number of fish escaping to spawn). The percentage of fish utilizing Trout Creek in relation to the Wind River has dramatically declined in recent years.

Hatchery introgression has been detected within the native populations of steelhead within the Wind River.

KEY QUESTIONS:

1. What is the historic and current life history, populations and distribution of fish and other aquatic organisms?
2. Do genetically pure populations of salmonids exist within the watershed?
3. How does stocking of non-native fish affect the native populations?
4. What introduced species have affected native species?
5. What aquatic species are considered at risk (i.e. threatened or endangered) within the Wind River?
6. What effects do commercial, sport and tribal fisheries have on native salmonids?
7. How does the Wind River watershed fit into the meta-population of the Columbia River and what role does it play in the recovery of anadromous fish stocks?
8. What native species affect aquatic populations?

Terrestrial

Wildlife

ISSUE: Many terrestrial forest-dwelling organisms are adapted to larger-sized patches than currently exist. Arrangement and size of forest patches have changed greatly over a short time.

KEY QUESTIONS:

1. What caused the changes (natural & human)?
2. How do forest patches look today? How did they look historically?
3. How are we managing the land - toward larger or smaller forest patches? Does this mgmt favor certain organisms?
4. Have certain edge-related species population levels increased & how do they affect less edge-dependent species?
5. Do riparian reserves currently provide movement corridors for late-successional forest related organisms?
6. Which organisms depend on larger patch sizes for their life-history requirements?
7. What does suitable habitat patch-size look like about known spotted owl centers? Are there opportunities for habitat restoration where centers lack contiguous habitat or where road decommissioning would improve habitat effectiveness?

8. What did the patch sizes and configurations across the landscape look like historically?
9. Do unmapped LSRs and other Northwest forest Plan reserve land allocations provide adequate habitat for pileated woodpecker and pine marten to allow the elimination of these GP Forest Plan allocated areas or do some areas need to remain?
10. Are there movement corridors (dispersal habitat) between LSRs and unmapped LSRs across the watershed for spotted owls & other LS related species?
11. What is the current seral condition and distribution within the LSR? Does it currently meet the needs of LS related species?
12. How much late-successional forest currently exists within the watershed, regardless of allocations, and is it well distributed about the landscape?

ISSUE: Special habitats and special habitat components are infrequent and play a key role in the life-history of many organisms.

KEY QUESTIONS:

1. What types of special habitats are there?
2. Where do special habitats occur?
3. Why are they important?
4. How are they currently managed?
5. Which organisms depend on special habitats for their life-history requirements?
6. How will the LSR land allocation in the Bear Creek drainage, previously Forest Plan deer winter range, affect future black-tailed deer population levels?
7. What is the total and effective road closure density in elk and deer biological winter range?
8. What is the distribution of nesting quality habitat for the spotted owl within reserve allocations and unmapped LSRs in Matrix?
9. Where are effective road closures needed to lessen harassment to wildlife?
10. What alternative actions can maintain special habitat qualities?
11. What are the current habitat protection measures for known plant and animal species?
12. Where do snag & CWD deficiencies exist (by 6th field watershed)?

ISSUE: Introduced and naturalized organisms affect native flora & fauna.

KEY QUESTIONS:

1. Which organisms are these, what is their rate & mode of spread, what is their abundance and distribution, where are their locations, and which & how are native flora & fauna affected by them?

HUMAN USES

Heritage Resources

ISSUE: For thousands of years to present times, portions of the Wind watershed have been used by Native American people. Cultural resource sites and continuing access to traditional resources have great cultural significance and value.

KEY QUESTIONS:

1. What areas are of special interest to Native American bands and tribes?
2. What resources are important for traditional uses and how should they be managed.?

Recreation

ISSUE: Dispersed recreation including camping occurs primarily in riparian areas throughout the watershed. Impacts associated with this activity include: trampled vegetation, denuded areas, soil compaction and erosion; human waste and associated health concerns and potential degradation of water quality; displacement of wildlife and alteration of habitat; and potential visitor dissatisfaction and displacement to less impacted areas.

KEY QUESTIONS:

1. What amount of dispersed recreation is appropriate within the watershed?
2. What is the resource capacity for this activity?
3. Are TES species being impacted by this activity?
4. Are State standards for surface water being exceeded in any dispersed recreation sites?
5. What actions may be taken to mitigate the impacts of this activity?
6. Are some areas more susceptible to impacts? Others more resilient?

ISSUE: More developed recreation facilities (campgrounds) are being managed by concessionaire operators, therefore increasing the cost to customers and displacing some users to non-designated camping areas (i.e. dispersed), potentially causing impacts listed above under dispersed camping issue.

KEY QUESTIONS:

1. What amount of increase in dispersed camping and associated impacts is acceptable?
2. Same as above for dispersed recreation issue.

ISSUE: In the two Wilderness areas, many of the existing high use areas and campsites are located on shorelines of lakes or streams.

KEY QUESTIONS:

1. Can campsites be successfully eliminated/relocated?
2. Are TES species being impacted by this activity?
3. Are State standards for surface water being exceeded in any camping locations?
4. What actions may be taken to mitigate the impacts of this activity?
5. Are some areas more susceptible to impacts? Others more resilient?

ISSUE: Special Forest Products:

There is a wide range of special forest products harvested from the watershed on an annual basis for personal and commercial uses. Examples include beargrass, berries, mushrooms, and boughs.

KEY QUESTIONS:

1. How is demand expected to change in the future?
2. What are biological concerns for species harvested?
3. What materials are being removed? From where?
4. Are user conflicts a problem?

WIND WATERSHED ANALYSIS

CHAPTER III

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CHAPTER III

CONDITIONS, CURRENT AND REFERENCE/HISTORIC, SYNTHESIS, AND INTERPRETATION

1. EROSION PROCESS

Current Condition

In the Wind River Watershed, geology and landform are important factors influencing the transport and production of sediment. The geology is mostly volcanic in origin with inter-beds of andesite and basalt with pyroclastic flows and tephra deposits. Most of the soils are derived from volcanic ash deposits and colluvial deposits from weathered bedrock.

In the north and northeast part of the watershed glacial activity has carved the landscape into gentle slopes with shallow soils and relatively stable landforms. Recent lava flows out of Indian Heaven and Trout Creek Hill (20,000 to 130,000 years old) appear to make up the most stable areas in the Watershed. The rest of the watershed is composed of older pyroclastic and basaltic flows which have weathered and produced soils containing more silts and clays. These areas are more susceptible to erosion and mass wasting.

Mass Wasting

Mass wasting is a natural process that will occur in certain areas regardless of management activities. Past active landslides continue to present potential for movement under certain conditions. There are also areas that are actively moving which can be seen from many stream channels. Along Big Hollow Creek there is an example of a large, active slide. Natural events or management activities, acting independently or together, can increase movement or initiate new movement. Rain on snow events combined with management activities can trigger movement specially in areas where past movement has occurred. Timber harvest has been shown to raise groundwater levels due to decreased evapo-transpiration, increased snow fall accumulation and increased infiltration of rain into the ground.

Fig. xx shows areas mapped as unstable and potentially unstable based on available data. The mapped areas are located in the older pyroclastic materials within the drainage. The more stable areas are located in the basalt flows from Trout Creek Hill to the mouth of the Wind River and in the Northeast part of the watershed in some of the flows out of Indian Heaven. Table III-1-1 gives a summary of unstable and potentially unstable ground by sub-basin within the watershed.

Surface Erosion

The erosion potential for the Wind River Watershed is moderate, based on soil classification, slope, aspect and rainfall in the area. Roads have been the major contributor of sediment to streams. This was caused by construction practices that removed the vegetation and duff, leaving bare soils on moderate to steep slopes that drain into streams. Table III-1-2 is a break down by sub-basin showing sediment transport from roads to streams.

This information is based on data from condition surveys on approximately 20% of the roads. There has been some extrapolation of data from other watersheds to estimate the quantities of sediment transported from roads. It will be possible to provide better information when more surveys are completed. Without the influence of roads, surface erosion and increases in sediment movement would probably be minimal except for a few years following removal of vegetation by fire or harvest.

Reference condition

Various volcanic processes have taken place that have shaped the landform we see today. These vary from volcanic activity 20+ million years ago to 20,000 years ago and glacial activity in the upper reaches of the watershed to the present processes of wind and water erosion that are continually changing the landscape.

Mass Wasting

Naturally occurring landslides in the watershed have been continuous throughout the history of the land. Most of these landslides are located in the older pyroclastic flows that have decomposed into silts and clays. Some of these landslides have been slowly moving over the years while some have been catastrophic events tied to other events such as large warm rainstorms on snow. Another source of land slides that occurred in the past would be from seismic activity (earthquakes).

Surface Erosion

Natural conditions for surface erosion were mainly from high intensity fires that would burn through areas leaving bare slopes. Tephra deposits from many of the volcanic eruptions in the past have also been very susceptible to erosion until vegetation reestablished on the slopes. The main difference between current and reference conditions is the addition of management activities to the landscape and suppression of large scale fires.

Synthesis

The mass wasting and surface erosion are some of the initial processes that move sediment from the hillslopes to the streams and influence the habitat necessary for aquatic plants and animals. These influences can be negative or positive to habitat. Coarse material deposited in the streams may enhance fish habitat while fine sediment may fill in the gravelly areas and decrease the habitat available. Also mass wasting events are likely to move the large woody debris into streams needed to form pools and provide hiding places and shade for aquatic animals.

TABLE III-1-1: Mass Wasting and Potentially Unstable Soils by Sub-basin

Sub-basin Number	Watershed	Watershed Size (Acres)	Watershed Size (SQ. MI.)	Landslides (Acres)	Percent Landslides by Watershed	Debris Flows (Acres)	Percent Debris Flows by Watershed	Potentially Unstable Soils (Acres)	Percent Unstable Soils by Watershed	Total (Acres)	Percent Total by Watershed
9A	Paradise	5416	8.46	83.69	1.55%			1,323.66	24.44%	1,407.35	25.98%
9B	Hdwaters Wind	8363	13.07	179.76	2.15%			1,472.17	17.60%	1,651.93	19.75%
9C	Lower Falls Crk	8111	12.67							0.00	0.00%
9D	Trapper	7417	11.59	154.53	2.08%	9.66	0.13%	430.92	5.81%	595.11	8.02%
9E	Big Hollow	4121	6.44	271.52	6.59%			270.40	6.56%	541.92	13.15%
9F	Dry	5754	8.99					352.73	6.13%	352.73	6.13%
9G	Ninemile	3501	5.47	66.31	1.89%			647.45	18.49%	713.76	20.38%
9H	Compass/ Crater	3790	5.92			20.07	0.53%			20.07	0.53%
9I	Upper Trout	6146	9.60	22.35	0.36%			425.02	6.92%	447.37	7.28%
9J	Middle Wind	13051	20.39	590.23	4.52%			1,936.02	14.83%	2,526.25	19.36%
9K	Eightmile	2356	3.68					88.57	3.76%	88.57	3.76%
9L	Upper Panther	10372	16.21	28.44	0.27%			646.42	6.23%	674.86	6.51%
9M	Layout	3552	5.55	43.31	1.22%	5.61	0.16%	700.50	19.72%	749.42	21.10%
9N	Lower Trout	8244	12.88					913.37	11.08%	913.37	11.08%
9O	Lower Bear	2045	3.20					10.37	0.51%	10.37	0.51%
9P	Upper Falls	5777	9.03							0.00	0.00%
9Q	Lower Panther	7184	11.22	74.50	1.04%	22.71	0.32%	465.14	6.47%	562.35	7.83%
9R	Mouse	2580	4.03	829.36	32.14%			973.06	37.71%	1,802.42	69.85%
9S	Cedar	3974	6.21	343.67	8.65%			906.54	22.81%	1,250.21	31.46%
9T	North Fork Bear	3719	5.81	349.98	9.41%			1,257.00	33.80%	1,606.98	43.21%
9U	Lower Wind	9465	14.79	5.39	0.06%					5.39	0.06%
9V	Upper Wind	3509	5.48					89.14	2.54%	89.14	2.54%
9W	Pete Gulch	3498	5.47	28.03	0.80%			319.56	9.13%	347.59	9.94%
9X	East Fork Bear	3751	5.86	148.12	3.95%			612.33	16.32%	760.45	20.27%
9Y	Brush	1876	2.93					0.31	0.02%	0.31	0.02%
9Z	Little Wind	5931	9.27	101.11	1.70%			756.94	12.76%	858.05	14.47%
Total for Watershed		143,503.96	224.22	3,320.30	2.31%	58.05	0.04%	14,597.62	10.17%	17,975.97	12.53%

TABLE III-1-2: Sediment Analysis Summary By Sub-Basin

<i>Sub-basin Number</i>	<i>Watershed</i>	<i>Watershed Size (Acres)</i>	<i>Watershed Size (SQ. MI.)</i>	<i>Road Length (Miles)</i>	<i>Road Density (Mi/sq. mi)</i>	<i>Road Prism Area (Acres)</i>	<i>Routed Total Sediment (Tons/Yr)</i>	<i>Total Routed Sediment by Sub-Basin (Tons/SQ.Mi.Yr)</i>
9A	Paradise	5416	8.46	19.30	2.28	55.78	109.23	12.91
9B	Headwaters Wind	8363	13.07	41.42	3.17	134.51	452.83	34.65
9C	Lower Falls Crk	8111	12.67	36.72	2.90	98.41	351.12	27.71
9D	Trapper	7417	11.59	6.07	0.52	19.78	42.20	3.64
9E	Big Hollow	4121	6.44	9.91	1.54	32.49	43.52	6.76
9F	Dry	5754	8.99	19.22	2.14	70.49	83.90	9.33
9G	Ninemile	3501	5.47	17.65	3.23	50.54	88.48	16.17
9H	Compass/Crater	3790	5.92	23.28	3.93	80.76	165.39	27.93
9I	Upper Trout	6146	9.60	32.12	3.34	109.87	137.55	14.32
9J	Middle Wind	13051	20.39	66.84	3.28	230.15	462.59	22.68
9K	Eightmile	2356	3.68	10.36	2.81	29.94	22.51	6.11
9L	Upper Panther	10372	16.21	52.29	3.23	170.60	410.11	25.30
9M	Layout	3552	5.55	17.49	3.15	55.41	63.57	11.45
9N	Lower Trout	8244	12.88	38.32	2.97	111.02	214.97	16.69
9O	Lower Bear	2045	3.20	9.15	2.86	45.22	53.22	16.66
9P	Upper Falls	5777	9.03	9.79	1.08	27.44	109.82	12.17
9Q	Lower Panther	7184	11.22	30.07	2.68	114.86	173.13	15.42
9R	Mouse	2580	4.03	8.44	2.09	33.04	41.45	10.28
9S	Cedar	3974	6.21	11.78	1.90	37.19	62.76	10.11
9T	North Fork Bear	3719	5.81	5.02	0.86	19.71	27.75	4.78
9U	Lower Wind	9465	14.79	44.52	3.01	197.48	239.43	16.19
9V	Upper Wind	3509	5.48	11.43	2.08	37.20	123.57	22.54
9W	Pete Gulch	3498	5.47	7.08	1.30	22.74	79.33	14.51
9X	East Fork Bear	3751	5.86	7.73	1.32	30.55	32.74	5.59
9Y	Brush	1876	2.93	6.47	2.21	27.16	24.76	8.45
9Z	Little Wind	5931	9.27	29.00	3.13	83.10	54.82	5.92
Total for Watershed		143,503.96	224.22	571.47		1,925.44	3,670.75	378.28

2. HYDROLOGY

Current Condition

Key Processes Affecting Basin Hydrology

Peak and low streamflows in the Wind River and its tributaries are a function of meteorologic processes combined with conditions and processes at the watershed scale that control the routing of water from hillslopes into stream channels. Because the Wind River lies in the western Cascades, climatic patterns are strongly controlled by marine-influenced air masses that move in off the Pacific Ocean. Summers are warm with infrequent precipitation, and during October through March, 80% of the watershed's moisture is delivered in a combination of rainfall and snow. Streamflows in the watershed range widely from summer low flows to the largest peak flows occurring in the winter. Some streams only flow during high flow events and are dry the remainder of the year (ephemeral streams). Others such as the mainstem of the Wind River increase by an order of magnitude from an average daily flow of less than 250 cubic feet per second (cfs) during low flows of August and September to over 2,000 cfs on an average day in December and January.

Summer low flows in the Wind River and its tributaries occur in the late summer months, with streams typically reaching their lowest point during August, September or occasionally October. Actual volume of flow at these times varies from year-to-year, based on the amount and timing of summer precipitation, size and condition of the year's snowpack, storage of water in surface and subsurface reservoirs (i.e. wetlands, groundwater), and evapotranspiration occurring from vegetation in the watershed. Activities that would potentially affect summer low flows include direct withdrawals of water from streams or groundwater, loss of water retention capacity in wetlands or other storage areas, and changes in vegetative cover.

Changes in summer low flows are important because water quantity is very closely tied with water quality. A decrease in water quantity during the low flow period of the year can have negative implications to water quality. In addition, a decrease in water quantity directly affects the amount of available fish habitat, which can be limiting during late summer months. In extreme low flow situations, fish can actually be stranded as streamflow continuity is interrupted by dry stream reaches.

Peak streamflows occur during the fall through spring period, in response to rainfall and snowmelt runoff. The largest measured peak flows on the Wind River have generally occurred during the November through February period when snow cover is prevalent over much of the watershed. Floods occurring during these times commonly result from warm, wet frontal systems coming off the Pacific Ocean. These systems bring rainfall, warm temperatures, and high winds, and are capable of melting a large volume of snow in addition to the rainfall they deliver.

Forest cover is a key factor affecting the hydrology of systems where rain-on-snow occurs because as forest cover is removed, accumulations of snow increase in the open areas. Rates of snowmelt are higher in the open areas as well because during rain-on-snow, the transfer of heat from the air to the snowpack is increased due to the increased windspeed and air turbulence over the snowpack. As incrementally more of the watershed is put into an open condition (i.e. by wild fire or timber harvest), the increased water available for runoff from each of the open areas can combine to increase the size of resulting streamflows.

In addition to the effect of forest cover removal, peak streamflows can be affected by alteration of water routing in a watershed by roading or other forms of soil compaction. By compacting the soil, water percolation is reduced, and overland water flow is increased. Cross-slope roads also intercept subsurface water flow at cutslopes, and convert it to surface flow through roadside ditches. Water flowing across the surface in this way moves much faster than subsurface flow. Roadside drainage ditches that drain to either perennial, intermittent, or ephemeral channels in effect increase the drainage density of a watershed, and increase the rate at which water is moved from the hillslopes into surface stream channels. This allows water to concentrate in channels much faster, and can result in higher peak flows.

An increase in peak flows is important to both water quality and fish habitat. Stream systems adapt to a range of flow conditions, as do fisheries that are supported by the stream. Once the magnitude of streamflows is increased, channel banks can be eroded, and bed material scoured at higher frequencies and at greater intensities than the system has evolved under. Pushing the system beyond its natural range can initiate negative impacts to fisheries, water quality, and other biota that use stream systems.

In the Wind River watershed, areas of greatest concern for altered snow accumulation and melt during rain-on-snow lie in the elevations between 1,500 and 3,500 feet. This elevation band is commonly referred to as the rain-on-snow (ROS) zone. Although rain-on-snow is not limited to these elevations, this is the area where it most commonly occurs.

Peak Flows

Streamflows have been measured at a number of locations in the Wind River watershed by the U.S. Geological Survey (USGS) and Forest Service (USFS). Forest Service measurements have been made primarily in the summer months during low flow conditions, at four baseline monitoring stations on the National Forest. These began in the 1970's, and have continued sporadically until the present. USGS measurements have been much more regular and extensive, covering the full spectrum of flows at stations both on and off the National Forest. The station with the longest period of record is on the Wind River just east of the town of Carson. This station is located approximately two river miles upstream of the mouth of the Wind River, above the confluence of the Wind and Little Wind River, and measured streamflow from 1935 until 1979. This station was re-established in the fall of 1995.

Prior to the flood of February 1996, the largest streamflow event recorded at the Wind River station near Carson was 45,700 cubic feet per second (cfs) during a January flood in 1974. Although the newly re-established gauge at this site was out of commission during the February 1996 flood, this event was

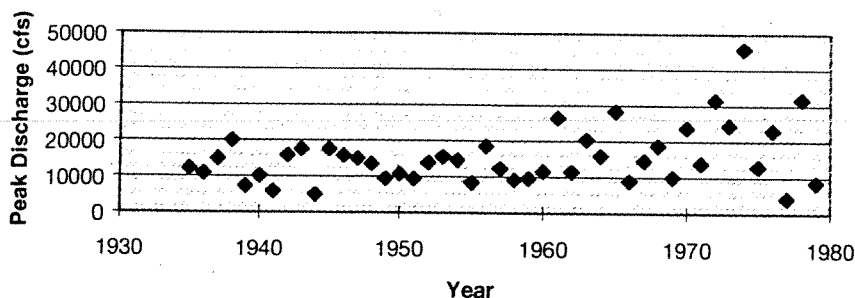


FIGURE III-2-1: Annual Flood Series for the Wind River near Carson, 1935-1979.

estimated to be approximately 54,000 cfs, eclipsing the previous record by nearly 20%. Figure III-2-1 shows the annual peak discharge on the Wind River for the period of 1935-1979. From the figure, it is evident that yearly differences in maximum flow can vary substantially. Annual peak flows at this station, can vary by more than an order of magnitude.

Noteworthy in this graph is the relatively tight scatter of points from 1935 until 1960, indicating that annual peak flows varied annually between approximately 5,000 and 20,000 cfs. From 1960 through 1979, the pattern becomes much more dispersed. During this period, both the average value and the range of values is increased. It is unknown whether, or how much of the change in pattern is due to changes occurring in the Wind River watershed during this time period, and how much is simply a reflection of larger scale climate patterns. However, a pattern similar to this has been seen in other watersheds in the region during the same general time period.

Factors Affecting Peak Flows

Seral class of forest vegetation is an important factor in assessing the potential for changes in runoff and peak streamflows due to management activities. From the early 1900's until the present, the Forest Service has been involved in fire suppression activities in the watershed. Over the same time period, logging activities increased and moved from the lower portions of the drainage into the headwaters. Over the course of the century, logging has replaced wildfire as the dominant disturbance process affecting forest vegetation at the landscape scale, and thus potentially affecting peak streamflows. Currently, approximately 1/5 of the watershed is in an early seral condition (i.e. either seedling/sapling or pole-sized trees) (Figure III-2-2).

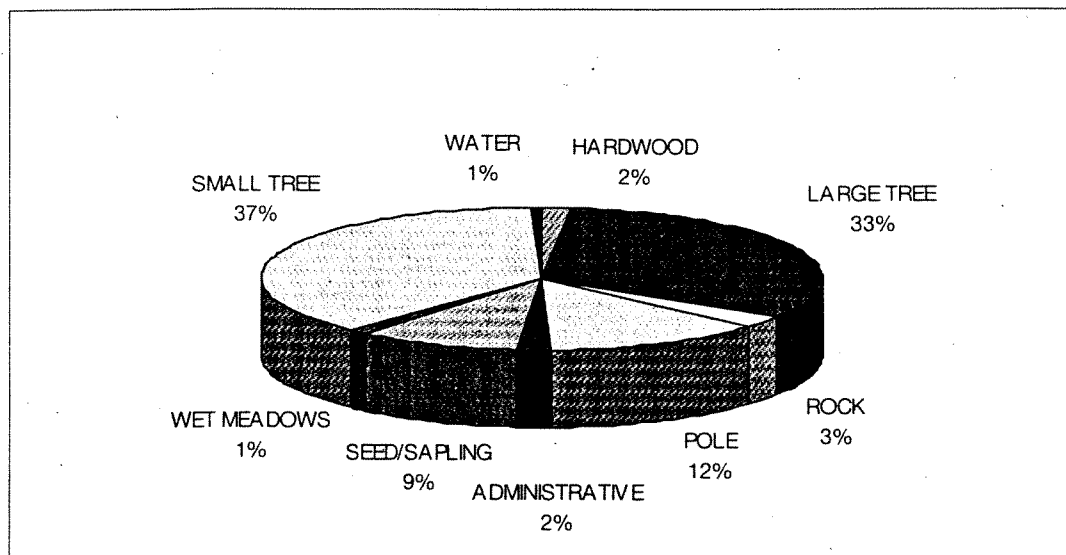


FIGURE III-2-2: Vegetation Seral Classes and Non-Forested Cover Classes in the Wind River Watershed.

Another way of representing the vegetative condition of a watershed from a hydrologic perspective is through the Aggregate Recovery Percentage (ARP). The ARP is an index of the amount of vegetative cover in a watershed that is hydrologically mature in terms of its response to snow accumulation and subsequent snowmelt during rainfall. As an increasing proportion of a watershed is put into an immature condition, the ARP is reduced, and the potential for elevated peak streamflows is increased. Watersheds with an ARP of 100 are considered 100% hydrologically recovered in terms of their response to rain-on-snow, whereas a watershed with an ARP of 0 would be fully unrecovered or hydrologically "immature." Currently, ARP's in the Wind River watershed range from 72 in Lower Falls and Ninemile Creeks to 97 in the Trapper Creek subwatershed. The average ARP for the entire Wind River watershed is 86. ARP

values are presented by subwatershed in Table III-2-1. Table III-2-1 also presents the percent of each subwatershed that lies within the rain-on-snow (ROS) zone. Subwatersheds with a high percentage of their area within the ROS zone are of particular concern for experiencing changes in peak streamflows as a result of changes in vegetative cover.

In addition to the effect timber harvest has had on vegetative and hydrologic maturity in the watershed, road development has further increased the potential there for elevated peak streamflows. Currently there are an average of 2.6 miles of road per square mile in the watershed. Densities range from 0.5 miles per square mile in the Trapper Creek subwatershed to 4.0 miles per square mile in the Compass/Crater Creek subwatershed Table III-2-1.

TABLE III-2-1: Aggregate Recovery Percentage, Percent Area in the Rain-on-Snow Elevation Zone, and Road Density by Subwatershed.

Subwatershed		Area (acres)	Area in ROS (%)	ARP (%)	Road Density (mi/sq. mi)
(number)	(name)				
09A	Paradise	5416	91	82	2.3
09B	Headwaters Wind	8363	100	75	3.2
09C	Lower Falls	8110	92	72	2.9
09D	Trapper	7417	73	97	0.5
09E	Big Hollow	4121	84	92	1.5
09F	Dry	5754	81	90	2.1
09G	Ninemile	3501	93	72	3.2
09H	Compass/Crater	3790	89	74	4.0
09I	Upper Trout	6146	91	76	3.4
09J	Middle Wind	13051	49	91	3.3
09K	Eightmile	2356	91	75	2.8
09L	Upper Panther	10372	79	74	3.2
09M	Layout	3552	96	79	3.2
09N	Lower Trout	8244	74	91	3.0
09O	Lower Bear	2045	33	89	2.9
09P	Upper Falls	5777	38	92	1.1
09Q	Lower Panther	7184	43	92	2.7
09R	Mouse	2580	87	95	2.1
09S	Cedar	3974	85	90	1.9
09T	North Fork Bear	3719	79	96	0.9
09U	Lower Wind	9465	20	94	3.0
09V	Upper Wind	3509	76	94	2.1
09W	Pete's Gulch	3498	44	86	1.3
09X	East Fork Bear	3751	85	93	1.3
09Y	Brush	1876	35	89	2.2
09Z	Little Wind	5931	53	89	3.1
09	Wind River Watershed	143502	70	86	2.6

Based on the information presented above, a risk rating was developed for assessing the relative risk of a subwatershed experiencing increased peak flows based on its current conditions. The rating takes into account the percent of each subwatershed in the rain-on-snow zone (that elevation band where rain-on-snow most commonly occurs), the Aggregate Recovery Percentage of the subwatershed, and the road density. These factors are scored and combined at the subwatershed scale and are presented in Figure III-2-3. Through this rating, six subwatersheds are identified as having the highest relative potential for experiencing increased peak flows as a result of past timber harvest and roading. These include: Headwaters Wind (B), Ninemile (G), Compass/Crater (H), Upper Trout (I), Upper Panther (L), and Layout (M). Others identified as having a relatively high potential include: Lower Falls, Eightmile, and Lower Trout.

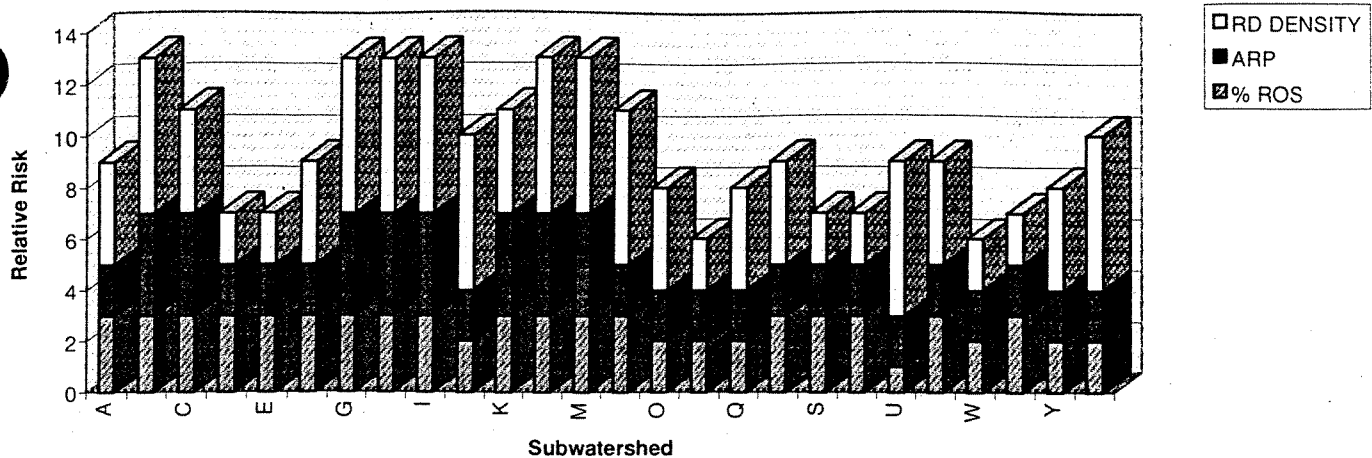


FIGURE III-2-3: Relative Risk for Increased Peak Streamflows Under Current Conditions

Potential for changes in peak streamflows as a result of changes in vegetative seral condition was further assessed using a hydrologic change model developed by the State of Washington. This model calculates differences in snow accumulation and melt based on changes in vegetative conditions in the watershed. Based on the amount of snow accumulation and calculated rates of snowmelt, the model predicts a volume of water available for runoff for a range of flood recurrence intervals. Differences in water available for runoff are then converted to streamflow to show differences in predicted flow under different vegetative conditions. This model does not in any way address routing of the water from hillslopes into stream channels, so the effect of roads on peak flows is not taken into account.

The model was run for each subwatershed in the Wind River watershed. Peak flows were calculated for the 2-year (return interval) streamflow event for each subwatershed under current conditions and under fully forested conditions. The 2-year event was used because it is these higher frequency events that are expected to show the greatest change in magnitude as a result of changes in forest cover, and because these events are considered to be the most important events from a channel condition and fish habitat perspective. Predicted streamflows under current conditions are compared against those under fully forested conditions to show the amount of expected change there has been to peak streamflows up to the present time. Figure III-2-4 summarizes results of running the model for the Wind River watershed. The figure shows how the magnitude of the 2-year peak streamflow is predicted to have increased over time as a result of timber harvest. Subwatersheds in which the 2-year flow is predicted to have increased by over 10% include: Lower Falls (C), Compass/Crater (H), Eightmile (K), Layout (M), Upper Panther (L), Lower Bear (O), and Brush Creek (Y).

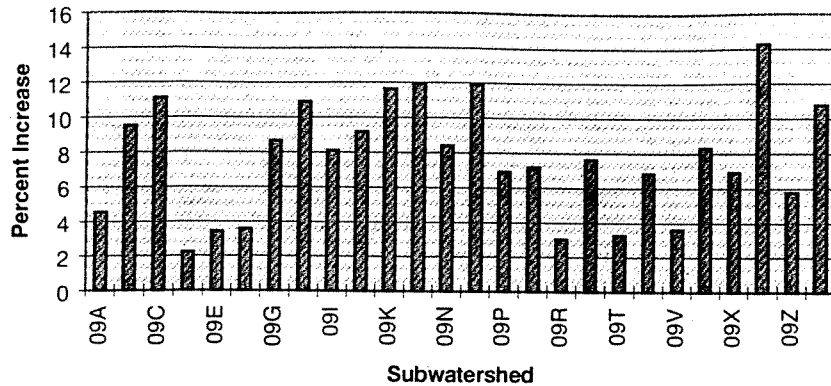


FIGURE III-2-4: Predicted Increase in the 2-Year Peak Streamflow Under Current Vegetation Conditions.

Historic Conditions

Historically, stand replacement fires were the most important disturbances that affected vegetation at a large scale, and consequently would affect snow accumulation, snowmelt, and peak streamflows in the Wind River watershed. Although insect and disease outbreaks occur in the watershed, these typically have not affected forest vegetation at the landscape scale as they do in watersheds with drier climates, such as those east of the Cascade Range. Fire frequency assessments in the region have found that return intervals for stand replacing fires in the Wind watershed would range from 10's to several 100's of years for fires covering anywhere from a few acres to thousands of acres in extreme cases. Following these types of events, rain-on-snow-driven peak streamflows would have increased, particularly when a large portion of a particular subwatershed was affected by the fire.

Although changes in peak streamflows could be relatively large following extensive fires, the effect of the high flows on stream channels may have been somewhat less than would be expected today under similar vegetative conditions. This is because streams historically had higher levels of in-channel woody debris, and more large standing trees along streambanks than under current conditions. Channels with a high degree of roughness, in-channel structure, and bank integrity would have been more robust to changes in flow regimes. Historically, fire may have removed much of the vegetation from the watershed, but in many cases would avoid or burn less intensely in the moister riparian areas. Riparian trees surviving the fire would continue to provide root strength and channel stability, and those that were burned would ultimately fall into the channel, providing increased channel roughness and contributing to in-channel structure and stability.

Historic variability in summer low flows occurred through differences in annual and seasonal precipitation and climatic conditions, and in response to large-scale vegetative disturbances such as fire. Following a large-scale fire, summer low flows would be expected to increase for some period, as water "losses" from the watershed through evapotranspiration were reduced. Conversely, at some time following a large fire, low flows may have decreased depending on the type and density of vegetation recolonizing the watershed. In addition, the effective flow from a fisheries standpoint may be decreased following a large fire and any associated mass wasting, due to aggradation of stream channels with coarse sediment, and the subsequent flow of stream water through the accumulated sediment rather than over it (i.e. subterranean flow).

Interpretation

This assessment uses two separate tools or methodologies to index concern levels for increased peak streamflows in the watershed. The relative risk rating aggregates information relating to elevations of each subwatershed and seral conditions of vegetation to get at the risk of changes in rain-on-snow generated water available for runoff. This risk rating also incorporates road density as a means of indexing changes in basin hydrology occurring from re-routing of hillslope runoff. Results of this rating give a relative indication of the potential for increased peak flows based on those current conditions. The synergistic effects of harvest-related changes in water available for runoff and changes in water routing due to roads are incorporated in this rating.

The Washington State Department of Natural Resources (DNR) Hydrologic Change module was used to model changes in snow accumulation and subsequent snowmelt during rainfall to predict changes in peak streamflows during the 2-year flood. This methodology focuses on changes in water available for runoff due to timber harvest, but neglects changes in water routing that occur from road systems. Although the results of these two methodologies are reasonably well correlated, not all of the subwatersheds showing a high relative risk also show large increases in predicted peak flow (and vice versa) (Table III-2-2).

TABLE III-2-2: Summary of peak flow risk ratings and predicted streamflow increases.

Code	Subwatershed Name	Peak Flow Relative Risk Rating	Predicted Increase 2-Yr Flow
A	Paradise	M	5
B	Hdwtrs Wind	H	10
C	Lower Falls	H	11
D	Trapper	L	2
E	Big Hollow	L	3
F	Dry	M	4
G	Ninemile	H	9
H	Compass/Crater	H	11
I	Upper Trout	H	8
J	Middle Wind	M	9
K	Eightmile	H	12
L	Upper Panther	H	11
M	Layout	H	12
N	Lower Trout	H	8
O	Lower Bear	M	12
P	Upper Falls	L	7
Q	Lower Panther	M	7
R	Mouse	M	3
S	Cedar	L	8
T	N.F. Bear	L	3
U	Lower Wind	M	7
V	Upper Wind	M	4
W	Pete's Gulch	L	8
X	E.F. Bear	L	7
Y	Brush	M	14
Z	Little Wind	M	6

Gray shaded=indicates high risk of subwatershed.

Because the risk rating takes into account the effects of roads and the synergism between road-related changes in water routing and changes in water available due to harvest, this tool is felt to be more comprehensive in some respects. However, results of this tool are somewhat less easily interpreted than those provided in the State of Washington's hydrologic change module. Moreover, the state module, being process-based allows some validation and better understanding of the individual components of it. Validation of these two approaches is now being done on the Forest, and will help with interpretation of the results of each tool. For purposes of this analysis, subwatersheds that were rated as "high" risk or had predicted peak flows increases of greater than 10% are identified as high risk subwatersheds (Map 13).

Trends

Seral class of forest vegetation within the Late Successional Reserve (LSR) will move toward hydrologically mature condition. This will help restore historic snow accumulation and melt processes, and reduce potential for increased peak streamflows in subwatersheds in the LSR. Seral class of forest vegetation in the matrix will continue toward a mix of age classes. Stands currently in a hydrologically immature condition will move toward mature condition, and those currently in mature condition will be harvested and moved into a hydrologically immature condition. The net rate of movement of these seral classes varies by subwatershed, as will the effects on peak streamflows. Paradise, Headwaters Wind, Pete's Gulch, and the Upper and Lower Falls subwatersheds will move more rapidly toward immature conditions in the near future due to proposed harvest activities there. Upper Trout Creek subwatersheds will move on average toward mature conditions because currently much of the vegetation in these subwatersheds is in immature condition, and regeneration harvest in this area is recommended to be deferred. Road decommissioning that includes surface ripping, planting, and removal of drainage structures will help restore hillslope hydrologic function and reduce effects to peak streamflows in subwatersheds where this occurs. Subwatersheds where harvest is not scheduled for this decade and where active road decommissioning occurs will show the greatest reduction in the potential for increased peak streamflows.

3. VEGETATION

Current Conditions

The current range of vegetative classes that exist within the entire watershed basin are displayed in Figure III-3-1. The main change in vegetation conditions from pre-settlement times to the present was the reduction in the late-successional forest from about 83,500 acres to 31,800 acres due to timber harvest and forest fires. This change was associated with a large increase in the amount of mid-successional forest in the small tree and single-story large tree category. The amount of early successional forest in the seedling/sapling and pole categories actually declined somewhat mainly due to fire suppression activities.

TABLE III-3-1: Current Vegetable Conditions - Entire Watershed

CONDITIONS	ACRES
NON-FOR	9,887
EARLY	34,118
MID	67,628
LATE	31,816

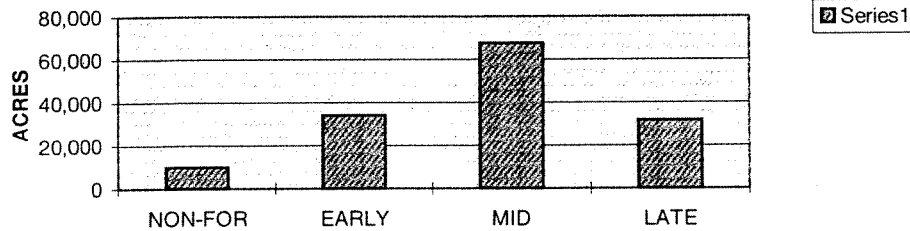


FIGURE III-3-1: Current Vegetation Conditions - Entire Watershed

The trend in the reduction of late-successional forest ended with the implementation of the Northwest Forest Plan. Late-Successional Reserves and Riparian Reserves will preserve the remaining late-successional stands in those areas. The amount will increase in future decades as young stands grow and mature. The LSR and Riparian Reserves currently contain 18,058 acres of seedlings, saplings, and poles in the early-successional category and 33,030 acres of small trees in the mid-successional category. While some harvest of late-successional stands will occur on Matrix lands, the future trend will be for an overall increase in this category due to the restricted harvest on reserved lands.

The current amount of mid-successional forest made up of small trees and large trees is high compared with historic conditions. This change is due to the re-growth of the burned areas since the mid 1800's. Contributing to this increase is the harvest of late-successional stands and a reduction in the occurrence of destructive forest fires. In the future, the amount of area in these categories will decrease as stands grow and mature to the late-successional class.

The future trend for early-successional stands is a reduction in acres across the basin. Past levels of timber harvest were much higher than today's levels and based on a larger available land base. The result is a higher amount of regeneration harvest in some sub-basins than would have occurred given today's harvest levels. Table III-3-2 displays the effects of 40 years of regeneration harvest on Matrix lands. Note that certain sub-basins show a higher historic harvest level than projected even-flow. These sub-basins were easily accessible and contained the oldest high priority stands for harvest. Harvest was concentrated in these areas.

TABLE III-3-2: Matrix 40 Years Of Regen Harvest Compared To Projected Evenflow

Matrix Sub-Watershed	Actual Regen Harvest 1955 to 1995	Projected Evenflow Harvest
Compass/Crater	1,166	677
H.W. Wind	2,655	2,486
Layout	1,384	1,004
L. Falls	1,584	1,140
Paradise	1,161	1,719
Petes Gulch	655	801
Upper Falls	661	575
Upper Panther	21	470
Upper Trout	229	110
Upper Wind	322	767

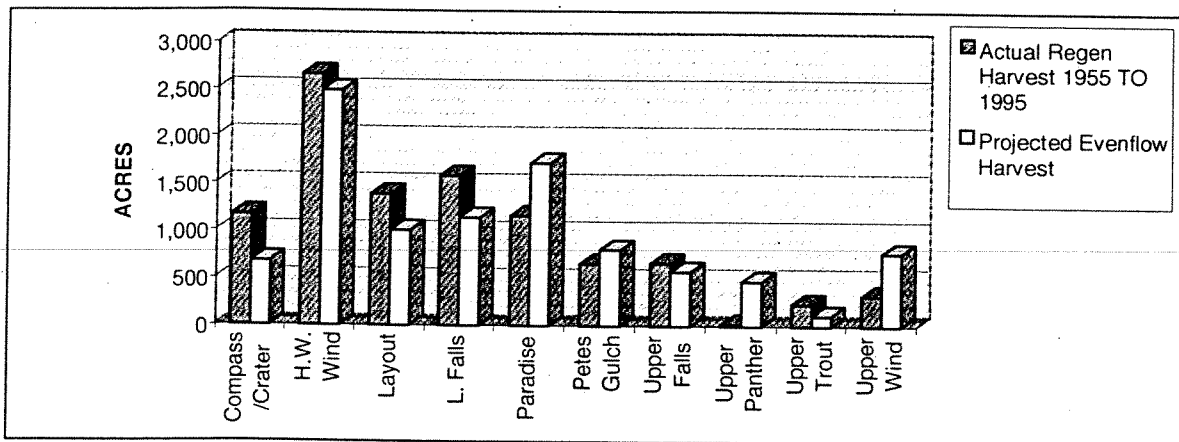


FIGURE III-3-2: Matrix 40 Years Of Regen Harvest Compared To Projected Evenflow

Reference Conditions

Pre-European settlement, which began after 1850 in the Wind River watershed, is the point of reference for vegetation conditions. Prior to settlement the forest of the Wind River basin contained two predominate age classes of timber stands. They were either late-successional old growth or early-successional young growth. Table III-3-3 displays the amount of acres in each successional class and how the proportions changed over time to the present day.

TABLE III-3-3: Amount of acres in each successional class and changes in vegetative seral stages over time

Period	Non-Forest	Early-Successional	Mid-Successional	Late-Successional
Circa 1850	6,700	40,700	12,485	83,556
Circa 1900	7,600	22,000	51,200	62,638
Current	9,887	34,118	67,628	31,816

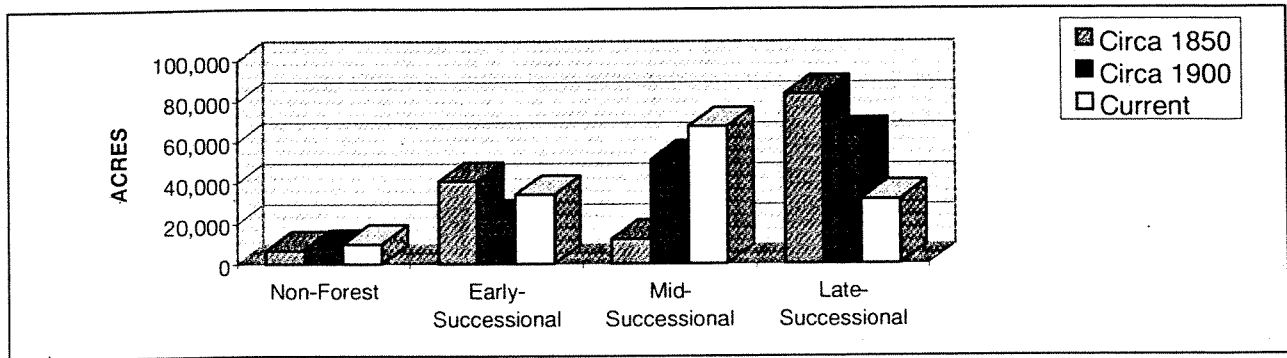


FIGURE III-3-3: Changes in vegetative seral stages over time

The late-successional old growth made up the largest class and occurred mainly along the Wind River valley floor and in the western drainages of Martha Creek, Trout Creek, Trapper Creek, Dry Creek, Lower Panther Creek, Lower Falls Creek, and the middle portion of Panther Creek. The stands that made up this part of the forest were generally over 200 years old and contained late-successional attributes of large trees with multiple layers, ages, and species along with snags and down wood. Early-successional young forests were created by wildfire and occurred over large areas. They ranged in age from 0 to 100 years old and contained varying amounts of residual stand components. In the mid 1800's young forests occupied much of the area in the drainages of the Little Wind, Bear Creek, Lower Panther Creek, Upper Falls Creek, Upper Paradise Creek, and the Upper Wind River around McCellan Meadows.

Wildfires were the disturbance events that replaced forests and began the early successional regeneration cycle. Fires started by either lightning or were set by Indians to improve the huckleberry fields and game habitat. Fires burned unchecked and created large expanses of evenaged forest between 1,000 and 20,000 acres in size. Western hemlock and Pacific silver fir forests at the lower to mid elevations developed into large expanses of late successional forest and were replaced by wildfire at an interval of 200 to 800 years. The subalpine forests along the crest of the Cascades were smaller in area and had a replacement interval of less than two hundred years. As pointed out by Fred Hall, U. S. Forest Service Plant Ecologist, it was common for stands in this area to be burned over by successive fires within a decade or two after an initial burn. This was caused by residual fuels from the initial fire reburning after several years of drying. The result was complete consumption of large material like tree boles, stumps, and roots along with any regeneration that came in after the first fire. These intensive fire events eliminated seed sources for large areas. Under such circumstances it took many decades for forests to regenerate. The pioneer species in

the western hemlock ecological zone was Douglas-fir which grew in a relatively open stand condition for several decades before closed canopy conditions developed. Refer to Appendix ___ - Fire Ecology and History, for further information on fires.

Early Settlement and Logging: The first timber harvesting in the Wind River watershed occurred when the area began to be settled in the 1870's. The first sawmills were built in the 1880's with logging taking place in the lower Wind River valley bottoms to exploit the large amount of readily accessible old growth Douglas-fir and western red cedar. After harvest, pioneers settled on the flatter logged over lands and converted them to farms and pastures. By 1890 settlers filed homestead entry claims up the Wind River valley as far as Soda Springs. The claims in the middle Wind River valley were ultimately bought up by the Wind River Lumber Company for the purpose of harvesting the timber.

By 1900 human activity began to have a noticeable effect on vegetation within the watershed (refer to Figure III-3-3). The early-successional class increased due to harvest of old growth and wildfires. Mid-successional conditions increased due to growth of young stands. Late successional forest decreased due to harvest and wildfires. Non-forest area increased due to conversion of forest land to non-forest uses like communities, farms, and pastures.

Initial logging was done by teams of horses and dollies on skid logs to ponds constructed along a river or creek. The logs were transported to the sawmill by floating them down the Wind River drainage. This was accomplished with a series of splash dams built on the Wind River and its tributaries. Logs were contained in the ponds behind the dams until there were enough for a run. When the gates of the dam were opened the logs would be released to float to the mouth of the river. By 1910 the logging company began using steam powered donkey sleds to cable yard logs to central landings for transportation to the ponds.

The first Forest Service timber sale was made in 1912 to Wind River Lumber Company. The sale enabled the company to invest in railroad logging equipment and access timber that had been inaccessible. Until 1925 numerous sales were made to the Wind River Lumber Company and the railroad extended up the Wind River to Paradise Creek. The company was forced out of business after the Wind River valley burn of 1925 consumed logging equipment plus 4.5 million board feet of felled and bucked timber. Until about 1948 subsequent timber harvest occurred primarily on private lands.

Era of Multiple Use and Intensive Forest Management: The increase in demand for resources after World War II to fuel and expanding economy contributed to renewed interest in timber harvest from the National Forests. The government adopted scientific forestry principles to intensively manage commercial forest lands for high yields of commodity outputs including timber, wildlife, fish, water, and recreation. Beginning in 1948 timber sales were again being offered in the Wind River watershed. In the ensuing years tremendous investments were made into forest road systems, fire protection, reforestation, timber stand improvement, and genetics in the watershed.

To meet congressionally mandated harvest levels the Wind River Ranger District sold between 40 million and 100 million board feet of timber annually from 1950 to 1993. A large portion of this timber came out of the Wind River watershed. The preferred harvest method was regeneration patch clearcuts followed by artificial reforestation by planting. The objective was to produce fast growing stands that maximized the production of saw logs. By 1995 over 32,000 acres of mature forest within the Wind River watershed had been regenerated and converted to early-successional plantations. Figure III-3-4 displays the acres of regeneration harvest by decade from 1941 to 1995. These figures represent acres cut as opposed to acres sold under contract and are influenced by timber market conditions. The highest period in the 1960's is likely due to increased harvest after the Columbus Day Storm. The next highest harvest period was the 1980's which was due to departure levels set by Congress and the President.

TABLE III-3-4: Historical Regeneration Harvest

YEAR	ACRES	YEAR	ACRES
1941-	1	1969-	2273
1942-	0	1970-	698
1943-	0	1971-	480
1944-	17	1972-	546
1945-	137	1973-	216
1946-	94	1974-	165
1947-	38	1975-	338
1948-	2	1976-	785
1949-	484	1977-	591
1950-	251	1978-	664
1951-	199	1979-	1887
1952-	83	1980-	830
1953-	225	1981-	497
1954-	446	1982-	253
1955-	335	1983-	215
1956-	826	1984-	653
1957-	372	1985-	1068
1958-	529	1986-	1014
1959-	1473	1987-	164
1960-	619	1988-	1015
1961-	584	1989-	727
1962-	363	1990-	1404
1963-	483	1991-	520
1964-	994	1992-	706
1965-	833	1993-	457
1966-	1698	1994-	508
1967-	679	1995-	415
1968-	1199		

HISTORICAL REGENERATION HARVEST WITHIN THE WIND RIVER BASIN 1941 TO 1995

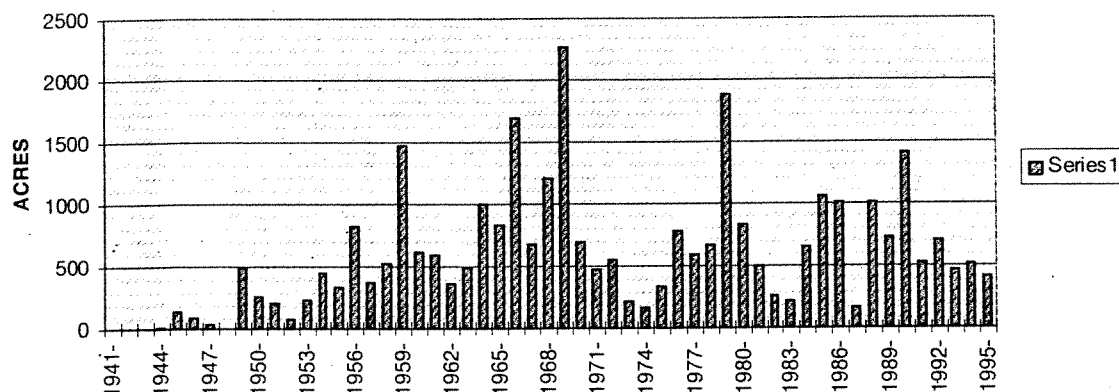


FIGURE III-3-4: Historical Regeneration Harvest

Plantations were planted with Douglas-fir because of rapid juvenile growth and wood value. At higher elevations above 3500 feet, noble fir was the preferred species because it withstood the colder winter environment. By 1975 a forest genetics program was in place to increase yields of Douglas-fir and noble fir through propagation of seedlings from select parent trees that had superior growth characteristics. Other species such as western hemlock, Pacific silver fir, western red cedar, western white pine, Englemann spruce, and lodgepole pine seeded into plantations or existed as residuals after harvest. Plantations were precommercial thinned at about age 15 to control overstocking and these other species were generally cut in favor of Douglas-fir and noble fir. The result was the creation of single species mono-cultures that contained little species diversity.

Forestry practices began to change in the mid 1980's as the public became concerned about the effects of intensive forest management on the stability and sustainability of the forest ecosystem. Issues dealing with harvest levels, species diversity, forest fragmentation, old growth, water quality, and threatened and endangered species divided the public on how the National Forests should be managed. To address these concerns managers, educators, and scientists developed new forestry concepts and changed the way forestry was practiced on Federal lands. The culmination of these efforts was in the issuing of the Northwest Forest Plan in April 1994.

Synthesis and Interpretation

Forest Health

Forest health is dependent on a resilient forest ecosystem free of catastrophic losses due to human and natural causes. In the Wind watershed the main factors influencing forest health are the condition of riparian zones, fragmentation, diversity, diseases, windthrow, insects, and invasion of non-native species.

1. Riparian Zones:

The riparian zones along streams are some of the most impacted areas within the watershed. Much of the logging in the past 40 years occurred along or adjacent to streams because the areas were readily accessible and contained high value timber. Figure 1 in Appendix B displays the percent of early-successional acres within the riparian zone of class 1, 2, and 3 streams. Streams that contain over 20% of the stream side zone in early-successional are likely to be lacking in shade and have problems with higher water temperatures. This holds true for Compass Creek, Crater Creek, Dry Creek, Layout Creek, and Trout Creek. Figure 2 in Appendix B displays the percent of the stream zones in the large tree class. Streams with less than 30% of the area in large trees are lacking in large wood structure. The future source for large wood in these streams is very limited and it will take 100 years or more for large trees to develop within the riparian zones. The most impacted streams are Wind River, Layout Creek, Trout Creek, and Paradise Creek.

2. Fragmentation:

Over the past 40 years, the practice of regeneration harvest by patch clearcutting has created an even distribution of openings across the landscape. Over 22,000 acres of patch clearcutting has occurred since 1955. The effect of this is a fragmentation of the late-successional continuous forest cover that existed prior to timber harvesting. Individual patches range from 10 to 60 acres and are comprised of early-successional young stands. In areas where successive harvest was done over several decades, patch sizes are cumulative and can reach several hundred acres in size. The main concerns with fragmentation are: 1) the impact on wildlife species that depend upon late-successional forest cover for their habitat; and 2) the sustainability of a healthy forest ecosystem. Outside of the Wilderness Area and the Research Natural Areas very little contiguous late-successional forest remains in the watershed.

3. Diversity:

Forest stands in the late-successional category contain the full range of plant species, tree sizes, tree ages, and woody debris the make up a diverse forest ecosystem. Areas that have been harvested are often lacking in these components. This is the result of many years of clean logging, complete slash disposal, stream channel cleanout, reforestation with only one species, and cultural practices that do not provide for diversity. Within the past decade, managers have attempted to reverse these practices and implement new forestry practices that maintain and increase forest diversity. Examples are alternatives to clearcutting, buffers on riparian areas, levels of tree retention, and snag retention.

4. Diseases:

Forest diseases for the most part are within endemic levels within the watershed. The types of diseases of concern are root diseases, stem diseases, and branch diseases.

- a) *Root Disease.* Two principal root diseases are phellinus and armillaria. Phellinus root disease is wide spread and is not considered a serious problem if infestation is less than 15% of an area. There are a few areas in Trout Creek and Dry Creek where the rate of infestation exceeds 15%. Armillaria root disease is also wide spread but is not considered a threat to forest health. Effects of these diseases can be minimized with forestry practices that maintain optimal stand densities and protect soils from compaction and displacement.
- b) *Stem Disease.* Of the several stem diseases white pine blister rust is the most destructive. Introduced into North America in the early 1900's from Siberia, this disease ravaged the western white pine stands resulting in widespread tree mortality. A few individual trees exhibit degrees of resistance to this disease. The Forest Service initiated a tree improvement program to inventory select trees and propagate resistant seedlings for out-planting into the forest. In the future, the number of disease resistant western white pine will increase and the species will remain a valuable component of the forest ecosystem.
- c) *Branch Disease.* Hemlock dwarf mistletoe is the main disease in this category and is wide spread throughout the range of western hemlock. In single-story stands this disease can be effectively managed through thinning. In multi-story stands with an infected overstory, the disease can be especially damaging because young trees are continually re-infected from the overstory. Regenerating western hemlock in these stands will be a challenge to land managers. Areas of heavy infection occur in the old growth stands of Trout Creek and Dry Creek drainages. These stands will remain infected until a stand replacement event like a fire takes place.

5. Windthrow:

Windthrow damage has been a major concern throughout the watershed. The amount of windthrow increased as the amount of clearcutting increased. Most damage occurred along the exposed edges of newly harvested cutting units. Ridge lines and ridge saddles are also areas prone to windthrow damage. In the future, the incidence of windthrow in the LSR should decrease as stands mature and form wind firmness. Windthrow will continue to be a concern on Matrix lands where most timber harvesting will occur. Retention trees left as groups and as single trees within units will be susceptible to windthrow for a period of time after harvest. Windthrown trees will be salvaged or left on-site to serve ecosystem needs.

6. Insects:

Insects and losses to insects are a natural part of the natural processes taking place within the forest ecosystem. Many insects occur in the basin at endemic levels. The most damaging insect is the Douglas-fir beetle which colonizes dead and dying Douglas-fir. Windthrow and logging slash provide a prime habitat for this beetle. The beetle will also invade stands weakened by drought and/or root disease. When populations build up in dead or weakened trees, adjacent live healthy trees can often times be killed. Salvage logging was employed in the past to remove beetle killed trees. In the future the amount of beetle activity will remain about the same depending on contributing factors like weather, drought, and windthrow. Within the LSR and Riparian zones trees killed by beetles will likely be retained for large woody debris. Salvage logging in the Matrix will be done as necessary to keep stands in a healthy condition.

7. *Non-native species:*

Non-native plants

Non-native or plants are exotics plants present in the watershed. These plants did not exist here prior to euro-american settlement. Exotics should be managed to avoid threats to natural biodiversity. Such threats include undesirable species and some species that have been "naturalized" and are considered desirable. In the analysis area, many exotics occur, but a list has not yet been tabulated. At this point, the only exotics that are managed are listed under noxious weeds. However, existence of any non-native species deviates from the historical point of reference, and should be tracked at some level.

Noxious Weeds

Noxious weeds and other invasive non-native plants are a threat to ecosystem health. These species are able to displace and out-compete native species, they reduce the quality and quantity of forage available for animals, and may cause runoff and soil erosion to increase (Lacey et al. 1989). Noxious weed infestations can cause untold economic losses to agricultural and forest crop production as well as a reduction in the value of the land for recreation, wildlife, and aesthetics.

Across the Pacific Northwest, there have been two major periods of weed introduction: initial euro-american settlement and post-1960's with the onset of greatly increased international commerce. Washington state has 633 weedy exotic plant species. The rate of increase in the region has been thus: 1901- 99 weedy species (73% annuals, 18% perennials, and 10% biennials; 1994- 800+ weedy species (70% perennials, 24% annuals, and 7% biennials). This represents not only an extreme increase in weeds, but a shift from annual weeds to perennial weeds. Perennial species are more successful in habitats with less disturbance, and remain covering that ground year-round as well as contributing to the soil seed bank (Rice, unpublished 1995).

The Federal Noxious Weed Act of 1974 as amended in 1990, (7 U.S.C. 2801 et seq.) and implementing regulations (36 CFR 22.8) state that the Forest Service shall cooperate with other agencies in the regulation of undesirable plants. In 1994, the Gifford Pinchot National Forest entered into a Memorandum of Understanding with Skamania County, the Columbia River Gorge National Scenic Area, and other agencies to control weeds across administrative boundaries. In the Wind watershed, noxious weeds are exchanged between variously administered lands, all of which have mutually low levels of noxious weed law enforcement (Laurie Penders, pers. comm.).

Several means of noxious weed control can be employed on federal lands in the Wind watershed: chemical, biological, manual, mechanical, and cultural. Chemical treatments using herbicides entail extensive environmental analysis for use on federal lands due to the FEIS on Competing and Unwanted Vegetation and the accompanying Mediated Agreement (USDA, 1988) and may not be the most efficient means of control. The other means are more readily employed and could stem further infestation that occur naturally with time.

TABLE III-3-5: Noxious weeds suspected and managed in the Wind watershed.

Common Name	Scientific Name	Class
velvetleaf	<i>Abutilon theophrasti</i>	A
Mediterranean sage	<i>Alvia aethiopsis</i>	A
Italian thistle	<i>Carduus pycnocephalus</i>	A
slenderflower thistle	<i>Carduus tenuiflorus</i>	A
purple starthistle	<i>Centaurea calcitrapa</i>	A
bighead knapweed	<i>Centaurea macrocephala</i>	A
Vochin knapweed	<i>Centaurea nigrescens</i>	A
common crupina	<i>Crupina vulagris</i>	A
Texas blueweed	<i>Helianthus ciliaris</i>	A
giant hogweed	<i>Heracleum mantegazzianum</i>	A
Venice mallow	<i>Hibiscus trionum</i>	A
mouseear hawkweed	<i>Hieracium pilosella</i>	A
dyer's woad	<i>Isatis tinctoria</i>	A
wild four o'clock	<i>Mirabilis nyctaginea</i>	A
peganum	<i>Peganum harmala</i>	A
unicorn-plant	<i>Proboscidea louisianica</i>	A
milk thistle	<i>Silybum marianum</i>	A
silverleaf knightshade	<i>Solanum elaeagnifolium</i>	A
buffalobur	<i>Solanum rostratum</i>	A
johnsongrass	<i>Sorghum halepense</i>	A
salt meadow cordgrass	<i>Spartina patens</i>	A
Syrian bean-caper	<i>Zygophyllum fabago</i>	A
camelthorn	<i>Alhagi pseualhagi</i>	B
slender foxtail	<i>Alopecurus myosuroides</i>	B
common bugloss	<i>Anchusa officinalis</i>	B
plumeless thistle	<i>Carduus acanthoides</i>	B
musk thistle	<i>Carduus nutans</i>	B
diffuse knapweed	<i>Centaurea diffusa</i>	B
spotted knapweed	<i>Centaurea maculosa</i>	B
yellow starthistle	<i>Centaurea solstitialis</i>	B
rush skeletonweed	<i>Chondrilla juncea</i>	B
yellow nutsedge	<i>Cyperus esculentus</i>	B
blueweed	<i>Echium vulgare</i>	B
leafy spurge	<i>Euphorbia esula</i>	B
orange hawkweed	<i>Hieracium aurantiacum</i>	B
yellow hawkweed	<i>Hieracium patense</i>	B
hybrid nettle	<i>Lamium hybridum</i>	B
perennial pepperweed	<i>Lepidium latifolium</i>	B
dalmatian toadflax	<i>Linaria dalmatica</i>	B
purple loosestrife	<i>Lythrum salicaria</i>	B
Eurasian milfoil	<i>Myriophyllum spicatum</i>	B
Scotch thistle	<i>Onopordum acanthium</i>	B
oxtongue hawkweed	<i>Picris hieraciodes</i>	B
tansy ragwort	<i>Senecio jacobaea</i>	B
perennial sowthistle	<i>Sonchus arvensis</i>	B
swainsonpea	<i>Sphaerophysa salsula</i>	B
jointed goatgrass	<i>Aegilops cylindrica</i>	C
brown knapweed	<i>Centaurea jacea</i>	C
meadow knapweed	<i>Centaurea jacea x nigra</i>	C
oxeye daisy	<i>Chrysanthemum leucanthemum</i>	C
Scotch broom	<i>Cytisus scoparius</i>	C
St. John's wort	<i>Hypericum perforatum</i>	C
spotted cats-ear	<i>Hypochaeris radicata</i>	C
smooth cordgrass	<i>Spartina alterniflora</i>	C
gorse	<i>Ulex europaeus</i>	C

Class A weeds are noxious weeds that are of limited distribution or are unrecorded in the state and are a serious threat. Goal is immediate eradication.

Class B weeds are noxious weeds that are limited in distribution or not recorded in a region of the state pose a serious threat to that region. Goal is control and eradication.

Class C weeds are other noxious weeds. Goal is eventual eradication.

Noxious weeds have been surveyed on most roadways in the watershed. The condition of the watershed in terms of noxious weed infestations is average; there are weeds that by law, require immediate treatment and those that legally and economically need to be treated eventually (see Table III-3-5). Noxious weeds occur in all sub-basins particularly, problematic areas are within the riparian zone of sensitive stream channel types and in wetlands. All weed occurrences are considered to be above the threshold level. A

list of noxious weeds for Skamania County and maps of the surveys are on file at the Wind River Ranger District, and a summary of the information is provided here.

The most problematic weeds in the Wind watershed are discussed below.

Tansy ragwort (*Senecio jacobaea*) (Class B) is a biennial that has two distinct life phases: the vegetative rosette, and the flowering stalk. A native to dry areas of Eurasia, a single large flowering stalk may produce more than 150,000 seeds which can remain viable in the soil for 15 years. Tansy ragwort contains pyrrolizidine alkaloids that poison the liver of domestic livestock grazers.

Tansy ragwort is the most pervasive weed found on the Gifford Pinchot National Forest. It occurs extensively along Trout Creek and in Black Creek Swamp, to name a few sensitive areas. It is found at most logging landings, in clearcuts and along logging roads. It appears in most places where machinery has rid the soil of ground cover and duff, and exposed the mineral soil to sun. Biological control agents (ragwort seed fly, cinnabar moth, and tansy ragwort fleabeetle) have proven effective at reducing population density. In the Wind watershed, higher elevations and excessive moisture may preclude these insects from maintaining viable populations.

Spotted knapweed (*Centaurea maculosa*) is a perennial plant that spreads by wind-blown seed or by seed transported by animals and vehicles. Livestock will graze spotted knapweed. Its taproot is stout and seed production is prolific.

St. John's wort (*Hypericum perforatum*) is a perennial weed that reproduces by short runners or by its prolific seed. It is found on nearly all the roadsides in the Wind watershed. St. John's wort contains a photo-activated toxic substance which affects white-haired animals when ingested. Ironically, this plant is desirable for popular alternative medicinal extracts and has become a Special Forest Product. Insects introduced to western United States have provided partial control of the weed.

Scotch broom (*Cytisus scoparius*) is a leguminous shrub that projects its seeds upon ripening. Seeds remain viable in the soil for multiple years. Scot's broom can be established on soils depauperate in nitrogen because, like other legumes, it transforms free nitrogen into usable nitrogen. It can amend the soil where it gets established, however, it tenaciously maintains wherever it gets established. Several established populations of Scot's broom are sufficiently dense to support biological control agents, however, these (*Leucoptera spartifoliella*, *Agonopterix nervosa*, and *Apion fuscirostre*) have not proven to be very effective.

Yellow hawkweed (*Hieracium pratense*) is a fibrous-rooted perennial herb, similar to orange hawkweed. Distribution of both hawkweeds is limited, but yellow hawkweed is more common east of the Cascades, and orange hawkweed is more common west of the Cascades.

Diffuse knapweed (*Centaurea diffusa*) is particularly threatening. It is highly competitive with rough, wirey stems, and numerous flowers. There are over 400 species of *Centaurea*, most originate from the Mediterranean region. Like spotted knapweed, diffuse knapweed takes over pasture and roadsides, is not palatable, and threatens to exclude native flora where it occurs especially disturbed areas where sunlight penetrates.

Meadow knapweed (*Centaurea jacea x nigra*), native to Europe, is now common in the Pacific Northwest. It is a hybrid species that infests roadsides, fields, and waste areas.

Future Vegetation Management Options

Matrix Land Management

The number of acres available for timber harvest on Matrix lands was determined using an even-flow calculation based on the area available for programmed timber harvest. A rotation age of 110 years was used as an average for all timber types and productivity classes. Table III-3-6 displays the acres available for each sub-basin. Available regeneration acres per decade were calculated by dividing all Matrix acres (minus 10% for designated Green Tree Reserve Areas) by the rotation length of 110 years and multiplying by 10 years. The total acres available for regeneration harvest in the next decade are 1,535 acres. Intermediate harvest acres were estimated using the assumption that all young stands would be thinned at least one time during a rotation. Acres available for intermediate cut in the next decade would be the same as for the regeneration cut or 1,535 acres.

TABLE III-3-6: Matrix - Evenflow Harvest Acres Outside of ROD Riparian

Sub-watershed	Forest Acres	Dedicated Reserve Acres	Regen cut per decade Acres	Available Regen Acres (Large Trees)	Available Regen Acres (Small Trees)	Young Stands (Small Trees)s
Compass Crater	1,280	128	104	421	-	127
Headwaters Wind	4,089	480	393	954	978	978
Layout	1,567	156	128	314	-	650
Lower Falls Creek	2,672	267	218	688	384	384
Paradise	2,865	286	234	791	650	650
Pete's Gulch	1,618	161	132	327	404	405
Upper Falls	1,169	116	96	627	64	64
Upper Panther	1,202	120	98	1,140	-	41
Upper Trout	199	19	16	70	-	13
Upper Wind	1,416	141	116	169	531	531
Total Acres	18,807	1,874	1,5335	5,501	3,138	3,843

Stand examinations need to be done on a continual basis to assess stand conditions and fill data gaps in the District vegetation data base. Exams are usually scheduled over the rotation of a stand at about 10 year intervals. Information is used to schedule precommercial thinning, pruning, fertilization, and harvest activities. Stands exams are the basis for prescriptions that are required prior to vegetation manipulation activities.

Precommercial thinning is prescribed for all young stands in the seedling/sapling category that are over the recommended stocking level. Density management is very important at the seedling/sapling stage because overcrowding severely reduces stand growth and vigor. Prescriptions are made to preserve and enhance species diversity. Of the total 4,340 acres of seedling/sapling stands in the Matrix, 165 acres are inventoried and prescribed for precommercial thinning. Plantation examinations need to be done periodically to prevent a data gap from occurring. Eventually all or most of the 4,340 acres of seed/saps will need to be treated to prevent overstocking. Plantations will continue to be available for precommercial treatment at an increasing rate for the next decade. After that the rate will decline and level off at about 200 acres per year.

Desired Future Condition - Matrix

The objective of Matrix lands is to manage the suitable lands for scheduled timber harvest while providing specified amounts of coarse woody debris and green tree retention. Also included is direction to buffer riparian areas and zones of potentially unstable soils. Figure III-3-6 displays the current and desired future condition (DFC) of vegetation that would exist on Matrix lands under ideal conditions. The desired future for late-successional stands would total 13,776 acres or 44% of the total Matrix area. Of this total 1,874 acres would be dedicated reserve patches within harvest units, 9,683 acres would be true riparian buffers, and 2,219 would be potentially unstable areas. All timber management activities would occur in the early and mid-successional categories.

TABLE III-3-6: Matrix Current And Desired Future Conditions

SERAL STAGE	CURRENT	FUTURE
NON-FOREST	1,504	1,504
EARLY	9,862	5,390
MID	15,524	11,543
LATE	4,419	13,776

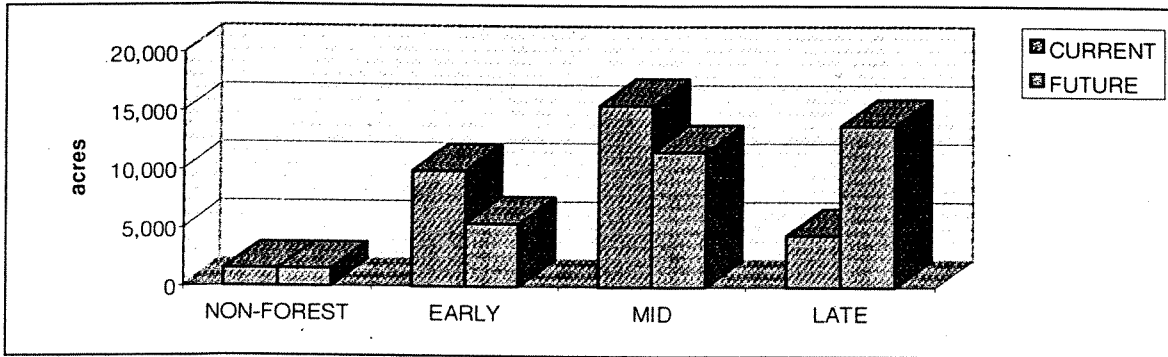


FIGURE III-3-6: Matrix Current And Desired Future Conditions

Late-Successional Reserve Lands and Riparian Reserves

The LSR contains 28,313 acres of land in the small tree category and 14,925 acres of land in the seedling/sapling/pole category. Many of these areas are overstocked and in need of stocking level control to keep them from becoming stagnated and to accelerate their development into late-successional. Table III-3-7 displays young stand acres within the LSR that may be available for project work. Two types of silvicultural activities would be proposed: 1) thinning and select tree harvest in areas with small trees; and 2) precommercial thinning in seedling/sapling stands.

Thinning and select tree harvest would be proposed in young stands for the purpose of accelerating stand development of late-successional attributes. Harvest prescriptions would vary by stand. Excess trees could be removed or utilized on site for such things as snags, down logs, or habitat structures depending on habitat needs. All sub-watersheds with acres in the Small Tree category would be candidates for treatment. In the future pole stands would be treated as they grow into the small tree class.

Precommercial thinning is prescribed for all young stands in the seedling/sapling category that are over the recommended stocking level. Density management is very important at the seedling/sapling stage because overcrowding severely reduces stand growth and vigor. Prescriptions are made to preserve and enhance species diversity. Of the total 6,269 acres of seedling/sapling stands, 798 acres are inventoried and prescribed for precommercial thinning. A data gap exists because many of the remaining 5,471 acres of sapling stands need to be examined to determine need for treatment. Eventually all or most of the 6,269 acres of seedlings will need to be treated to prevent overstocking.

TABLE III-3-7: Current LSR Young Stand Seral Stage Acres By Sub-Watershed

Sub-watershed	S/Sap	Poles	L.For	Sm. Tree
Big Hollow	145	575	113	1,383
Brush		148		609
Cedar	281	266	10	922
Compass/Crater	135	656		88
Dry	273	639	26	3,158
E.Fork Bear	176	339		1,011
Eightmile	633	773		1,590
Little Wind		378		114
Lower Bear	183	165	22	517
Lower Falls Cr	705	830	88	1,079
Lower Panther	373	198	29	2,706
Lower Trout	437	671		3,816
Lower Wind				562
Middle Wind	887	1,168	29	5,895
Mouse	104	61	7	767
Ninemile	527	790		1,066
N.F. Bear	23	183	19	1,427
Paradise				
Trapper	80	32		285
Upper Panther		47	30	155
Upper Trout	1,226	727		624
Upper Wind	39	10		539
Total Acres	6,629	8,656		28,313
Average Age	13 yrs	38 yrs		110 yrs

Young stand treatment within the Riparian Reserves will be important to the development of future large wood. Currently 43% of the area within the Riparian Reserves occurs in the young classes of seed/sap, poles, and small trees. Seed/sap stands will need to be precommercial thinned and stocking in the small tree stands will need to be reduced in order to grow large wood as rapidly as possible.

Desired Future Condition of the Late-Successional Reserve (LSR)

The objective of Late-Successional Reserve (LSR) is to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional species. Table III-3-8 displays the current and desired future condition (DFC) of vegetation within the LSR. Achievement of the DFC will greatly increasing the amount of late-successional forest that currently exists. The model provides for a certain amount of regeneration that would be expected to occur over time at a light disturbance level. It will take 50 years and more to achieve the DFC. Currently there are 36,969 acres of stands in the pole and small tree categories that need to grow and mature. Many of these stands are over stocked and will be in need of stocking control in order for them to develop into late-successional multi-story stands.

TABLE III-3-8: LSR Current And Desired Future Conditions

SERIAL STAGE	CURRENT	FUTURE
NON-FOR	4,336	4,336
EARLY	16,173	3,900
MID	35,786	14,823
LATE	21,724	54,613

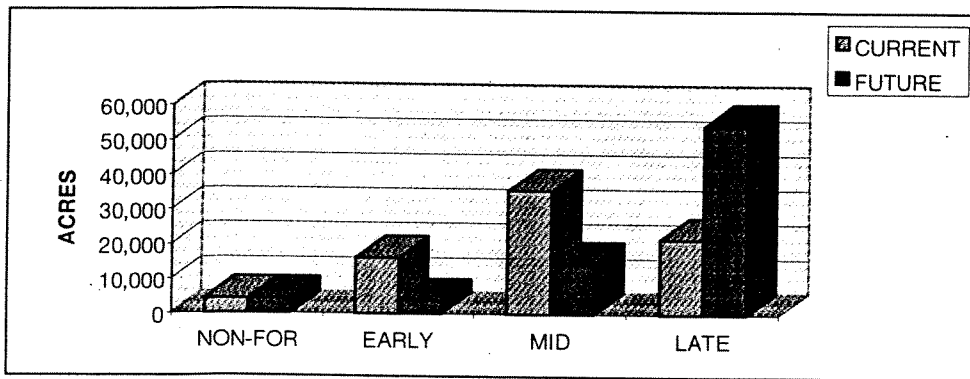


FIGURE III-3-8: LSR Current And Desired Future Conditions

4. STREAM CHANNELS AND FISHERIES HABITAT

Current conditions

Current conditions are the result of natural processes and stochastic events. In the Wind watershed these include: volcanic eruptions, earthquakes, fire, erosion/sedimentation, stream bank vegetation, instream large woody debris (LWD), and peak flows. Humans have affected stream channels within the Wind River basin by: riparian timber harvest, fire, splash damming, hydro-electric dams, irrigation diversions, stream clean-outs, up-slope timber harvest, fisheries habitat manipulation, dikes, roads, and campgrounds.

Volcanic Eruptions: Volcanic eruptions were the most prevalent land forming process within the Wind River watershed. Basalt flows approximately 300,000 years before present (YBP) formed many of the waterfalls within the basin such Shipperd Falls. Evidence of more recent volcanic activity (6,000 YBP) can be found in the Trout Creek "Flats" area. Lahar flows stemming from eruption(s) on West Crater have helped to create the low gradient alluvial valley in the upper Trout Creek watershed.

Land-slides: Land-slides can transport enormous amounts of sediment and large wood into streams altering sediment budgets and routing. Raw eroding hill slopes may persist for decades increasing sedimentation within stream channels. Landslides are natural events and can contribute LWD and large boulders for channel complexity. However, human activities such as logging, road building, and burning may also trigger or accelerate landslides. Channel widths may expand and depth decrease to compensate for the increased sediment load.

Earthquakes: Earthquakes have probably played a minor role relative to volcanoes in the formation of stream channels within the Wind River basin. Earthquakes can create waterfalls or trigger landslides which impound water and form lakes.

Fire, Stream Bank Vegetation, Instream Large Woody Debris (LWD) and Peak flows: Fire can alter stream channels by burning upslope and riparian vegetation. Upslope burns affect stream channels leaving vast areas open where snow can accumulate and free water is no longer stored by living roots. Warm chinook winds and rain melt the snow pack rapidly causing extreme peak flows. These peak or flood flows alter channels by mobilizing floodplain LWD, reducing lower bank vegetation, and redistributing streambed substrate. Human caused fire in the *early part of the century* increased the intensity and frequency of fires within the Wind River watershed. The impacts to stream channels from human caused fire in the early 1900's are more severe than that of natural fires due to the frequency and intensity. Fire suppression efforts in the *later part of the century* have probably significantly reduced wildland fires within the Wind River basin.

If riparian vegetation is burned bank stability and future LWD will be lost. Large living root masses are crucial to maintenance and integrity of stream banks and channels. LWD is essential to the distribution and routing of both water velocities and sediment. Once large trees fall into the stream they dissipate the stream energy by slowing water velocity which reduces shear stress.

Erosion/Sedimentation: Erosion and sedimentation are natural processes that characterize channel types. Erosion naturally takes place along stream banks and naturally unstable areas where land slides occur. As sediment moves through channels substrate, the size is sorted by the streams energy, i.e.; the bigger/steeper the stream, the bigger the streambed substrate will be.

Riparian Timber Harvest: In the early part of this century riparian timber harvest was a common occurrence that was usually associated with splash damming. Riparian timber harvest continued to some extent within the Wind River watershed until 1992 and the implementation of the President's Forest Plan

and the Aquatic Conservation Strategy. Riparian timber harvest has similar effects as fire; removing bank stability and a future source of LWD.

Splash Dams: Splash dams on the Wind River were used to transport logs down to the mills along the Columbia River from the late 1800's to 1949. Splash dams altered stream channels by trapping sediment above the dams and flushing/scouring sediment and LWD from the channels that existed below the dams. Before the streams were dammed the channels were cleaned of LWD and nick points or places where debris would accumulate were blasted with dynamite. The combination of these two actions created a type of basalt log flume that will persist until the next century. After the splash dam was constructed timber was harvested along the banks and near hill slopes and dumped into the pond formed by the dam. When the pond was full of logs and river levels were sufficient, the gates to the dam were opened allowing the contents to be "splashed" violently down river. The abrasiveness of the logs and artificial floods against the rootless banks destroyed bank and channel stability. The peak flows and restriction of sediment scoured channels below the dams to bedrock.

Hydro-electric Dams and Irrigation: Hydro-electric and water irrigation diversion dams affect stream channels by altering the normal flow regime and trapping sediment above and depleting the sediment source below. These types of dams were constructed of concrete making them more permanent structures than the wooden splash dams. The effects of concrete dams are more subtle and longer lasting than the splash dams.

Stream Clean-outs: Stream clean-outs were common practice for both splash damming and fisheries habitat "improvement." As late as 1982 logging slash as well as natural log jams were removed from stream channels to improve fish migration or protect structures such as bridges. What the early foresters and fishery biologist were unaware of was that removing this LWD from the stream was not only removing vital fish hiding cover but also removing the channels natural sediment traps and velocity dissipaters. Removing LWD from stream channels releases sediment, reduces the roughness, and increases the streams energy. As the streams energy is increased banks and stream bed begin to erode, channel stability is decreased and the stream begins to lose its sinuosity or straighten out. As the stream becomes straighter it gains more energy and may begin to erode its own bed and begin to "down-cut" or scour out the channel increasing the gradient and increasing the bed substrate size. This is not only bad for the fish, but bad news for bridges, roads and property.

Up-slope Timber Harvest, Peak Flows, Sedimentation and Erosion: Up-slope timber harvest can indirectly affect stream channels by increasing peak flows, erosion, and sedimentation. (See; Fire, Stream Bank Vegetation, Instream Large Woody Debris (LWD) and Peak flows).

Fisheries Habitat Manipulation: Fisheries habitat manipulation can affect stream channels by altering pools, LWD, substrate composition, channel width, depth, gradient, and riparian vegetation.

River Dikes and Roads: Dikes and Roads constructed along stream corridors can affect channels by cutting off the natural ability of a river to meander, reducing stream shade, and potential large woody debris. Reducing meanders increases the water surface slope or increases water velocities downstream. Roads and dikes can also increase velocities by "pinching" or narrowing the stream channel. The affects of increasing water velocities is similar to that of increased peak flows.

Campgrounds: Campgrounds are often constructed adjacent to bodies of water or within floodplains. Campgrounds indirectly affect stream channels by flood control or protection devices such as dikes and/or rip-rapping. Most campgrounds developed within floodplains contain a rip-rapped wall that constricts flow and accelerates water velocities downstream which impacts banks and channel stability. An example of this is Beaver Campground.

Historic Conditions

Stream Channels, Riparian Vegetation and Fish Habitat

The historic (before 1850) or "undisturbed" conditions of stream channels within the Wind River watershed could have been characterized as shaded and loaded with wood, BIG WOOD. Stream surveys were not conducted until 1935 after the entire mainstem Wind River corridor had been logged and splash dammed from the confluence with the Columbia River to Paradise Creek (river mile 20). Old timber cruises from 1918 yield some insight as to the condition of the Wind River and its riparian areas.

"Apply the simile of your crossed hands, the left hand delineating Wind River basin above Trout Creek. The wrist and palms represent the flat valley lands (above Stabler bridge), practically all of which will be logged off by the end of the season of 1919. There remain only the narrow flat bottomed canyons lying between burnt ridges and such back slopes as will yield a stand in which logging can be carried on with hope of profit. **The cream has been skimmed from the basin.**" (H.D. Langille, 1919).

Langille goes on to describe the timber within the riparian corridors; "This narrow strip of timber is of good quality, the fir ranging from 2 to 8 feet in diameter and averaging 2700 feet per tree." You do not need an extremely active imagination to envision boating the Wind River back then would have more than likely been out of the question, walking the river would have been a nightmare but for the fish, it would have been a paradise!

The first stream surveys were conducted in 1935, 1936, 1937 and 1940 by the United States Bureau of Fisheries to inventory streams for prospective "fisheries enhancement" as mitigation measures for the construction of Bonneville dam. These surveys are interesting and lend insight into the general habitat conditions and species distribution. These same sections or reaches of stream were surveyed again in 1992 using the same criteria for pools. The results of these "re-surveys" are a bit misleading due to the differences in season and water levels in which the surveys were conducted. The 1930's surveys were carried out in November, June and September. Tables III-4-1 and III-4-2 indicate an increase in pools per mile for the Wind River, Trout Creek, and Panther Creek and a decrease in pools per mile for Trapper Creek.

TABLE III-4-1: Oregon State University analyzed changes for intermediate size pools in the Wind River, Trout, Panther, and Trapper Creeks from 1935 to 1992, Skamania County Washington. Intermediate pools were defined as >25 yd² area and > 3 feet deep.

Stream	River Miles	1935-1945 # Pools	1935-1945 Pools/mi	1987-1992 # Pools	1987-1992 Pools/mi	% change*
Trout	6.8	20	2.9	144	21.2	+203
Wind	20.4	67	3.3	204	10.2	+631
Panther	6.2	39	6.3	65	10.5	+67
Trapper	2.0	36	18.0	18	9.0	-50
Total	35.4	162	4.6	431	12.2	+165

TABLE III-4-2: Oregon State University analyzed changes for large size pools in the Wind River, Trout, Panther, and Trapper Creeks from 1935 to 1992, Skamania County Washington. Large pools were defined as >25 yd² area and > 6 feet deep.

Stream	River Miles	1935-1945 # Pools	1935-1945 Pools/mi	1987-1992 # Pools	1987-1992 Pools/mi	% change *
Trout	6.8	6	0.9	10	1.5	+67
Wind	20.4	55	2.7	63	3.1	+15
Panther	6.2	10	1.6	4	0.6	-63
Trapper	2.0	7	2.0	1	0.5	-75
Total	35.4	75	2.1	80	2.3	+10

When the Wind River, Panther and Trapper Creek surveys are scrutinized the differences can be attributed directly to the 1935 surveys being conducted during the fall freshets in November and the 1992 re-surveys conducted during low flows in the late summer. The streams were transporting distinctly different volumes of water and and/or had different observable pool regimes. The inverse is true for Trout Creek. When the survey was taken in 1935 there were two water diversions; one hydro-electric and the other irrigation. The surveyor commented "Water is exceptionally low and no water is flowing through the fish ladder..." and "At the time of the survey the creek was abnormally low, the discharge of water being 4 c.f.s." Probably a very significant portion of the water was being diverted to the nursery fields for irrigation and pools that were recorded in 1992 were not counted in 1935 because they were dry.

Current Conditions, Synthesis, and Interpretation

Stream Channels, Riparian Vegetation, and Fish Habitat

We are left with a scant picture of what the "pristine" watershed truly looked like. Virtually the entire watershed has been managed in some form. Even Trapper Creek, the Wind Rivers only wilderness watershed contains developments on the lower reaches that have altered the stream coarse/channel, reduced large woody debris, and riparian vegetation.

Channel Types of the Wind River: Streams are directly affected by eight major variables; channel width, depth, slope, roughness, discharge, sediment load, and substrate size (Leopold et al. 1964). Nature and physics hold the same laws accountable; you cannot get something for nothing/for every reaction there is an opposite and equal reaction. If any one of the above mentioned variables is altered the channel pattern will alter to adjust or compensate for the change. This basic understanding becomes extremely important when dealing with streams. Sometimes seemingly minor disturbances can seriously degrade stream channels and aquatic habitat. The Rosgen (1994) stream classification system incorporates solid principles of fluvial geomorphology and helps us delineate sensitive areas and helps to evaluate the evolutionary state of a stream. The Rosgen classification system incorporates channel slope, meander width ratio, channel entrenchment, sinuosity, and bankfull width to depth ratio. Stream classification categorizes channels from A - F based on this criteria. Substrate size is delineated by a numeric system 1 - 6, bedrock to silt/clay respectively. For the purposes of this watershed analysis channels were typed by aerial photos, topographic maps and field reviews. Due to the lack of site specific data, most channels were typed out as A, B, C or E. Where higher resolution data was available, other channel types (D, F, & G) were identified.

Basically, Rosgen A channels are typified by low sinuosities, low width to depth ratios (W/D), high gradients ($>.1 - .039$), and entrenched such as cascades or waterfalls. The lower Wind River canyon, containing Shipperd Falls, is a classic A channel. B channels typically have moderate W/D ratios, moderately entrenched, and sinuous with lower gradients ($.09 - .2$). The lower reaches of Falls Creek is a fairly typical of B channels found throughout the watershed. C channels contain moderate to high W/D ratios, high sinuosity, slightly entrenched, and low gradients ($.04 - <.001$). Trout Creek flats and the Wind River between Ninemile Creek and Stabler Bridge are good examples of C channels. E channels are characterized by slight entrenchment, very low W/D ratios, very high sinuosities and low gradients ($.04 - <.02$). E channels are more typical of "East side" environments, however, Black Creek Swamp, Upper Falls Creek, and the East Fork Trout Creek provide very nice examples. Map 15 shows the location and distribution of various channel types within the Wind River watershed.

Channel Evolution: Historic aerial photos show the progression or evolution of stream channels. This evolution or "adjustment" occurs typically when peak flows are increased, sediment load is altered, or riparian vegetation is disturbed. The observed changes can be described by stream types. For instance, Trout Creek Flats area is now dominated with C4 (bar 6), F4, and G4 channel types. Aerial photos from 1954 and abandoned meanders show evidence that at one time this area was dominated with E4 and C4 channel types. The removal of old-growth timber from the banks of Trout Creek removed the roots that were holding the banks and channel together. As the banks sluff into the stream they deliver both coarse and fine particles of soil which increase suspended sediments and bed load. "Bed load" consist of the larger particles that roll or slide across the bottom of the stream bed. Each stream has evolved to transport a certain amount of sediment. If excess sediment enters a stream the channel must compensate or adjust to the new sediment load. Without adequate large living rootwads and large instream woody debris stream banks composed of unconsolidated soil and gravel have no lateral resistance. An increase in sediment load displaces water within the channel placing even more pressure on the banks accelerating erosion, increasing channel width, and reducing the depth. These actions produce a wide shallow channel which has a large surface area exposed to the sun. "Healthy" C channels typically have bankfull width to depth ratios between 12 and 30. Currently, width to depth ratios range from 19 to 64 within Trout Creek. As the channel slope steepens to compensate for the increased sediment load, meander cut-offs are occurring creating gullies. As this occurs, the stream degrades its bed and abandons its floodplain.

The consequences of this are severe with respect to aquatic habitat. The degradation of this channel is leading to a decrease in spawning habitat for native summer steelhead. The degradation and aggradation of the bed are changing the size and quality of the substrate which was once one of the primary spawning grounds for wild steelhead within the Wind River. The following list the known degraded channels within the Wind River watershed: Dry Creek 3, Middle Wind Rivers 1 & 2, Layout Creek 1, and Trout Creeks 5 & 6.

Evaluation of Fisheries Habitat: Four criteria used to evaluate fisheries habitat are:

- 1) Large woody debris,
- 2) Pools per mile,
- 3) Width to depth ratio, and
- 4) Maximum water temperature. Based on historic data, the Pacific Northwest Research Station in Corvallis, Oregon developed numeric values for these criteria.

The numeric values are:

- **LWD: 80 pieces per mile >24" in diameter at the butt and >50' in length**
- **Pools/Mile:**

GOOD POOL HABITAT

Wetted Width (feet)	Pools/Mile
5	184
10	96
15	70
20	56
25	47
50	26
75	23
100	18
125	14
150	12
175	10
200	9

- **Width to Depth Ratio: <10 (measured as mean wetted width divided by mean depth.)**
- **Maximum Water Temperature: 61°F (16°C)**

Results of Survey

Twenty-four streams containing seventy-six reaches were surveyed with the USDA Forest Service, Region 6, Hankin and Reeves, stream survey methodology (R6 Level II). Of the seventy-six reaches of stream surveyed within the Wind River watershed, only 26% of the streams met the criteria for LWD, only 7% met the criteria for pools/mile, and all baseline water temperature stations exceeded 16°C. Width to depth ratios appeared to be in better shape with only 26% of the surveyed reaches exceeding the established standard of 10. In order for the stream survey data to be useful in watershed or habitat analysis, it is imperative to attempt to evaluate each watershed independent of the regional DFC's.

Seventy-six reaches of stream totaling 69.6 river miles were surveyed with the R6 level II survey protocol. Of these 76 reaches, 74% did not meet the drc for large woody debris (LWD) and 93% failed to meet the criteria for pools/mile. The existing drc's may be a good long term goal for resource managers to strive for but they do not help evaluate and prioritize watersheds for restoration. In order to analyze a watershed, prioritize restoration, and identify high quality refugia, stream survey data must be rated against the other streams within the basin that contain the same geomorphic characteristics. The biggest problem with quantifying or defining the "natural" range of variability is that statistically there are very few streams reaches that can be used for control or historic references. Disturbance should be minimal or at least "natural" when trying to determine a reaches "fitness." The following narrative discusses key habitat values and provides recommendations to analyze habitat and watershed conditions.

Peak Flows: Peak flows are generated by snow melt, rain on snow events, and rain run-off. Peak flows can be increased by fires, clear-cutting, road building, and urbanization. King and Tennyson (1984) found when as little as 3.9% of a forested watershed was occupied by roads hydrological behaviors were altered. Roads can increase the magnitude and intensity of peak flows by decreasing infiltration rates and interception, and diversion of surface and subsurface flows (Hauge et al. 1979). Increased peak flows can alter channels by destabilizing banks and disturbing channel processes (see Table III-2-2).

The following criteria was used to evaluate watersheds risk for increased peak flows: Road densities, ARP's, Peak flow Potential and percent increase in two year flood events. The following watersheds have

a high probability of negatively affecting peak flows: Compass/Crater Creek (H), Upper Panther (L), Layout Creek (M), Nine-mile Creek (G), and Lower Falls Creek (C).

Erosion and Sediment: Sediment and sediment transport are natural processes that provide streams with a source of substrate and nutrients. Sediment is naturally delivered to streams by a variety of mechanisms such as landslides and bank erosion. The sediment load is the quantity and size of the material a stream typically transports. When streams or watersheds are disturbed by fire, logging, or roading excess sediment can be delivered to the stream altering both quantity and composition of the substrate.

Sub-watersheds were evaluated for erosion and sediment by: road crossings per square mile, peak flow turbidity, mass wasting, surface erosion, and channel stability. The sub-watersheds that pose the greatest threat to adversely affecting channels from erosion/sedimentation are: Compass/Crater Creek, Upper Trout Creek, Middle Wind River, Upper Panther Creek, Layout Creek, Upper Wind River, Lower Wind River, Mouse Creek, NF of Bear Creek, Upper Falls Creek, Lower Trout Creek, and Eightmile Creek. Sub-watersheds generating the highest turbidities and potentially adversely affecting aquatic organisms are: Lower Wind River, Lower Trout Creek, Lower Panther Creek, Mouse Creek, Middle Wind, and the Upper Wind River respectively (see Tables III-1-1 and II-1-2).

The majority of streams that exhibit poor channel stability ratings contain excessive bank erosion. The majority of sediment generated within these areas comes directly from bank erosion. The stream reaches which show poor bank/channel stability are: Dry Creek 1, Twelve-mile 1, Upper Wind 1 & 5, Youngman 1 & 2, Middle Wind 3, Trout 2, 5, 6, 7, Crater 2 & 4, and Layout 1. Impacts of increased sedimentation from a landslide show up in the channel stability rating within reach 2 of Proverbial Creek (see Table III-4-9).

Riparian and Stream Bank Vegetation: Riparian vegetation plays an enormous role in the health of aquatic ecosystems. Riparian vegetation provides the stream with a source of LWD, stream shade, and bank stability. The roots of trees and shrubs hold banks together and prevent erosion. Different species of trees provide various degrees of LWD, bank protection, and shade. Alder is a relatively shallow rooted deciduous species that typically does not provide adequate root depth for bank protection on larger streams. Alder is a nitrogen "fixer" and is an important component of the aquatic ecosystem. However, the lack of root depth creates a lack of bank stability along larger streams which allows peak flows to erode tons of sediment into the stream. Monitoring stations within the Trout Creek flats area have documented erosion rates of over 40 cubic feet per linear foot of bank in a single bankfull event in alder dominated systems. Channel shifts and braiding occur seasonally and varies depending on peak flows. In 1994, a portion of Trout Creek (reach 5), shifted over 65 feet from it's original thalweg. Under mature conifer dominated riparian conditions, periodic high flows that prevent vegetative encroachment into the stream channel is good; it typically encourages plant succession and enhances fish habitat. However, the existing radical shifting sets back the stream healing process by wiping out seedling, sapling aged trees and shrubs, increasing width to depth ratios, filling in pools, and aggrading the channel. Alder is also not very long lived in the stream and typically does not produce "quality" LWD. In addition, alder does not provide thermal protection in the winter. It is extremely important to have a diversity of tree species within riparian areas. Identifying areas that contain homogenous stands of small diameter riparian vegetation provides insight into the health of a stream. The following streams have poor riparian conditions: Crater 1, 2, 3 & 4; Eight mile 1; Upper Wind 3 & 5; Trout 3, 4, 5, 6, 7; Proverbial 1; Paradise 1; Pete's Gulch II 1; Pete's Gulch 2; Oldman 1 & 2; Middle Wind 3; Panther 2; and Compass 1 (see Table III-4-9).

Large Instream Woody Debris (LWD):

Large wood has both physical and biotic impacts within salmonid streams. The physical effects LWD has on streams includes changes in stability of stream banks and channels, storage of sediment, dissipation of stream energy, and alteration of channel flows (Bryant, 1983, Everest and Meehan 1981, Harmon et al 1986). Riparian timber harvest, fire, splash damming, road building, developments, and stream clean-outs have reduced instream LWD within many reaches of stream of the Wind River watershed.

The frequency of logs >24" diameter falls short of the 80 pieces per mile dfc in 56 of the 76 surveyed reaches of stream. There are many variables that affect the retention of large woody material with bankfull width and channel type perhaps the most influential. Thirty-two "undisturbed" reaches were channel typed (Rosgen, 1994 methodology) and evaluated for numbers of brush, small, and large woody debris per mile. Table III-4-3 provides the average/mean, confidence intervals, and minimum expected numbers of LWD per mile for all wood classes by Rosgen channel type. It appears that the dfc for large wood is a reasonable *minimum* criteria for the Wind River watershed. Broken out by channel type, the minimum, maximum and average numbers of >24" LWD/mile we would expect to see under native conditions within the Wind River is shown in Table III-4-4. In order to gain better insight into the which streams contain the best and worst quantities of wood a new "Bare Wood Index" was developed. The lower end of the confidence limits was used to derive the *minimum* numbers of LWD/mile by channel type. Streams that exceeded the minimum LWD for *all* classes of wood (brush, small & large LWD/mile), were categorized as "**Minimum**," reaches that fell short in one or two of the wood classes were classified as "**Needy**," and those reaches that did not contain the minimum LWD/mile for *all* classes were categorized as "**Very Low**."

The streams that fell into the "Minimum" category are: Trapper 4, Rush 1 & 2, Twelve-mile 1, East Fork Trout Creeks 2 & 3, Cedar 3, Upper Wind River 1, 2 & 4, Panther 7, Layout 2, Dry 2, and Crater 2, The streams that fell into the "Very Low" category are: Pete's Gulch II 1 & 2, Panther 1, 4 & 5, East Fork Trout 4, Mid Wind 1, 2 & 3, Pete's Gulch 1 & 2, Trout 4, 5, & 6, Dry 3, Crater 1, 3, 5 & 6, Oldman 1, 2 & 3, Proverbial 1, Planting 1, SF Planting 1 & 2, Trapper 1, and Compass 1,2 & 3 (see Table II-4-9).

TABLE III-4-3: LWD within undisturbed reaches of stream by channel type for the Wind River Watershed, Skamania County Washington.

Undisturbed Rosgen "A" Channels (N=13)

	Brush/Mile	Small/Mile	Large/Mile
Mean	104	59	47
CI 95%	29	19	12
Expected Minimum	75/Mile	40/Mile	35/Mile

Undisturbed Rosgen "B" Channels (N=8)

	Brush/Mile	Small/Mile	Large/Mile
Mean	74	55	45
CI 95%	20	11	11
Expected Minimum	30/Mile	42/Mile	34/Mile

Undisturbed Rosgen "C" Channels (N=11)

	Brush/Mile	Small/Mile	Large/Mile
Mean	72	94	37
CI 95%	22	51	9
Expected Minimum	51/Mile	43/Mile	32/Mile

Brush = pieces of wood 12"-23" in diameter and >25' in length
 Small = pieces of wood 24"-35" in diameter and > 50' in length
 Large = pieces of wood >36" in diameter and > 50' in length

TABLE III-4-4: Expected natural range of LWD/mile for different channel types within the Wind River watershed, Skamania County Washington.

Channels	LWD/Mile		
	Average	Maximum	Minimum
A	106/mile	134/mile	75/mile
B	101/mile	124/mile	76/mile
C	130/mile	181/mile	75/mile

Stream Pools: By definition a pool is an area of the stream with reduced water velocities, typically deeper than the surrounding areas, with a smooth surface. Pools are created by structure in the banks or channel that scour or impound water during peak flows. As peak flows recede, pools become depositional areas for fine sediment. Pool quality and quantity can be reduced if the sediment load of a stream is increased by bank erosion or landslides. Pools can be lost if the structural elements that create them such as LWD are removed.

Pool Frequency: Ninety-three percent of the surveyed reaches within the Wind River watershed did not meet the dfc for pools per mile. Again, the established pools/mile dfc may be a good long term goal but it does not help us analyze and prioritize reaches of stream in the basin. A pool quality index developed during the course of this analysis was found to be more useful with respect to identifying reaches of stream which contain poor pool habitat.

The main problem with evaluating pool frequencies from level II stream survey data is that the consistency between observers (and consistency of individuals) is poor in identifying and delineating pool habitat. We conducted a test reach program on the South Zone of the GP in 1994, with crews from Mount St. Helens, Mount Adams and Wind River participating. The percentage of the reach area defined as pool varied from 6% to 35% among the four data sets (one control "master" set), and the pool frequencies ranged from 5 to 69 pools/mile. Some variation resulted from a change in the flow level in the test segment between the time of the first and last survey. Roper and Scarnecchia (1995) reported similar results from a consistency study conducted in the South Umpqua River basin in 1992 and 1993. In their study, 8 observers with training and experience similar to that completed by surveyors on the GP showed a similar pattern of inconsistency both in the total number of habitat units delineated in the reach (range 15-21) and in the percentage of the area defined as pools (range 34%-66%). It was observed that many habitat units classified as pools by some observers were classified by others as glides. Not surprisingly, the individual that measured the lowest pool area identified the highest percentage of the reach as glide habitat. In the GP test reach study, only one observer identified a glide, but the combined percentage of pools and glides that the individual delineated was only 6.5% of the total area surveyed. This same observer delineated only eight habitat units (range for all observers was 8-36, 26 in the control data set). The low number resulted from excessive lumping of the area occupied by small pools into riffle habitat units. No relationship is observable in the test reach data between data quality on the GP test reach between observers with varying levels of experience or training. A control data set was collected by Charlie Cochran and Mike Falér. The least experienced observer in the test came closest to mirroring the control data set. Perhaps surveyors on the Forest have not been sufficiently subjected to quality control, or have not been informed of the results of quality control sessions conducted by regional or forest coordinators. If this has been the case over the six years of implementing this protocol on the GP, then pool frequency data collected over this period may not be acceptable as a basis for evaluation of fish habitat or determining restoration needs. If we wish to continue using pool data for evaluation or planning, all surveyors need to be tested and informed of the results before any data is collected that is to be used in this respect.

Pool frequency does not always appear to be a positive indicator of the health of stream systems based on level II survey data analysis. Pools in degraded systems are often abundant but of very poor quality due to large percentages of pool area and shallow depths. A pool quality index provides a better analysis tool, and has been developed from existing SMART data. Measured pool areas and maximum depths were quarried from the SMART data base. Taking the pool surface area by reach, and dividing it by the average maximum pool depth times the pool area provides a quality index value that can be used to evaluate pool

fitness; where A = pool area of reach, D_{max} = maximum pool depth and P_q = pool quality index:

$$\{[A/(A \times D_{\max})] \times 100\} = P_q.$$

The smaller the value the better the pool quality analogous to width to depth ratios. The surveyed reaches were broken out into Rosgen channel types then the upper confidence limits for the pool quality index were derived. Table III-XX-4-5 shows the upper confidence limits for good pool quality. Reaches of stream that exceed the upper confidence interval were considered to have **poor pool quality**. The reaches of stream that contain poor pool quality are listed below: East Fork Trout Creek 2; Compass 1; Crater 1, 2 & 6; Layout 1, 2 & 3; Oldman 2 & 3; Planting 3 & 4; Paradise 1; Upper Wind 2, 3 & 4; Youngman 1 & 3; Proverbial 2; Dry 1; Cedar 2 & 3; Eight-mile 2; and Mouse 1 (see Table III-4-9).

TABLE III-4-5: Pool quality index by Rosgen Channel type for 76 reaches of stream within the Wind River watershed, Skamania County Washington.

	Pool Quality Indices (P _q) for Rosgen Channels		
	"A" (N=23)	"B" (N=24)	"C" (N=25)
Mean	71	49	57
CI 95%	7	9	12
Expected Maximum	58	58	69
	>58 = "Poor"	>58 = "Poor"	>69 = "Poor"

Stream Width to Depth Ratios: Width to depth measurements are taken to evaluate the health of a stream. As banks sluff into the stream they deliver both coarse and fine particles of soil which increase suspended sediments and bed load. "Bed load" consist of the larger particles that roll or slide across the bottom of the stream bed. Each stream has evolved to transport a certain amount of sediment. If excess sediment enters a stream the channel must compensate or adjust to the new sediment load. Without adequate large living rootwads and large instream woody debris streams that contain banks composed of unconsolidated soil and gravel have little lateral resistance. An increase in sediment load displaces water within the channel placing even more pressure on the banks. This accelerates erosion, increases channel width, and reduces the depth. These actions produce a wide shallow channel which has a large surface area exposed to the sun.

Width to depth ratios <10 = "poor" (measured as mean wetted width divided by mean depth) was found to be a fairly good indicator of channel health. When maximum water temperatures are of concern, wetted width to depth ratios are extremely important. In an attempt to refine this drc for the Wind River, stream reaches were broken out by their Rosgen channel type and wetted width to depth ratio maximum values were calculated.

TABLE III-4-6: Expected minimum wetted width/depth ratios for Rosgen Channels within the Wind River Watershed, Skamania County Washington.

	Wetted Width/Depth Ratios for Rosgen Channels		
	"A" (N=23)	"B" (N=24)	"C" (N=27)
Mean	8.5	6.7	6.8
CI 95%	1.6	1.0	1.5
Expected Maximum	10	8	9
	>10 = "Poor"	>8 = "Poor"	>9 = "Poor"

The bankfull width to depth measurements calculated in SMART were not used in this analysis and probably should not be used for any habitat analysis. Problems with this attribute result from observer's inconsistency. It is becoming obvious that the majority of seasonal stream surveyors are not confident/competent in their ability to identify bankfull flow marks in most channels. Stream surveyors enter a stream at low flow with little or no knowledge of what types of events occurred the previous year and often miss the mark by a foot or two which results in dramatic differences in the ratio. In many cases the measurements are so severely incorrect that the data

is useless, i.e., off by 10 or more feet in narrow, entrenched channels. Average values from the test reach data sets ranged from about 11:1 to 31:1 (mean = 21, control data set value = 31) between four observers. Other sources of variation stems from the limited number of samples and only measuring at "Nth" units. If this much variation occurs, regardless of the cause (natural or observer error), then it doesn't make sense to collect or attempt to analyze this data. I suggest either 1) making the measurement quantifiable and taking the guess work out by measuring wetted bankfull width, or 2) trained fisheries biologist and hydrologist be responsible for taking a day and measuring the bankfull width/depth for each reach, or 3) doing away with bankfull width/depth measurements in the level II protocol. Taking the guess work out of the measurement by measuring average **wetted** width and average depth for the entire channel. Low flow measurements will remain relatively consistent and when considered with the channel type and valley segment stream health and width/depth bankfull ratios would correlate. A new dfc range was established for each channel type. Table III-4-6 provides the average upper confidence limits, and confidence interval for wetted width/depth measurements. The streams that contain poor width to depth ratios are: Upper Wind 1; 2, 3, & 4; Panther Creek 2, 3, & 5; Trapper 2; Eight mile 2; Planting 3; Middle Wind 1 & 2; Cedar 2; Trout Creek 2, 5, & 7; Crater 1 & 5; Paradise 1; Layout Creek 1; and Compass 1 (see Table III-4-9).

Channel Stability: The Pfankuch stability rating has been used in part to evaluate this watershed. This systematic procedure developed by Pfankuch was used to evaluate the resistive capacity of stream channels to the detachment of bed and bank materials provide information about the streams capacity to adjust and recover from changes in flows and increases in sediment production. The variables associated with evaluating channel stability are: land form, mass wasting, LWD, vegetative bank protection, width to depth ratios, bank stability, substrate type, and aquatic vegetation (Pfankuch, 1978). Data on the Wind River has been collected via this methodology since 1981 and has continued to be an important part of the Wind River's stream survey protocol. The Pfankuch stability index is rated numerically for each variable; ≤ 38 = Excellent; 39 - 76 = Good; 77 - 114 = Fair; and ≥ 115 = Poor. Pfankuch ratings for 74 reaches were refined by calculating the upper confidence limits by Rosgen channel type. The stream reaches which show poor channel stability are: Twelve-mile 1; Panther 2, 3, & 5; Upper Wind 1 & 5; Youngman 1 & 2; Middle Wind 3; Cedar 2; proverbial 2; Panther 6; Trout 2, 5, 6, 7; Planting 4; Crater 2 & 4; and Layout 1 (see Table III-4-9).

TABLE III-4-7: Pfankuch stability ratings refined by Rosgen channel type for 76 reaches within the Wind River watershed, Skamania County Washington.

	"A" (N=23)	"B" (N=22)	"C" (N=25)
Mean	76	68	90
CI	9	5	8
Expected	85	73	98
Maximum	>85 = "Poor"	>73 = "Poor"	>98 = "Poor"

Stream Condition Rating: Due to the lack of historic data, we had to base our historic habitat conditions on statistically derived data in order to answer the question "**how do the current conditions differ from conditions presumed to have occurred historically?**" On smaller stream channels, we assumed that the historic conditions of the Wind River watershed mirrored that of what we see statistically in the reaches of stream that have had minimal disturbance. The evaluation criteria used to rate the condition of each reach was: "sensitive" 6th field watersheds, number of pools/mile, pool quality index P_q , "wetted" width to depth ratio, numbers of LWD/mile, Bare wood index, Pfankuch channel stability index, dominant riparian vegetation class, and dominant riparian vegetation species. Table III-4-9 provides the evaluation criteria and relative rating values used for reach evaluation. Table III-4-9 shows the relative condition rating for each reach of surveyed stream.

Stream Structures

In recent years the Wind River Ranger District has implemented structural restoration projects in effort to restore lost fish habitat or mitigate the effects of forest management practices. The District installed for 287 structure or structural complexes throughout much of the watershed between 1980 and 1986 (see Table III-4-8).

An evaluation of structure success indicated that 52 % of the structures were estimated to be fully meeting their intended objectives throughout the entire Wind River basin. The incidence of full success varied among the Wind River sub-basins (ranges: 11-100%, mean 74 %).

Contrary to what might be expected, structures placed high gradient channels faired better than those in low gradient conditions. Rosgen A channels were fully successful 100% of the time (N= 2), compared to 75% full success in B channels (N= 94) and 69% in C channels (N= 191). Rosgen A channels are generally regarded as poor candidates for structural rehabilitation due to their high gradient (>5%) and inherently poor bank stability. Our success could be explained by the fact that we had a very small sample size. Furthermore, this data may be biased because the structures in the A channel (fish passage with baffles) lends itself to being relatively successful.

TABLE III-4-8 Stream Structure Installations. Wind River Ranger District, Carson, Washington.

Date Installed	6TH Fid Watershed	Number Installed
1980	J	1
1981	Q	4
1983	I	8
1984	D	9
1984	N	2
1984	Q	9
1985	C	52
1985	J	8
1985	P	24
1985	Q	9
1986	S	4
1987	I	65
1988	B	19
1988	N	19
1989	C	20
1989	F	2
1989	I	2
1992	I	18
1992	J	8
1993	J	3
1994	I	1

TABLE III-4-9: Condition ratings for 76 reaches within the Wind River Watershed Skamania County, WA

Condition Rating	Stream Name	Reach #	6th Field H20shed	Pools/Mile	A/AxD	W/D Ratio	^Total LWD/mile	Bare Wood Index	Channel Stability	Riparian Veg. "Size"	Riparian Veg. "Species"	Rosgen Channel Type
3	TRAPPER	4	Trapper	7	35.71	5.2	96	Min	51	LT	CC	B
3	RUSH CK 06 94	2	Rush	28.0	26.60	6.79	95	Min	74	MT	CC	A
2	PANTHER CK 09 94	7	Lower Pnt	36.0	27.03	6.03	108	Min	44	MT	CD	A
2	RUSH CK 06 94	1	Rush	29.0	23.18	6.99	122	Min	70	MT	CC	A
1	TRAPPER	3	Trapper	15	49.26	8.7	56	Needy	58	MT	CH	B
1	E FK TROUT GK 09 92	1	Upper Trt	63.0	58.08	7	258	Needy	67	LT	CD	E
1	E FK TROUT CK 09 92	2	Upper Trt	30.0	64.04	4	308	Min	75	LT	CD	C
1	E FK TROUT CK 09 92	3	Upper Trt	70.0	37.00	4	227	Min	77	LT	CD	G
1	CEDAR CK 09 94	1	Cedar	#DIVA!					89			
0	TRAPPER	5	Trapper	4	35.7	4.8	39	Needy	51	MT	CD	B
0	PARADISE CK 09 93	2	Paradise	22.0	34.09	6.03	75	Needy	53	MT	CD	B
0	MOUSE CK 09 94	1	Mouse	110.0	62.34	8.36	78	Needy	70			B
0	UPPER WIND R 09 91	4	Headwater	14.0	142.86	15.4	156	Min	59	LT	CD	A
0	12 MILE CK 09 94	1	Upper Pnt	53.0	41.83	3.39	287	Min	74	MT	HV	B
0	DRY CREEK 09 92	2	Dry Cr	45.0	40.00	7.4	110	Min	81	ST	HA	C
0	CEDAR CK 09 94	3	Cedar	98.0	72.46	8.22	122	Min	79	ST	CD	A
0	TRAPPER	1	Trapper	17	57.07	7.5	53	Very Low	61	LT	HB	C
-1	PANTHER CK 09 94	3	Lower Pnt	21.0	25.42	11.4	28	Needy	91	MT	CC	B
-1	10 MILE 09 94	1	Upper Pnt	112.0	52.04	6.3		Needy	96	LT	CC	C
-1	TRAPPER	2	Trapper	23	57.47	15.5	40	Needy	53	LT	CC	C
-1	LAYOUT CK 09 91	3	Layout	14.0	65.22		87	Needy	62	ST	CD	A
-1	8 MILE CK 09 94	2	8 Mile	83.0	78.95	9.08	101	Needy	52	SP	HV	A
-1	UPPER WIND R 09 91	2	Headwater	22.0	95.24	15	167	Min	69	LT	CH	A
-1	UPPER WIND R 09 91	1	Mid Wind	28.0	55.56	10.6	111	Min	141	LT	CD	C
-1	LAYOUT CK 09 91	2	Layout	45.0	62.52	9.59	99	Min	55	ST	HA	B
-1	SF PLANTING CK 09 92	1	Lower Trt	0.0	45.45	2.82	0	Very Low		SS	HV	A
-2	CRATER CREEK 09 93	2	Crtr/Cmps	13.0	34.36	2.44	123	Minimum		SP	HA	B
-2	PANTHER CK 09 94	1	Lower Pnt	#DIVA!		0	0	Very Low				A
-2	PETES GULCH CK II	2	Pete's	75.0	#DIVA!	0	0	Very Low	85	LT	CD	E
-2	PANTHER CK 09 94	4	Lower Pnt	30.0	22.10	8.42	32	Very Low	90	MT	CC	C
-2	E FK TROUT CK 09 92	4	Upper Trt	0.0	#DIVA!	0	0	Very Low	62			B
-2	DRY CREEK 09 92	3	Dry Cr	50.0	55.56	0.83	0.6	Very Low	76	ST	HA	G
-2	PLANTING CK 09 92	2	Lower Trt	60.0	47.62	4.19	25	Needy	58	ST	HA	A
-2	PLANTING CK 09 92	3	Lower Trt	70.0	90.91	10.3	11	Needy	58	ST	HA	A
-3	CEDAR CK 09 94	2	Cedar	51.0	72.73	9.13		Needy	78	LT	CD	B
-3	8 MILE CK 09 94	1	8 mile	52.0	51.38	4.21	62	Needy	77	SP	HA	E
-3	COMPASS CREEK 09 93	2	Crtr/Cmps	21.0	35.23	4.37	29	Very Low	75	MT	CH	A
-3	COMPASS CREEK 09 93	3	Crtr/Cmps	17.0	30.30	2.33	36	Very Low	70	MT	CD	A
-3	MIDDLE WIND 09 93	2	Mid Wind	26.0	23.08	10.1	4	Very Low	87	LT	CD	D
-4	YOUNGMAN CK 09 93	1	Headwater	37.0	80.00	5.6	71	Needy	91	LT	CD	B
-4	UPPER WIND R 09 91	3	Headwater	25.0	84.51	14.3	73	Needy	66	SP	HA	A
-4	UPPER WIND R 09 91	5	Headwater	12.0	#DIVA!	122		Needy	83	SP	HA	A
-4	TROUT CK 09 95	3	Lower Trt	11.0	#DIVA!	31		Needy	51	SS	HA	B
-4	PROVERBIAL CK 09 95	2	Paradise	44.0	86.96	7.04	11	Needy	103	ST	CD	B
-4	DRY CREEK 09 92	1	Dry Cr	31.0	58.82	9.88	48	Needy	87	ST	HA	C
-5	PANTHER CK 09 94	6	Lower Pnt	34.0	27.62	7.85	77	Needy	77	MT	CD	B
-5	MIDDLE WIND 09 93	4	Upper Wd	38.0	30.30	5.58	2	Needy	134	ST	HA	B
-5	TROUT CK 09 95	2	Lower Trt	29.0	25.32	8.03	42	Needy	75	GF	GF	B
-5	PETES GULCH CK 09 95	1	Pete's	36.0	43.17	3.71	11	Very Low	86	ST	CD	A
-5	TROUT CK 09 95	4	Lower Trt	18.0	22.73	6.77	12	Very Low	48	SS	HA	A
-5	SF PLANTING CK 09 92	2	Lower Trt	0.0	23.26	1.12	62	Very Low		ST	HA	A
-5	PROVERBIAL CK 09 95	1	Paradise	43.0	55.56	7.17	15	Very Low	67	SS	HA	A
-5	CRATER CREEK 09 89	5	Crtr/Cmps	25.0	36.36	9.13	35	Very Low	53	ST	HA	A
-5	CRATER CREEK 09 89	6	Crtr/Cmps	27.0	66.67	3.82	42	Very Low	73	ST	HV	A
-5	PLANTING CK 09 92	1	Lower Trt	47.0	48.54	5.34	71	Very Low	72	SS	HV	A
-6	YOUNGMAN CK 09 93	2	Headwater	50.0	88.61	3.81	54	Needy	85	SP	HV	A
-6	PLANTING CK 09 92	4	Lower Trt	82.0	62.50	4.25	70	Needy	104	ST	HA	B
-6	PARADISE CK 09 93	1	Paradise	20.0	83.33	15.7	63	Needy	82	SP	HA	C
-6	CRATER CREEK 09 89	2	Crtr/Cmps	46.0	95.24	9.07	54	Needy	115	ST	HA	C
-6	CRATER CREEK 09 89	4	Crtr/Cmps	43.0	36.36	4.98	76	Needy	83	SP	HA	B
-6	PETES GULCH CK II	1	Pete's	26.0	50.63	7.34	7	Very Low	83	SS	HA	A
-6	PETES GULCH CK 09 95	2	Pete's	31.0	24.10	5.27	7	Very Low	79	SS	HA	A
-6	PANTHER CK 09 94	5	Lower Pnt	33.0	33.71	10.4	14	Very Low	84	ST	HA	B
-6	OLDMAN CK 09 93	1	Headwater	18.0	49.38	3.06	18	Very Low		SP	HA	B
-6	OLDMAN CK 09 93	3	Headwater	20.0	120.00	4.32	2	Very Low		ST	HA	B
-6	MIDDLE WIND 09 93	3	Upper Wd	34.0	33.33	7.33	8	Very Low	103	SP	HA	C
-6	CRATER CREEK 09 89	3	Crtr/Cmps	32.0	33.33	5.07	14	Very Low	83	SP	HA	C
-7	PANTHER CK 09 94	2	Lower Pnt	18.0	26.32	8.76	42	Needy	97	SP	HA	B
-7	TROUT CK 09 95	7	Lower Trt	28.0	37.27	9.65	0	Needy	74	SP	HA	B
-7	LAYOUT CK 09 91	1	Layout	33.0	67.11	11.1	51	Needy	124	ST	HA	C
-7	CRATER CREEK 09 89	1	Crtr/Cmps	34.0	66.07	13	61	Needy	91	SP	HA	C
-7	CRATER CREEK 09 93	1	Crtr/Cmps	22.0	71.43	9.21	63	Very Low		SP	HA	A
-7	OLDMAN CK 09 93	2	Headwater	22.0	88.89	4.09	2	Very Low		SP	HA	A
-7	TROUT CK 09 95	6	Upper Trt	24.0	33.61	6.25	16	Very Low	113	SS	HA	C
-8	TROUT CK 09 95	5	Upper Trt	22.0	50.00	12.6	9	Very Low	108	SP	HA	C
-8	MIDDLE WIND 09 93	1	Mid Wind	15.0	35.18	12.3	6	Very Low		ST	HA	D
-8	COMPASS CREEK 09 93	1	Crtr/Cmps	38.0	64.52	9.03	19	Very Low	100	SP	HA	C

The Best!

The Worst!

KEY

+1 0 -1

The lowest structure success was recorded in Trout Creek, a drainage characterized by low gradient alluvial valleys with excessive bedload movement and a high peak flow risk (see Figure III-4-1). The fine erosive bank material associated with alluvial channels is likely to contribute to the lower success in C channels. Nawa and Frissell (1992) indicate there is a positive relationship between failure rate and peak flows. They suggest that success may be dependent on elevation and those structures above the of the transitory snow zone may be outside the influence of peak flows. In an evaluation of 59 structures in the Wind River basin, Frissell and Nawa reported a 42 percent success rate.

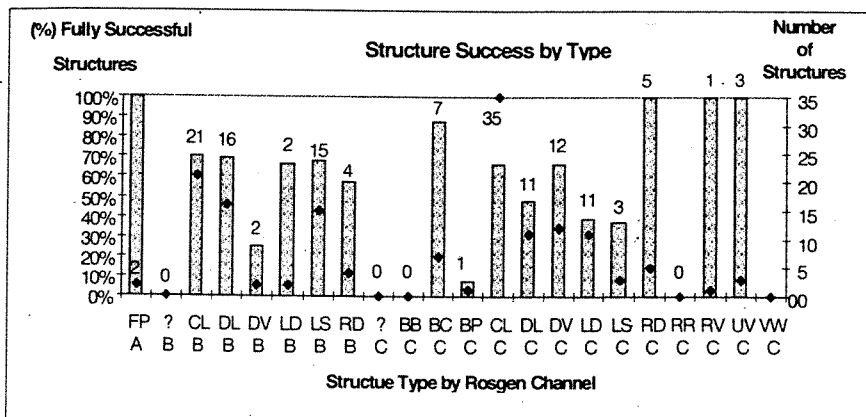


FIGURE III-4-1: Structure Success Compared to Structure Type. Wind River Ranger District Carson Washington. Abbreviations: FP= Fish Pass; BB= Boulder Berm; BC= Boulder Cluster; CL= Cover Log; DL= Digger Log; DV= Downstream 'V'; LD= Log Deflector; LS= Log Sill; RD= Rock Deflector; RR= Riparian Revegetation; UV= Upstream 'V'; ?= undefined type. Rosgen Channel abbreviations (bottom): A=A channel, B= B Channel; C= C Channel.

This analysis aggregated the Wind River basin structures into unique types (modified from USDA Forest Service, Region 6 In Channel Structure Maintenance Survey). The "type" of structure is undoubtedly a contributing factor to the success of the project. Each structure was labeled as fully, partially, or not meeting the intended objective (i.e. scouring pool, pool or providing fish cover).

Full success was recorded with ten different structure types among all channel types (A channel = 1, B channel = 6, C Channels = 10). Full success varied between Rosgen B channels (range 0-100%, mean = 51%) and Rosgen C channels (range 0-100%, mean = 46%). Cover Logs were attempted far more times than any other structure type (N=56) with a relative good performance in both B and C channel types (70% and 66% respectively): In C channels three structure types were fully successful at meeting their defined objective on all occasions including; the upstream 'V' (n=3), bank revetment (N=1) and the rock deflector (N=5). The two fishes passage structures in the A channel were also fully successful. There were three structure types that were less than fully successful on all occasions including; boulder berms, riparian revegetation, and an undescribed structure type.

It is unknown why the multi-boulder berm performed poorly in Trapper Creek. The riparian revegetation structure have been susceptible to browse and excessive lateral bank migration in Trout Creek. Plant survival exams conducted in 1994-1996 indicated that there is a 77% success rate in the Trout Creek basin. However, these "structures" are not expected to have yet reached their intended potential long-term objectives of providing stream shade and bank stability.

Structure length was another characteristic evaluated in the Wind River basin. Length categories were described as; full spanning, partial spanning or above the wetted perimeter (e.g. on lower stream banks).

In Rosgen B channels, partial spanning structures out-performed full spanning structures. However, in C channels the full spanning structures were more likely to be fully successful than the partial spanning structure (see Fig. III-4-2). It was unexpected that C channels would benefit from full spanning structures. This result may be explained by the fact that many successful structures were placed in low discharge, narrow streams with a relatively small, intact drainage. Full spanning structures placed in high volume C channels (i.e. Trout Creek) performed very poorly in all circumstances. All the lower bank structures have been evaluated as being less than fully successful. These structures are all riparian revegetation projects located in Trout Creek. Lower bank instability explains part of the lowered success. However, as described above, these planting have yet to reach their potential.

This analysis classified structures based on their primary intended function (see Fig. III-4-3). Structures were intended to function as cover far more than . Throughout the Wind River basin, structures were designed to satisfy ten different functions. Fully successful structures varied with intended function in Rosgen B channels (range 0-100%, mean = 58%) and Rosgen C channels (range= 0-100% , mean = 55%). In B channels there were nine intended functions compared to eight intended functions in C channels and two functions in A Channels. Fifty-four percent of the Wind River's successful structures were intended to function as cover (N=83). Cover structures were slightly higher incidence of full success in B channels (76%) than in C channels (60%). Channel aggradation was equally successful in both B and C channels. However, gravel recruitment was far more successful in the lower gradient C channels than in the steeper B channels. Similarly, creation of high flow refuge was successful on a limited scale in Falls Creek C channels.

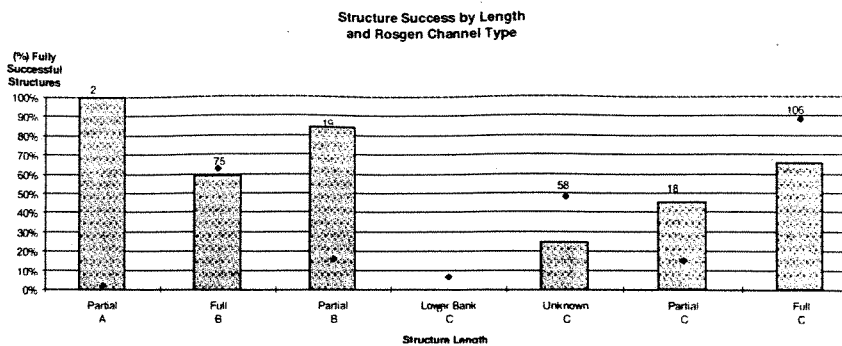


FIGURE III-4-2: Fully Successful Stream Structures compared to structure relative length. Wind River Ranger District, Carson, Washington. Length definition: Full = full channel spanning, Partial = partial channel spanning. Rosgen Channel abbreviations (bottom): A=A channel, B= B Channel; C= C Channel

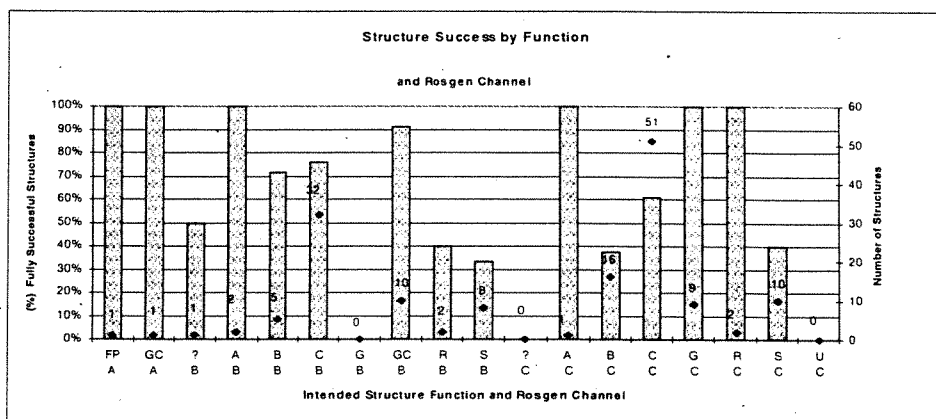


FIGURE III-4-3: Fully successful stream structures compared to stream function. Wind River Ranger District, Carson, Washington. Function abbreviation: FP= fish pass, GC= gradient control, ?= undefined, A= aggrade channel, B= Bank protection, C= Cover, G= Gravel Recruitment, R= High Flow Refuge, S= Scour, U= upland stability. Rosgen Channel abbreviations (bottom): A=A channel, B= B Channel; C= C Channel.

The material used to construct a given structure had a bearing on its success (see Figure III-4-4). Structures composed of single boulders or metal (culvert baffles) were described as fully successful on all occasions (N=4). Single logs were by far the most frequently used materials (N=107). As expected, single log structures were more successful in B channels (61%) than in C channels (58%). Riparian planting with hardwood and conifers had a low incidence of full success. This may be explained by the fact that there is a 10-20 percent natural mortality expected with transplants. It is likely that this was not taken in to account by the surveyors. Another contributing factor may be that the objective for riparian planting is long-term and is not expected to be fully successful for decades (20-100 yr.). Another explanation for poor success in riparian planting may be attributed to fact that all riparian planting riparian planting has been implemented in Trout Creek Flats which has propensity towards devastating lateral bank migration. Lastly, young transplants are very vulnerable to the preponderance of browsing ungulates (i.e. deer and elk) in this area.

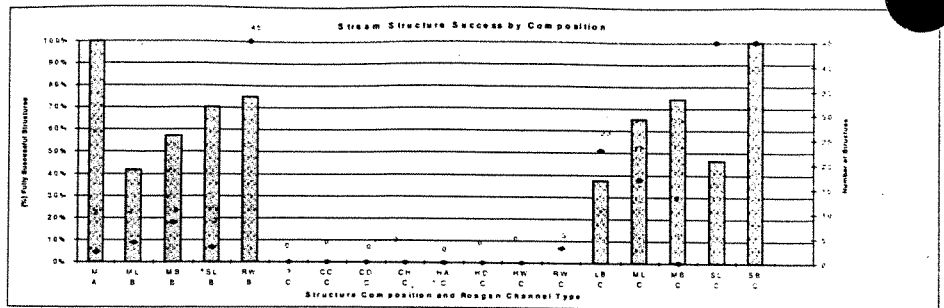


FIGURE III-4-4: Fully successful stream structures compared to structure composition. Wind River Ranger District; Carson, Washington. Composition abbreviations (top): ? = undefined, CC= cottonwood transplants, CD=Douglas fir transplants, CH= hemlock transplants, HA= Red Alder transplants, HD= dogwood transplants, RW= Root wad, LB= log/boulder complex, ML= multi logs, SL= single logs, MB= multi boulders, M= metal, SB= single boulder. Rosgen Channel abbreviations (bottom): A=A channel, B= B Channel; C= C Channel

Hydrology Assessment for the Wind River Watershed Analysis

5. WATER QUALITY

Waters Within the Wind River Watershed

Streams within the National Forest are classed by the Northwest Forest Plan (NFP) as either “perennial fish-bearing”, “perennial non fish-bearing”, or “intermittent.” Perennial streams are those that flow water year-round. Intermittent streams are those that only have flow during some part of the year. Some intermittent streams flow only during rainfall or high flow conditions, and others may flow for most of the year, but run dry for a short period of time in the late summer. Table III-5-1 lists the miles of stream in the watershed, and the acres of lakes, ponds and wetlands. For purposes of this analysis, stream classes provided in the NFP were applied to all streams in the watershed to the extent that classes could be determined from local knowledge of the non-Federal portion of the watershed.

TABLE III-5-1: Miles of stream in the watershed

Aquatic Resources	Miles/Acres
Perennial Fish-Bearing Streams	181 mi.
Perennial Non Fish-Bearing Streams	55 mi.
Intermittent Streams	901 mi.
Lakes/Ponds	293 ac.
Wet Meadows	1645 ac.

Beneficial Uses and Key Water Quality Parameters

All streams and lakes within the Wind River watershed are rated by the Washington State Department of Ecology (WSDOE) as either Class AA (extraordinary), Class A (excellent), or Lake Class. Stream segments on National Forest lands are rated as Class AA, as are all streams that feed lakes within the watershed. Specific water quality criteria have been established by WSDOE for each of these classes in conformance with the present and potential uses of the water. The purpose for these criteria and the state water quality standards is to ensure that water quality is maintained at levels that continue to support beneficial uses of those waters. The Wind River watershed has a number of important beneficial uses that drive the need for water quality protection. Table III-5-2 identifies the beneficial uses that occur in the watershed, the subwatersheds they are located in, and the primary water quality parameters of concern. The table is not inclusive of all water quality parameters that may affect the identified beneficial use, but identifies the key or dominant parameters of concern.

TABLE III-5-2: Beneficial uses that occur in the watershed, the subwatersheds they are located in, and the primary water quality parameters of concern

Beneficial Use	Subwatershed	Primary Parameters of Concern
Carson Municipal Watershed	T,X,O	Turbidity, Fecal Coliform
Domestic Water Supply	D,J,N,O,Q,S,U,Z	Turbidity, Fecal Coliform
Carson Fish Hatchery	J	Temperature, Turbidity
Anadromous Fish	Known: A-O,M-V,X,Y Suspected: W,Z	Temperature, Turbidity
Resident Fish	A-Z	Temperature, Turbidity
High Use Recreation	A,J,N,Q,U,V	Fecal Coliform, Turbidity

The Carson Municipal Watershed is comprised of the North and East Fork of Bear Creek, and the upper end of the Lower Bear Creek subwatersheds (Map 14). The entire watershed above the intake is on National Forest land. Activities in this area that could pose a threat to the primary water quality parameters of concern include timber harvest, road and landing construction, and recreational uses of the watershed. The numerous domestic water sources in the Wind River watershed (Map 14) would be sensitive to the same types of disturbance.

The Carson Fish Hatchery is located on the Wind River at the mouth of Tyee Springs Creek (Map 14). Water quality concerns at the hatchery are primarily focused on water coming from Tyee Springs, since that is the water used at the hatchery. The springs are located approximately one half mile above the hatchery, and supply nearly all of the water contained in the stream used by the hatchery. As such, potential threats to the primary water quality concerns for the hatchery are focused on activities that would occur at or near the springs that would increase inputs of sediment, heat, or other contaminants.

Anadromous fish including chinook salmon and steelhead are widespread through the watershed (Map 14). Much of the fishery now present throughout much of the watershed is comprised of hatchery fish or their offspring. However, there are still native fish using the watershed, most notably the native steelhead run in that occurs in the Trout Creek subwatersheds. This stock has been targeted for special protection and restoration because of the declining numbers of returning fish, and the poor habitat conditions in these subwatersheds. In addition to the anadromous fish, there are many more miles of fish-bearing streams that support resident populations of rainbow, cutthroat, and brook trout. Potential threats to the primary water quality parameters of concern are those activities that would increase water temperatures or sediment inputs. On National Forest lands, those activities are largely focused on timber harvest and road or landing construction. Continued sediment input from areas of excessive streambank cutting, existing road systems, recreation areas and other developed sites is also a concern.

Areas identified here as high recreational use include those areas heavily used by the public for swimming or playing in the water. These "high use areas" are commonly associated with developed recreation sites on the Forest, but include other ("dispersed") sites as well, both on and off the National Forest. These sites can be considered both "source" and "response" sites. Most importantly, they are sensitive to changes in fecal coliform, and the concerns associated with presence of coliform. However, they are also likely to be one of the largest source areas for coliform introduction because of the high levels of human use. They are also sensitive to changes in water clarity (turbidity), but at the same time can be sources of increased turbidity due to disturbance of the streambanks and bed.

Water Quality Data Sources

Over time, a great deal of water quality data has been collected at different locations, at different times, and by different agencies in the Wind River watershed. Much of this data is now available through the EPA Storet database. For purposes of this analysis, much of the data found in Storet has limited utility. A majority of the data in the database was gathered for purposes of monitoring a particular project. The data is thus very limited in scope and duration, often consisting of a single measurement at a single location. There is little or no information as to the conditions under which the sampling occurred, so it is unknown whether the data represents background conditions, or conditions that are resultant from a management activity. Further limiting the usefulness of some of the data in terms of comparing presently collected data with historic, is the changes that have occurred in units of measure or analysis techniques over time. Changes in analysis methodology often don't allow for direct comparison of results.

Over the past decade or more, some of the most consistent water quality monitoring in the watershed has been done at the Forest Service baseline water quality monitoring stations. The four baseline stations in the watershed include: Wind River near the Carson Fish Hatchery, Trout Creek just above Hemlock, Trapper Creek upstream of the summer homes, and Bear Creek near the municipal watershed water diversion. Parameters measured include: discharge, water temperature, turbidity, conductivity and pH. Discharge is generally measured three times per season at these stations, and grab samples for turbidity, conductivity and pH are taken at the same times (generally during the June-September period). Water temperatures are monitored continuously over the summer months using continuous recording data loggers. Table III-5-3 summarizes results of this monitoring over the 1985-1995 period.

TABLE III-5-3: Results of this monitoring over the 1985-1995 period.

BASELINE	WATER TEMP. (C)			TURBIDITY (NTU)			CONDUCT			pH			FLOW (CFS)
	Av	Mx	Mn	Av	Mx	Mn	Av	Mx	Mn	Av	Mx	Mn	Mn
Wind	na	23	na	3.2	68	0.2	58	112	34	7.1	8.2	5.6	4
Trout	na	25	na	1.1	3.1	0.3	31	35	25	6.9	7.8	5.3	3
Trapper	na	18	na	1.0	2.8	0.3	73	98	42	7.1	7.8	6.0	2
Bear	na	18	na	1.1	4.1	0.2	72	90	55	7.1	7.9	5.8	<1

The data show a relatively wide range of conditions over the time periods monitored. Much of this is due to seasonal or year-to-year variability in climatic conditions and streamflow, but some may also be due to instrument or measurement error. To date there has been little quality control for water quality monitoring done on the Forest. The District is making an effort to correct this so that in the future, a higher level of confidence can be given to the data collected. Confidence in the data presented here is highest for the water temperature and discharge measurements. Water temperature probes are generally calibrated yearly, and recorded values are easily confirmed by use of a handheld thermometer. Discharge measurements have been taken with flow meters that have been sent in on a semi-regular basis for calibration. However, turbidity, pH, and conductivity all rely on instrument measurements which are difficult to verify by other means, and require use of fresh standards for calibration. Of particular concern in this light are some of the pH measurements which appear low based on more recent monitoring in the watershed.

Conditions and Processes

Water Temperature

Current Conditions

Results of water temperature monitoring at baseline monitoring stations and at other inventory stations on the National Forest indicate that water temperatures on a number of streams have exceeded the state water quality standard. Temperature exceedances on Trout Creek over the past several years have resulted in that stream being listed on the 1994 303(d) list compiled by the Washington State Department of Ecology. All streams known to have been monitored for annual maximum water temperature are on the National Forest, and as such are required to meet the standard for class AA streams, which is 16 degrees Celsius (C). Table III-5-4 presents the maximum recorded water temperature at all stations where monitoring has been conducted to assess maximum water temperature.

TABLE III-5-4: Maximum recorded water temperature at all stations where monitoring has been conducted.

Stream	Location	Years Monitored	Max. Temp (C)	Year of Max. <i>years with</i>
Wind*	Above Carson Fish Hatchery	1977-present	23	1980
Trout*	Above Hemlock Reservoir	1977-present	25	1990, 1992
Trapper*	Above summer homes	1977-present	18	1981, 1986
Bear*	At Carson Water Diversion	1977-present	18	1983, 1986, 1987
Wind	Above Paradise Campground	1993 only	16	1993
Paradise	Above Paradise Campground	1993 only	14	1993
U. Trout	At 43 Rd. bridge	1993 only	18	1993
Compass	At 33 Rd xing	1993 only	14	1993
Crater	At 33 Rd xing	1993 only	19	1993
Layout	Above confluence w/Trout	1993 only	17	1993

State 16°

*Baseline Water Quality Monitoring Station

Water temperatures at the Trout Creek baseline station are the highest temperatures measured in the watershed, and frequently exceed the state water quality standard during summer months. Numerous water temperature standard exceedances have also been recorded at the Wind River, and during some years, maximum temperatures on the Wind exceed those on Trout Creek. Monitoring stations on Bear Creek and Trapper Creek have exceeded state water quality standards for temperature as well, but never reach the temperature levels found in Trout Creek and the Wind River. Four of the six inventory stations reported here are in the Trout Creek subwatershed, and contribute flow to Trout Creek above the baseline station, thus influencing the temperatures experienced there. These stations include Upper Trout, Compass, Crater, and Layout. Three of these four stations exceeded the state standard during this one year of monitoring, indicating that the temperature problem in Trout Creek is not confined to the lower mainstem where the baseline station is located, but includes the upper watershed and its major tributaries as well.

Possibly of greater consequence than maximum water temperature from a beneficial use standpoint, is the duration and frequency of the high temperature. Figure III-5-1 shows the number of days the water temperature standard was exceeded at the four baseline water quality monitoring stations from 1977

through 1994. In some cases, the standard may have only been exceeded for an hour of the day, but in other cases, water temperatures exceeded the standard for several hours, day after day. The longer the period of elevated temperature, and the greater the frequency of these excursions, the greater the likelihood of impacts to fish and other aquatic organisms in the stream.

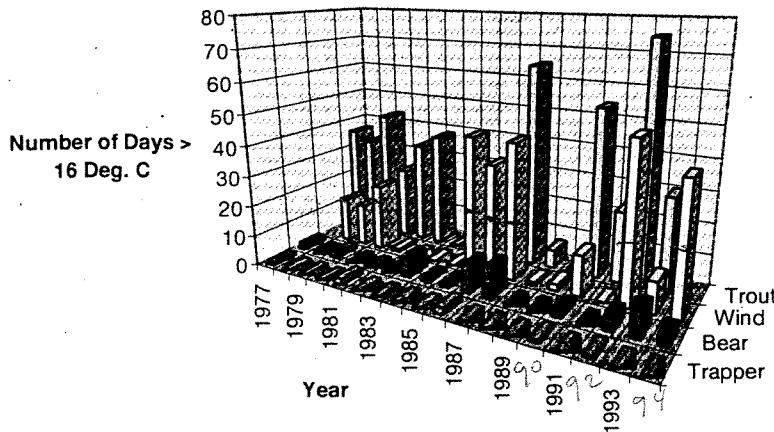


FIGURE III-5-1: Number of days water temperature exceeds 16 degrees Celsius.

Figure III-5-1 illustrates the magnitude of the temperature problem in Trout Creek and the Wind River, but also shows the relatively few exceedances occurring in Trapper and Bear Creeks over the time periods monitored. Differences seen between streams in terms of both maximum water temperature (Figure III-5-4) and in days of water quality standard exceedance may be caused by a number of factors. Ambient air temperature and discharge are two factors that can vary substantially from year to year, and are important factors influencing water temperature. The dominant onsite factor effecting change on stream water temperatures however, and the most important difference between the four baseline stations, is the amount of heating that occurs through solar radiation. This is a function of both the amount of direct access the sun has to the stream, but also the exposed surface area-to-volume ratio of the stream (i.e. its width/depth ratio). As width/depth ratio increases, the relative proportion of the stream water directly exposed to the sun is increased.

Although the baseline station on Trout Creek is located in the Lower Trout subwatershed, much of the heating that occurs in this stream occurs in the upper reaches of Trout Creek, and in its major tributaries including Compass, Crater, and Layout Creeks. These streams generally have high width/depth ratios (see Stream Channels section of this report) which allows a large surface area of potential exposure to solar radiation. In addition, much of the upper Trout Creek watershed (including the Upper Trout, Compass/Crater, and Layout subwatersheds) has had extensive timber harvest in the past, which often included removal of riparian forest cover. This has allowed some of these channels to further widen, and has increased their exposure to direct solar input, allowing the excessive stream heating. Conditions are similar though not as severe along the mainstem of the upper Wind River, contributing to the water temperature problem at that baseline station. The Trapper and Bear Creek systems are dominated by B channels, which have lower width-to-depth ratios, and because of this are less sensitive to heating from direct solar radiation. In addition, harvest occurring along these channel types is less likely to cause channel widening.

Figure III-5-2 shows the percent of the riparian area in each subwatershed that is in early seral vegetation. This data helps to illustrate the cause of the differences in maximum stream temperature and the duration of the high temperatures. The figure shows extremely high levels of early seral conditions in the riparian areas of Compass/Crater and Layout subwatersheds (45% and 49% respectively). These two subwatersheds stand out far and above any others in the watershed, and suggest the cause for the high water temperatures measured downstream at the Trout Creek baseline station. Riparian areas in the Upper and Lower Trout subwatersheds are also high in early seral vegetation (i.e. greater than or equal to 30%). Noteworthy is the low percentage of early seral conditions in the riparian areas of Trapper Creek (0%), and the North and East Forks of Bear Creek (2% and 1% respectively). Both the Bear Creek and Trapper Creek baseline stations consistently have lower maximum water temperatures than either the Trout Creek or the Wind River stations. Water temperatures at the Wind River station are largely affected by flows from the Headwaters and Upper Wind (11% and 24% in early seral), Dry Creek (26% in early seral), Upper and Lower Falls Creek (21% and 23%), and Ninemile Creek (22%).

EARLY SUCCESSIONAL VEGETATION IN THE CLASS 1, 2, & 3 STREAMS OF THE TRUE RIPARIAN ZONE

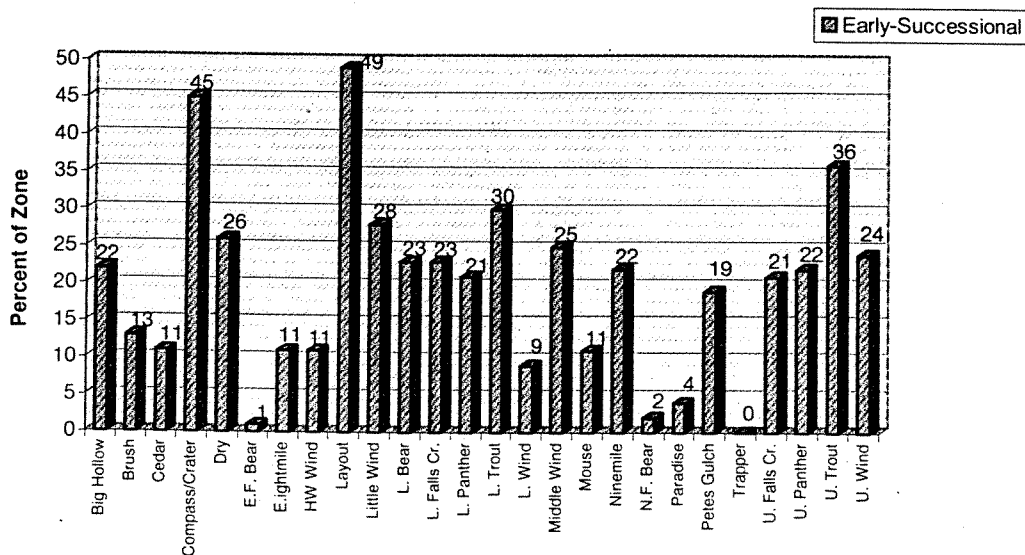


FIGURE III-5-2: Percent of the Riparian Reserve in Early Seral Vegetation on all Perennial Streams.

Historic Conditions

Historically, maximum water temperatures in streams in the watershed varied from year-to-year based on differences in air temperature and streamflow levels during the summer months. Overlaying that annual variability, were longer term shifts in temperature due to changes in canopy density over the streams. When the canopy was opened up, summer temperatures would be increased and winter temperatures decreased because of the direct exposure of the stream surface to the sun and open sky. The primary factors affecting riparian canopy cover in this watershed were fire and debris torrents or floods that removed riparian vegetation. The Regional Ecologic Assessment Project (REAP) conducted in 1993, determined that in the analysis area that included the Wind River watershed, riparian areas historically had anywhere from 5 to 30% early seral vegetation at any given time. This was described as the “range of natural conditions” (RNC) for this area. REAP further described the “range of natural” conditions for maximum water temperatures in the area to be from 7 to 20 degrees C.

Based on the current maximum temperatures recorded in Trapper Creek and Bear Creek, it is likely that these streams have historically been at the upper end of the RNC for temperature described in REAP. Because of the degree of disturbance that has occurred in both the upper Trout Creek and Wind River watersheds, it is difficult to predict what past temperatures were in those streams, though clearly they were lower than current maximums.

Interpretation

Few streams have been monitored for maximum water temperatures in the watershed, but in every stream where monitoring has occurred, water quality standards for temperature have been exceeded in the past 10 to 20 years. Over the past decade, the region has experienced drought conditions that have caused summer streamflows to be lower than normal. This has contributed to the high maximum water temperatures across the watershed, but does not explain the differences in maximum temperature between streams where monitoring has been done. These differences are likely more attributable to differences in channel type, condition, and riparian canopy cover.

Monitoring stations with a high percentage of their contributing stream area in C channel types and with a high percent of the riparian area in early seral vegetation (Upper Trout Creek subwatersheds and the Middle and Upper Wind) had the highest recorded temperatures. These streams also maintained the high temperatures for longer periods of time during the summer months. The two stream systems dominated by B channels and where much less of the riparian area has been harvested (Trapper and Bear), have consistently had lower maximum temperatures, and fewer days of high temperature. Based on the limited data available, other streams in the watershed that may be of greatest concern from a water temperature standpoint include: Dry Creek (38% of its length in C channel and 26% of the riparian area in early seral vegetation); Lower Panther (33% in C channel and 21% in early seral); and Lower Falls (29% in C channel and 23% in early seral). All three of these streams are used by both anadromous and resident fish.

Information provided in this assessment also helps in describing historic or natural ranges of temperature in the watershed. Trapper Creek, which is essentially in its "natural" condition above the monitoring station, has exceeded the state standard in four years of the past 19 years of monitoring. The relatively high temperatures in Trapper Creek may be a result of heat inputs from subsurface water sources, or may be a reflection of the relatively open canopy conditions along a riparian area that is largely in a late seral condition. In either case, Trapper Creek provides an indication that even under natural conditions, some streams in the watershed may have temperatures that tend toward the higher end of the RNC described in REAP. Maximum temperatures at Bear Creek provide further evidence that streams in the watershed may range toward the upper end of the RNC with little or no human-caused disturbance. Water temperatures at the Bear Creek station have reached a maximum of 18 degrees C, and have exceeded the state standard in 12 of the past 18 years of monitoring there. This stream has a combined average of less than 2% of its riparian area in early seral vegetation above the monitoring station.

Implications of the high temperatures to fisheries in the watershed are dependent on the degree and duration of high temperature. Stream reaches with high temperatures that are due to increased solar inputs may be areas of high primary productivity, which would provide increased food for the fish. However, when temperatures reach very high levels as they have at some monitoring stations, dissolved oxygen levels in the stream may be so depressed that fish cannot survive or become weakened and subject to disease. This is particularly true when the high temperatures are sustained over extended time periods or over a large portion of the watershed accessed by the fish. Although actual monitoring of fish response is difficult, it is felt that temperatures in the Trout Creek watershed and possibly in parts of the Wind River may be at levels that are lethal or near lethal to the anadromous fish using these streams. Response of the fishery may be more in terms of decreased strength and viability of individual fish, or avoidance of these high temperature systems by the fish. Monitoring of returning adult steelhead in the Trout Creek watershed over the past 12 years has found a dramatic decrease in numbers of steelhead spawning in the watershed (see fisheries section of this report). It is unknown how much of the drop in the run is due to

habitat conditions in the watershed, but it is clear that the water temperatures in Trout Creek and possibly in the Wind River are reaching lethal or near lethal levels for these fish, and may be in part responsible for the declining run.

Turbidity

Current Conditions

Limited turbidity monitoring has been done in the watershed on a consistent basis. Monitoring at the baseline stations has been the most regular form of water quality monitoring, but has focused on low flow periods. Turbidities measured during these months provide a reasonable estimate of background conditions during low flows, but do not address the changes in turbidity that occur with increased flow. It is presumed that turbidity is also collected in the Bear Creek watershed or at the Carson water treatment plant to monitor incoming turbidity levels, but this data was not available for this analysis.

State water quality standards for turbidity allow for an incremental increase (i.e. 5 NTU's at turbidity levels <50, or 10% at turbidities >50) above background turbidity levels. It is thus critical to know background levels of turbidity to be able to assess compliance with the state standard. Turbidity is closely linked with stream discharge, because at higher discharge, more sediment can be made available through streambank cutting, or from upslope erosional processes occurring during the storm. Moreover, during these conditions the stream has greater power to both entrain and maintain sediment in suspension. Because of this relationship between turbidity and streamflow, a determination of background turbidity levels must include paired measurements of turbidity and flow at a range of flow conditions. This has not yet been done for streams in the watershed. Nevertheless, turbidity data from the baseline stations is presented in Table III-5-5 as an indication of current levels of turbidity at those stations during low flow conditions.

TABLE III-5-5: Current levels of turbidity

Station	Years Monitored	Avg. Turbidity (NTU)	Max. Turbidity (NTU)	Min. Turbidity (NTU)
Wind	1985-1995	0.9	2.8	0.2
Trout	1985-1993	1.1	3.1	0.3
Trapper	1985-1995	1.0	2.8	0.3
Bear	1985-1994	1.1	4.1	0.2

To begin characterizing turbidities more broadly across the watershed, turbidity monitoring was initiated during the fall of 1995 on each of the major tributaries to the Wind River. Grab samples were collected at three streamflow stages to assess spatial differences in turbidity, and response characteristics of each of the tributaries to precipitation and increased flow. Samples were collected as close to the mouth of each tributary as possible given access and time limitations. Table III-5-3 displays the range of turbidities measured at each station, with a qualitative indication of streamflow at the time of monitoring. Actual streamflows were not measured at the time of sampling, but can be indexed from continuous flow measurements being recorded at USGS gauging stations near the mouth of the Wind River and in Trout Creek.

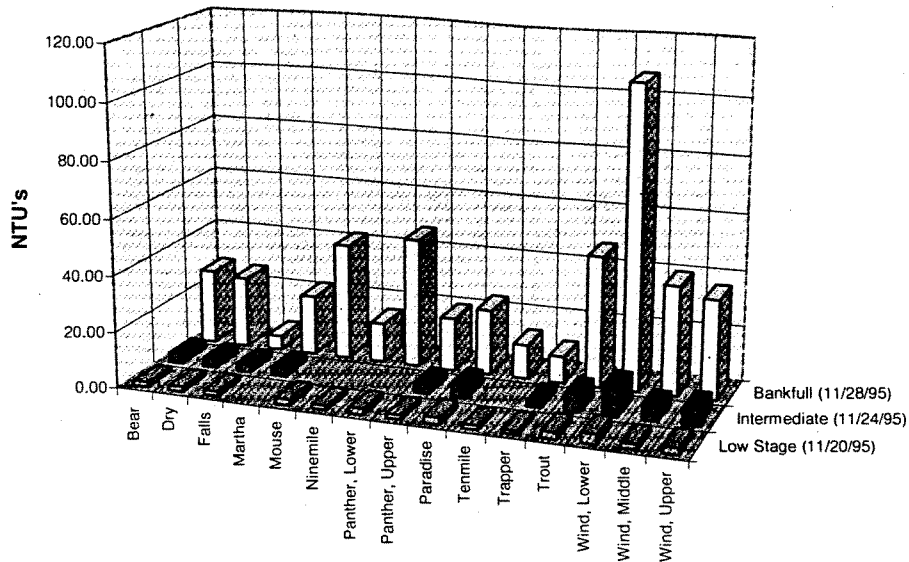


FIGURE III-5-3: Turbidities in the Wind River Watershed Over a Range of Flow Conditions

Although extremely limited, this data set does suggest some spatial patterns in turbidity levels in the watershed. At all flow stages, turbidity was greatest at the Lower Wind monitoring station. During bankfull flow, turbidity at this station (107 NTU's) was more than double that measured at any other station. The middle and upper mainstem of the Wind River were relatively high as well during bankfull conditions, at 39 and 35 NTU's respectively. Other streams with relatively high turbidities during the bankfull event include Trout Creek (47 NTU's), Lower Panther (46 NTU's), and Mouse Creek (42 NTU's). Stations where turbidity remained low during the bankfull flow include Falls Creek (5 NTU's), Trapper Creek (9 NTU's), and Tennile Creek (12 NTU's).

In general, streams with the highest turbidities at low stage also had the highest turbidity levels during the bankfull flow. These same streams showed the largest percent increases as well. Relative changes in turbidity from low flow to high flow range from just a 3-fold increase at the Falls Creek station to a 30-fold increase on the Lower Wind River. This provides an indication of the relative sensitivity of these streams to precipitation and increased streamflow.

Because turbidity is by nature highly variable over time and space, these results may be more a reflection of very specific events occurring just upstream of the sample location at the time of the sampling, than showing a pattern or trend in turbidity levels. Future data collection at these sample points should help to strengthen or discount the apparent patterns shown here. Nevertheless, the data are presented to begin characterizing conditions and to help understand spatial and temporal patterns of turbidity at the watershed scale.

Potential sources of turbidity include sediment introduction from harvest units, roads, and other developed areas, but also include sediment production occurring through streambank cutting and bank or slope failures. Upslope mass wasting potential is relatively low in the Wind River basin compared with other watersheds on the Forest (see Mass Wasting section of this report), so this is likely a relatively small part of the source for turbidity over the long term. However, as evidenced by the recent slide that occurred at Stabler during the February 1996 flood, over shorter time periods, input of sediment from mass wasting can be a very large contributor to instream turbidity levels. This event introduced large volumes of

sediment directly into the mainstem of the Wind River, and has continued to supply fine sediment during subsequent rainfall events due to surface erosion from the bare soils.

More chronic, though lower intensity inputs of sediment in the watershed, are a result of sediment contributions from roads, harvest units, other areas where surface vegetation and soils have been disturbed, and from streambank cutting. Sediment production from roads is characterized by subwatershed in this report (see Surface Erosion section of this report). Generally, sediment production from roads was found to be highest in the Headwaters Wind, Lower Falls, and Compass/Crater subwatersheds. Production was also high in the Upper Panther, Middle Wind, and Upper Wind subwatersheds. Locations where roads cross streams are one of the primary avenues for sediment from the road prism to be delivered to a stream system. Figure III-5-4 shows the density of road crossings (number of road crossings per square mile of watershed area) by subwatershed.

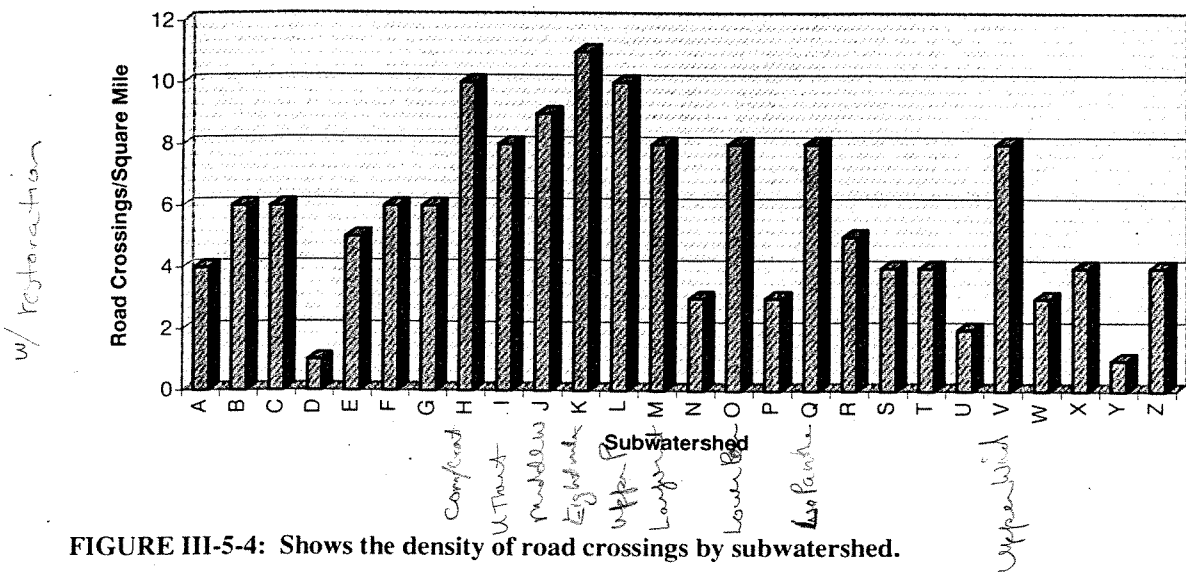


FIGURE III-5-4: Shows the density of road crossings by subwatershed.

Highest road crossing densities in the watershed occur in the Eightmile, Compass/Crater, and Upper Panther subwatersheds. Other subwatersheds with high crossing densities (i.e. greater than or equal to 8 crossings per square mile) include Upper Trout, Layout, Middle Wind, Lower Bear, Lower Panther, and Upper Wind. Many of these correspond with stations where turbidity was high during the 1995 monitoring project. In particular, Eightmile, Upper Panther and Lower Panther, all with high road crossing densities flow past the Lower Panther turbidity station, which had one of the highest turbidities during bankfull flow conditions. Similarly, Compass/Crater, Layout and Upper Trout all drain past the Trout Creek turbidity station which also had one of the highest turbidities during bankfull flow. All of the subwatersheds monitored drain through the Lower Wind, where turbidities were by far the highest. Although the Lower Wind has a very low density of road crossings according to Figure III-5-4, it may be due to the fact that much of this subwatershed is on non-Federal land, and the data for that area is less complete than that available for the National Forest land.

Sediment from stream channels can be another important component in the total sediment load carried by a stream, and the potential for this is largely a function of the stream channel type and its condition. Much of the upper and middle Wind River as well as many stream segments in the Trout Creek subwatershed have been classified as Rosgen C type channels (see Stream Channels section of this report). These channel types have an increased potential for delivering sediment, particularly when they have been de-stabilized by riparian timber harvest and large woody debris removal. Figure III-5-2 presented earlier

in this section indicates areas where riparian vegetation is in an early seral condition. Watersheds with Rosgen C type channels and a high degree of early seral riparian vegetation are particularly subject to sediment introduction from streambanks. These streams include all of the major tributaries to Upper Trout Creek, the Middle and Upper Wind, Dry Creek, Lower Panther, and Lower Falls. ✓

Areas of the watershed where natural vegetation has been removed or where there is continuous disturbance of the ground cover and soils comprise another important, but difficult to assess source of sediment to the drainage network. Harvest units are an obvious source, but due to rapid revegetation of these areas in addition to the streamside buffers and other mitigation applied to units on the National Forest, sediment from these areas (not including the roads used to access the units) tends to be relatively short term. Longer term, chronic, or repeated inputs of sediment occur from areas where vegetative cover has been removed and not allowed to recover. These sources in the Wind River watershed include orchards, areas used for livestock or agriculture, commercial and residential developments, the Wind River Nursery, and areas of heavy recreational use. Locations?

The extent of inputs from these sources on non-Federal land is unknown, but is likely to be higher in lower portions of the watershed since that area is more heavily populated. On Forest land, the high use recreational areas are located on MAP 14. These areas are most commonly located near either streams or lakes, and tend to be source areas for sediment inputs. Although these sources are relatively discreet locations of sediment supply, the sites are spread out around the watershed. The Wind River Nursery is probably the largest single source of sediment on the National Forest. This is primarily because of the size of the area, the frequency of disturbance of the topsoil, and the sparse vegetative cover over most of the fields. This area includes approximately 180 acres of fields in the Lower Trout Creek subwatershed. Nursery management practices have been adjusted over time to minimize sediment input to the Trout Creek system, but fields that are bare or sparsely vegetated continue to be a source of sediment, particularly in winter months and during heavy rains. Some of the nursery fields drain to Trout Creek above Hemlock Lake, and in those cases, coarser sediments are deposited in the lake. Fields that drain to Trout Creek below the dam, along with the finer materials delivered above the dam are routed through Trout Creek into the Wind River. main stem

Historic Conditions

Historic turbidities were linked closely to large scale disturbances including fire, mass wasting and flooding. Inputs from surface soil erosion were negligible under fully forested conditions, but would have increased for a short period following fire, particularly in the case of high intensity burns that scorched soils. Although the watershed is considered relatively stable in terms of mass wasting, following large scale or intense fires the potential for mass wasting would have increased for a period of time. Additionally, even though the watershed as a whole is considered relatively stable, there are areas of localized instability (e.g., hillslope above the Stabler area) which would have failed at some interval, providing episodic spikes in turbidity. The most frequent cause for changes in turbidity under historic conditions was likely the occurrence of high streamflow events that caused streambank cutting or scour. The C channels in the watershed, such as those in the lower gradient reaches of Trout Creek and its tributaries, and along the middle and upper Wind River would be most responsive to increased flow levels because of the types of channels found there.

Interpretation

This assessment focuses on two measures to characterize turbidity in the watershed. Actual turbidity measurements, though limited temporally and spatially, are used to indicate *response* characteristics of the subwatersheds where measurements were made. Other indices are used to characterize potential *source* areas of sediment. These focus on sediment from road systems, from streambanks, and from other developed areas.

Related to turbidity *response*, the lower Wind River station stands out far above all other stations in terms of both turbidity levels during high flow, and the relative change in turbidity from low to high flow (Table III-5-6). This station is located at the bottom of the watershed, so water quality here is affected by conditions and processes occurring throughout the upper watershed in addition to those factors operating within the Lower Wind subwatershed. Turbidity levels measured at this station reflect sediment inputs from along the lower Wind River as well as those introduced upstream that have been carried down to this reach. In addition, because stream gradients throughout much of this reach are relatively high, sediment delivered to the upstream portion of this reach will generally be transported to the lower end where stream gradient drops. For practical purposes, any fine sediment delivered from the Lower Trout, Middle Wind, Lower Panther, Lower Bear, or Brush Creek subwatersheds to the mainstem of the Wind River is routed to the lowermost reaches of the Wind or into the Columbia River because of the high stream gradients through most of this subwatershed. Other subwatersheds showing a relatively high response in terms of turbidity include the Upper Wind, Lower Trout, Lower Panther, and Mouse Creek.

TABLE III-5-6: Summary of Parameters used in turbidity assessment.

Code	Subwatershed Name	Turbidity Factor of Increase (Low/High Flow)	Road Crossing Density	% Stream Length in Rosgen C Channel	% Early Seral in Riparian	% Land Area Converted to Non-forest
A	Paradise	9	4	22	4	<1
B	Hdwrs Wind	15	6	0	11	0
C	Lower Falls	3	6	29	23	0
D	Trapper	7	1	18	0	1
E	Big Hollow		5	4	22	0
F	Dry	15	6	38	26	0
G	Ninemile	8	6	0	22	0
H	Compass/Crater		10	33	45	0
I	Upper Trout		8	30	36	0
J	Middle Wind		9	43	25	1
K	Eightmile		11	8	11	0
L	Upper Panther	12	10	0	22	0
M	Layout		8	38	49	0
N	Lower Trout	19	3	10	30	4
O	Lower Bear		8	20	23	<1
P	Upper Falls		3	16	21	0
Q	Lower Panther	21	8	33	21	3
R	Mouse	19	5	0	11	0
S	Cedar		4	0	11	<1
T	N.F. Bear		4	0	2	0
U	Lower Wind	30	2	0	9	17
V	Upper Wind	21	8	?	24	<1
W	Pete's Gulch		3	0	19	0
X	E.F. Bear	15	4	8	1	0
Y	Brush		1	20	13	3
Z	Little Wind		4	0	28	6

In terms of *source* areas for sediment, the lower Wind River subwatershed appears to have a relatively low potential for contributing sediment based on the road crossing density, channel type, and riparian seral class. However, this subwatershed has by far the largest proportion of its area in a developed condition, the greatest density of human use, and the largest percentage of land converted from forestland to some other use. In addition, because most of this subwatershed is on non-Federal land, it is likely that some of the data available for this subwatershed through the Gifford Pinchot Geographic Information System (i.e. road crossing densities etc.) is at a lower level of resolution, and may be less accurate than that available for National Forest lands.

Subwatersheds with the highest potential for sediment delivery based on the criteria used in this assessment include all of the subwatersheds contributing to Lower Trout Creek, including Layout, Compass/Crater, and Upper Trout, which have high road crossing densities, a high percentage of their contributing channel length in C channels, and much of the riparian area in an early seral condition. The Lower Trout subwatershed also has sediment contributions from the Wind River Nursery and Wind River Ranger District compound, located near the lower end of this subwatershed. Other subwatersheds of concern from a sediment source standpoint include the Middle Wind, Lower Panther and Lower Bear.

Data from the turbidity monitoring tend to corroborate that these areas are sediment sources as well. Actual turbidity levels measured in Trout were highest in the watershed next to those measured on the lower Wind. As noted above, the subwatersheds contributing flow to this station also had the highest potential for sediment contributions based on the criteria used in this assessment. Similarly, the Lower Panther monitoring station identified high levels of turbidity and this subwatershed also has a high potential for sediment delivery. The Middle Wind and Lower Bear subwatersheds, both with relatively high potentials for sediment input, are direct contributors to flow in the Lower Wind where measured turbidities and the relative increase in turbidity were highest in the watershed.

Subwatersheds where areas of high potential for sediment delivery overlie the same areas used by anadromous fish for spawning (i.e. the Upper Trout Creek subwatersheds) may be areas of greatest concern at the watershed scale. Deposition of fine sediment in spawning areas can fill interstitial areas in spawning gravels and impede oxygenation of fish eggs buried in the gravel. Coarser material deposited in these reaches can also fill pools and lead to widening and shallowing of the stream, exacerbating problems with shading and water temperature. Near the mouth of the watershed, deposition of sediment has also been identified as a concern from a boating and accessibility standpoint.

Trends and Implications to Beneficial Uses

Because the Northwest Forest Plan identified the Wind River watershed as a Tier I Key watershed, and much of the Federal portion of the watershed as a Late Successional Reserve, future timber harvest and associated road construction on the National Forest will be reduced from past levels. However, on those areas within the watershed that are in Matrix, harvest levels may remain high or increase. Recreational use of the watershed is likely to continue or increase over time as populations increase in the vicinity and in the Portland metropolitan area.

Maximum water temperatures on streams across the Federal portion of the watershed should decline over time as previously harvested areas recover. Riparian Reserves that are now along all streams on the National Forest will prohibit future timber harvest that would tend to increase exposure of streams to solar radiation. Revegetation work will accelerate natural rates of tree development, and selective thinning of young stands will promote more rapid development of shade. Recovery of shade levels on the Upper Trout Creek system may require additional time because channels there need to be stabilized as well. Current rates of channel migration there have slowed reestablishment of riparian vegetation in some cases when seedlings were lost during channel migration or channel shifts.

In general, turbidity levels across the Federal portion of the watershed should be reduced due to a reduction in new road construction. Decommissioning of roads will help reduce long term turbidity levels, though may create short term increases on a site-by-site basis. In subwatersheds where roads are closed but not decommissioned, turbidity levels may actually increase over present levels due to a lack of road maintenance including culvert cleanout and drainage repair. In areas where turbidity levels are largely a function of excessive streambank cutting and migration such as the upper Trout Creek subwatersheds, turbidity levels may be reduced slowly over time as riparian conditions are improved, channels are stabilized, and uplands move toward hydrologic maturity.

With increased recreational use of the Forest, fecal coliform levels may be increased in and around high use recreational areas.

6. SPECIES AND HABITATS

Aquatic Species and Habitats

Current Conditions

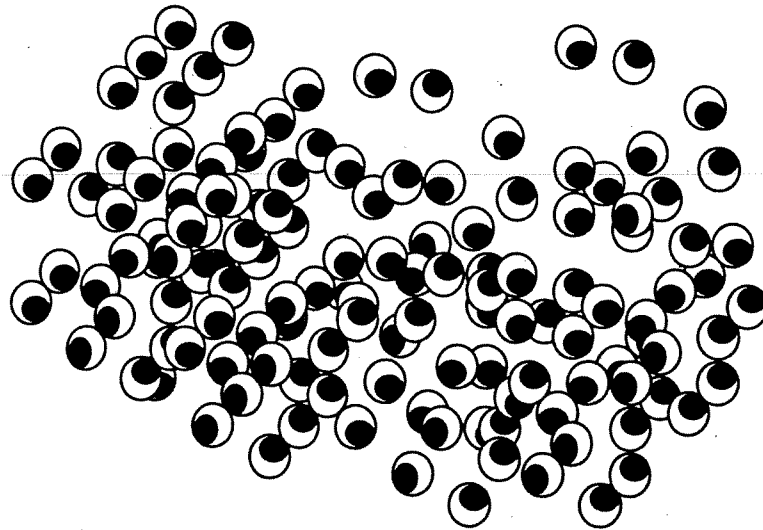
Sea-run cutthroat are listed as extinct in the Wind River basin in the 1991 Pacific Salmon at the crossroads: Stocks at risk from California, Oregon, Idaho, and Washington. Wind River winter steelhead are listed as a high risk for extinction and summer steelhead are at a moderate risk for extinction (Nehlsen, 1992). In addition a fall race population of chinook that dominated the lower reach of the Wind River is thought to be extinct or composed primarily of strays.

Salmonids are extremely sensitive to changes in watershed conditions. Hydropower, fishing, logging, mining, agriculture, and urban growth have caused serious losses in salmonid habitat and populations. Physical, hydrological, chemical and biological processes affect aquatic organisms. Resident salmonids such as cutthroat trout (*Oncorhynchus clarki*) that spend their entire life in freshwater are extremely susceptible to changes in watershed conditions. Anadromous salmonids have a variety of life strategies with some species such as the pink salmon (*Oncorhynchus gorbuscha*) only spending a few months in fresh water where as summer race steelhead (*Oncorhynchus mykiss*) may spend up to four years in freshwater. Both steelhead and spring chinook (*Oncorhynchus tshawytscha*) are very sensitive to watershed conditions due to the amount of time they spend in fresh water. Both of these species of fish now occur in the Wind River above Shipherd Falls. Steelhead are the only stock of anadromous fish indigenous to the watershed above Shipherd Falls.

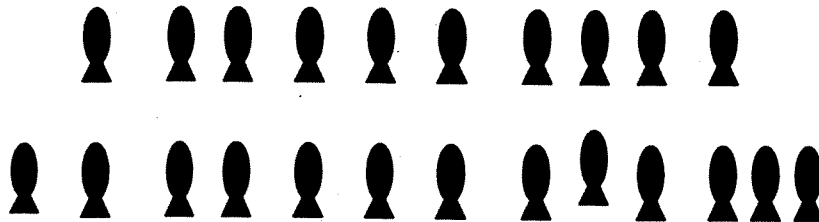
Salmonids such as summer race steelhead typically suffer the greatest mortality during the juvenile fresh water phase; egg incubation to Smoltification Figure III-6-a. If the physical, hydrological, chemical and biological factors contributing to increased mortality can be identified and then corrected mortality could be decreased and in theory populations would respond positively. This document will identify some of the factors adversely impacting salmonids within the Wind River watershed. Management actions and restoration projects will be recommended based on the data within this analysis.

**Spawning Adult
Potential Progeny
(Eggs)**

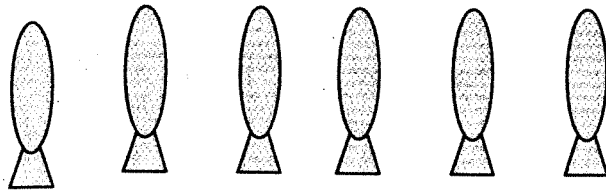
60 - 90 Days



**Egg to Fry
60 - 90 Days**



**Fry to Smolt One to
Four Years**



**Smolt to
Adult (Ocean
phase)**

**One to Four
Years**



**A 50/50 male/female ratio could
fertilize and deposit 200,000
eggs.**

**Only 22,400 of the eggs
will make it to the fry
stage. (89% Mortality)**

**Out of the 22,400 fry, only
1,075 will make it to the
smolt stage. (95%
Mortality)**

**Seventy-five may make it
back from the ocean to
spawn. (93% Mortality)**

FIGURE III-6-a: Diagrammatic sketch of survival at various life stages based on the Wild Wind River Summer Steelhead Fecundity and Egg to Smolt Survival Estimates (Unpublished Data, Rawding, 1996)

Geography and geology dictate the physical, chemical, and biological make up of watersheds which drives the evolution of the contained aquatic ecosystem.

Geography: The position relative to the equator, specific geographic region (proximity to oceans, mountain ranges, etc.), and drainage orientation imposes certain climatological characteristics on the watershed.

Geology: Geological events such as earthquakes and volcanic eruptions form the physical topographic features and the minerals available to the watershed.

Geographic region, topography, mineral composition, and climate composes the unique watershed environment that orchestrates the evolution of plant and animal biota within.

The processes that will be used to evaluate watershed conditions are: peak flows, stream channels, erosion/sedimentation, subterranean flows, width to depth ratios, maximum water temperatures, conductivity, pH, dissolved oxygen, riparian vegetation, large woody debris (LWD), biological "hot spots", competition, disease, genetics, and fishing pressure.

Physical Stream Conditions Affecting Aquatic Organisms

Peak Flows

Peak flows have important biological affects to spawning, migration, and fish habitat. Fish species such as steelhead and salmon have evolved with specific seasonal water regimes. Peak flows can directly affect aquatic organisms by impeding or causing premature migration, and washing away or crushing incubating eggs. Peak flows are generated by snow melt, rain on snow events, and rain run-off. Peak flows can be increased by fires, clear-cutting, road building, and urbanization. King and Tennyson (1984) found when as little as 3.9% of a forested watershed was occupied by roads hydrological behaviors were altered. Roads can increase the magnitude and intensity of peak flows by decreasing infiltration rates and interception and diversion of surface and subsurface flows (Hauge et al. 1979).

Peak flows in the Wind River have played a large role in the natural selection of salmonids. Native steelhead immigration, emigration and spawning revolve around the peak flow periods. Figure III-6-b shows the relationships between adult steelhead immigration, spawning, egg incubation, and smolt emigration vs. average peak flow periods.

The following criteria was used to evaluate watersheds risk for increased peak flows: road densities, ARP's, peak flow potential and percent increase in two year flood events. **The following watersheds have a high probability of negatively affecting peak flows and aquatic organisms: Compass/Crater Creek (H), Upper Panther Creek (L), Layout Creek (M), Nine-mile Creek (G), and Lower Falls Creek (C) (see Table III-2-2).**

Stream Channels

Different stream channel types provide fish with different seasonal habitats at various life stages. For instance, C4 channel types within the Wind River provides the majority salmonid spawning within the Wind River watershed. B Channels also provide areas of spawning habitat but are predominately utilized as rearing areas or migration corridors. As channels degrade or aggrade their functions relative to fish may change. In the Trout Creek watershed, reaches of C channel that have degraded to F channels have altered spawning habitat by dropping out of their floodplains, concentrating the flows, increasing water surface slopes and substrate sizes. **Degraded channels that have a high risk of adversely impacting salmonids are: Dry Creek 3, Middle Wind River 1 & 2, Layout Creek 1, and Trout 5 & 6 (see Table III-4-9).**

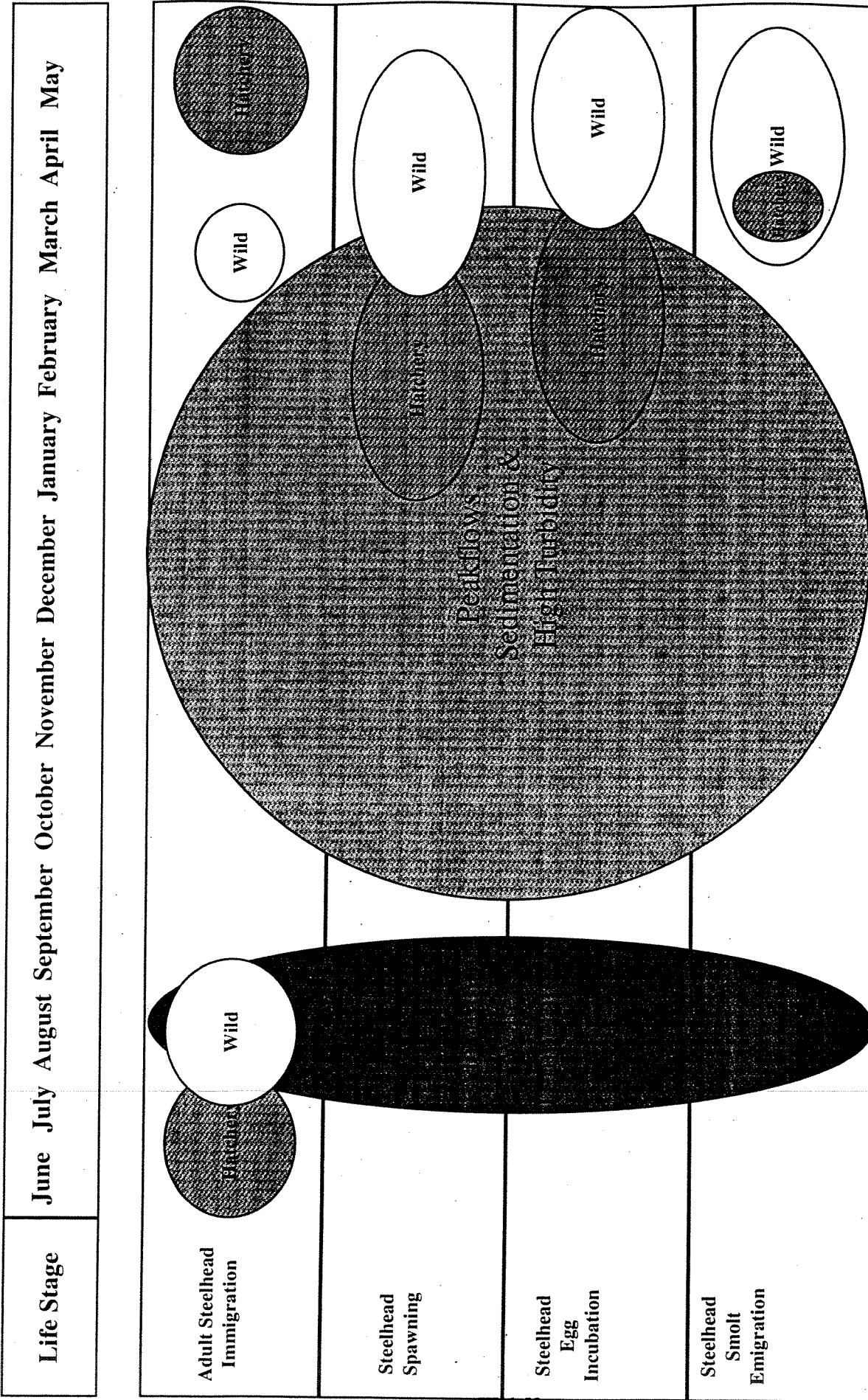


FIGURE III-6-b: Life stages of wild and hatchery steelhead in relation to maximum water temperatures, peakflows, sedimentation and high turbidity within the Wind River Watershed, Skamania County, Washington.



Life Stage

June July August September October November December January February March April May

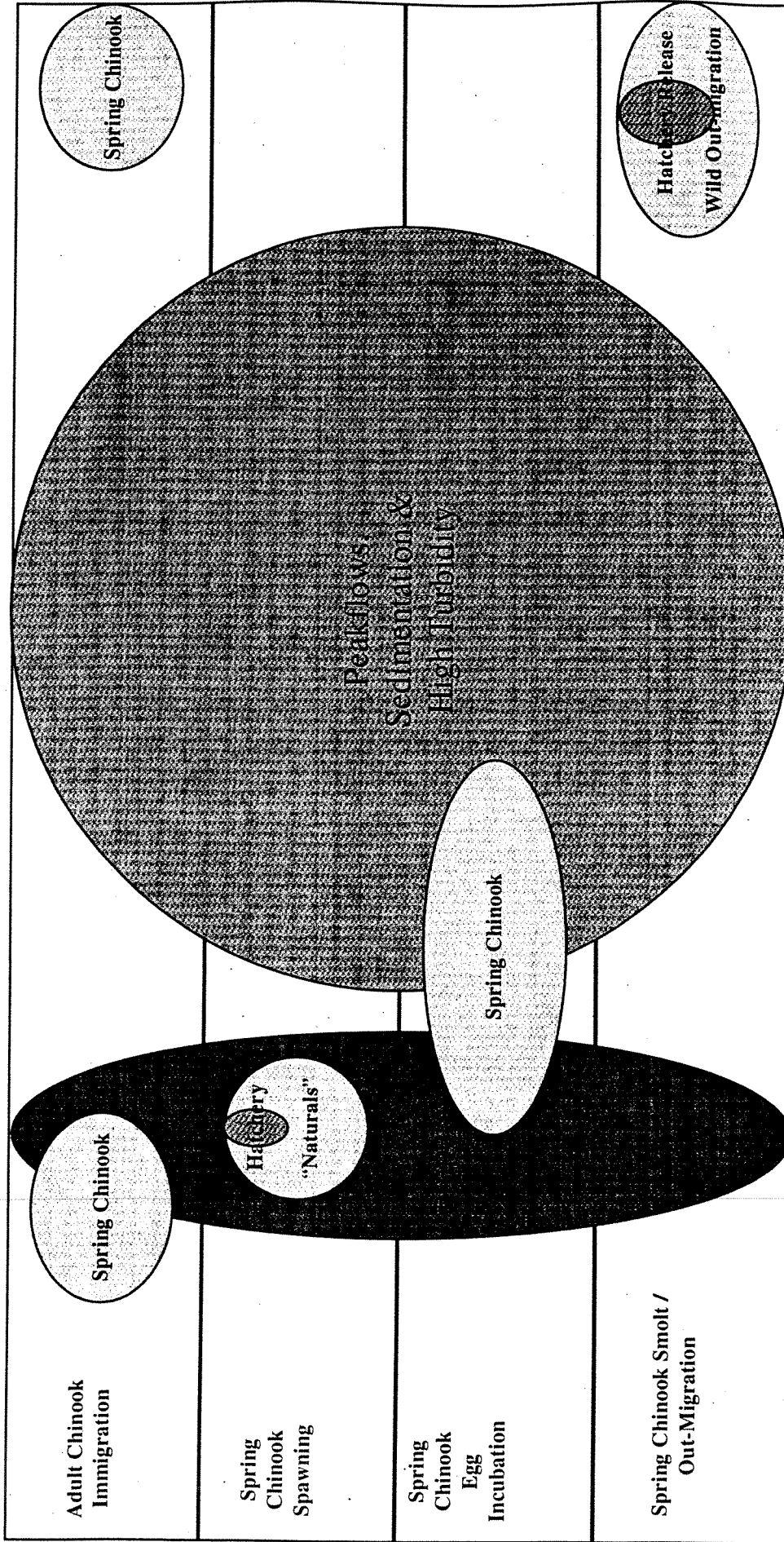


FIGURE III-6-c: Life stages of natural and hatchery spring chinook in relation to maximum water temperatures, peak flows, sedimentation, and high turbidity within the Wind River Watershed, Skamania County, Washington.

A channels can and often impede migration (see Map 15). One of the more dominant hydrological features within the Wind River, Shipherd Falls was a migration barrier to all anadromous fish except steelhead. Other waterfalls, dams and culverts throughout the watershed have blocked anadromous migration and isolated resident fish populations(Map 16).

Human engineered "A channels" such as dams or diversions can pose serious problems for both resident and anadromous fish. Anadromous salmonids within the Wind River watershed must negotiate Bonneville dam to emigrate to the ocean and also to immigrate back to spawn. Steelhead within the Trout Creek watershed must negotiate two dams; both Bonneville and Hemlock Dam. Both structures have fish ladders which require extensive maintenance and monitoring. While Hemlock Dam and Reservoir complex seem harmless, there is evidence that this structure impedes both smolt emigration and adult immigration; Schools of juvenile steelhead have been consistently observed "kegging up" in Hemlock Lake after warm water events, apparently trying to find their way to cooler waters downstream. In addition, a kelt was found in 1993 at the base of the dam with a broken back. Apparently inflicted when the fish tried to emigrate downstream and landed on the rocks at the base of the dam.

Hemlock Lake Sedimentation Analysis was conducted in 1996 reported on the feasibility of sedimentation removal Seesholtz (1996) raised several issues related to removing sediment including: 1). the impact of sediment removal on Wind River Fish and 2). Benefits from silt could be short-term. The report concludes that the benefits derived from the removal of the silt would be short term. The area cleared would refill with new sediment suspended in stream flow during peak flow. The probability is high that this would occur within the first year after removal. (Seesholtz, 1996) Irrigation water is filtered through a traveling screen before entering an 18 inch conduit leading to the pumphouse. Since the 1978 construction of the screening system it is believed that to be effective at preventing juvenile fish are no longer impelled in the irrigation system (Biggs, 1994 personal communication). However, water passing through the screen has an approach velocity in excess of 0.4 feet per second and exceeds State standards (Bates, 1994 memo) . The pumphouse operates at a fixed rate of 17 cfs. When irrigation demands are below the fixed pumping volume (17 cfs) , the excess water is propelled back into the spillway. This jet of water has been know to create a false attraction for upstream migrants and has prompted false leaping signals. Therefore, adult steelhead have been observed leaping into the jet of water at the base of the pumphouse with fatal consequences (Mcfall, personal communication). Furthermore, the inefficient use of this irrigation water has been a contributing factor to the premature drawdown of the reservoir (Wieman, 1994).

Fisheries code for the State of Washington requires dams or obstructions across or in streams include a durable and efficient fish passage facility. The Hemlock Dam is a total barrier to fish passage. To allow the fish to migrate upstream the dam was constructed with a weir and pool type fish ladder. This historical passage facility has some serious design limitations. Dr. John (Jack) Osborn (1988) noted that "the fish ladder has several problems with it that if overcome should significantly increase the number of fish which will successfully use it to pass the dam." The biggest problem is the insufficient attraction flow at high flows (Wind 1989:7,11). Migrating fish have a low probability of finding the ladder entrance as because the weak attraction flow is easily diffused by the dam spill. Once fish enter the ladder they have little opportunity to rest as they ascend the ladder because the pools between the ladder steps do not dissipate the water's energy. Closely related to poor resting water is the problem with insufficient pool size between the steps which do not facilitate jumping. Water volumes within the ladder are difficult to adjust and compensate for varying reservoir levels. Fish risk injury as debris commonly accumulates in the ladder and at the upstream screen. The Forest Service has failed recent impromptu State inspections (1994 and 1995) based on build-up of woody debris. It is estimated that the Trout Creek fish passage facility accounts for 5 percent adult mortality. Fish ladder improvements to increase attraction flow began in 1995.

Downstream migration at the dam is also a concern. The smolt mortality through the existing Trout Creek facility is greater than 15 (Wind 1989:12). At the present there is no specific downstream passage facility associated with Hemlock Dam. Juvenile fish are commonly observed in the fish ladder during the migration and into the summer months. In the recent past, dam flash boards have been managed to

provide and orifice for out-migrating fish. A positive response to this management has not been documented. Schools of smolts and parr commonly congregate at the dam crest during the migration season (March through June) and often times again in September (Wieman, 1994). Apparent delays in migration indicate that out-migrating steelhead (smoltifying fish in the spring or those escaping high water temperatures in the fall) may have a difficulty negotiating the 28 concrete structures. Delays in migration increases susceptibility angling mortality (see Fishing Pressure), increases risk of disease (see Disease) and increases risk of residualization.

The lethal impingement of juvenile fish has been another documented source of mortality at the Hemlock dam site (Wieman, 1994). Temporary wooden flash boards are seasonally constructed on the dam's crest to increase the reservoir storage capacity. High approach velocities result where water is forced through relatively small cracks in the dam's flash board structure. Juvenile fish are overcome by the forceful sucking action.

Structures within the Wind River watershed that are adversely impacting aquatic resources: Hemlock dam, Shipherd Falls ladder, irrigation diversion at Martha Creek, domestic water diversion at Bear Creek, and "the old coffer dam" above Shipherd Falls, Wind River Compass Creek Culvert (reach 5), Oldman Creek (three culverts, one per reach) and Youngman Creek culvert near the mouth (see Map 16).

Pools

Pools are extremely important to aquatic organisms and are used by salmonids for rearing and resting. Pools provide thermal refuges during summer low flows and winter cold. Water temperatures at the bottom of one pool were 2.2°C cooler than peak temperatures in an adjacent riffle. Also temperatures were above 22°C for a much shorter period each day in the pool than in the riffle (Anderson and Miyajima 1975). Spawning gravel is typically found in the pool tail crest.

Reaches of stream that contain low numbers of pools per mile and/or poor pool quality limit salmonid populations. Ninety-three percent of the surveyed reaches within the Wind River watershed contained poor pool quality and quantity. **The reaches of stream that contain poor pools and that are perceived to be limiting salmonid production within the Wind River watershed are: East Fork Trout Creek 2; Compass Creek 1; Crater Creek 1,2 & 6; Layout Creek 1,2 & 3; Oldman Creek 2 & 3; Planting Creek 3 & 4; Paradise Creek 1; Upper Wind River 2, 3 & 4; Youngman Creek 1 & 3; Proverbial Creek 2; Dry Creek 1; Cedar Creek 2 & 3; Eight-mile Creek 2; and Mouse Creek 1 (see III-3-15 and III-5).**

Erosion and Sedimentation

Erosion and sedimentation have been shown to degrade aquatic habitat. Salmonids (trout and salmon) use gravel to cover fertilized eggs for incubation. These gravel nest or redds protect the eggs and allows oxygenated water to pass over the embryonic surfaces. If excess sediment enters the stream, the spaces between the gravel can become clogged cutting off the supply of oxygen, suffocating the developing eggs (Chapman and Mcleod 1987).

Sediment and sediment transport are natural processes that provide streams with a source of substrate and nutrients. Sediment is naturally delivered to streams by a variety of mechanisms such as landslides and bank erosion. All streams and their associated aquatic organisms evolved to a natural "sediment load" or regime. The sediment load is the quantity and size of the material a stream typically transports. The sediment regime and composition determines the quantity and quality of aquatic habitat. When streams or watersheds are disturbed or disrupted by dams, fire, logging, or roading excess sediment can be delivered to the stream altering both quantity and composition of the substrate. This shift in sediment composition can directly and indirectly effect aquatic organisms by altering water quality, incubation, larval development, and juvenile rearing habitat.

If erosion is severe suspended sediment can clog the gills of juvenile fish and kill them (Branson and Batch 1972, Everhart and Duchrow 1970, Herbert and Richards 1963). Suspended sediment or turbidity is the visible suspension of smaller particles of sediment typically carried by all streams. Turbidity meters measure the clarity of the water by passing a beam of light through a sample. A sensor assigns a NTU value for the amount of light that passes through the sample. Turbidity levels are typically tied to stream flow levels. At higher flow levels, sediment inputs are usually greater, and streams have greater capacity to entrain and maintain finer sediments in suspension. High turbidities/suspended sediment can affect aquatic organisms by killing them directly, by reducing growth rates and resistance to disease, by preventing successful development of eggs or larvae, by modifying natural movement or migration patterns, or by reducing the natural availability of food. (U.S. EPA, 1986)

Sub-watersheds were evaluated for erosion, sedimentation by: road crossings per square mile, peak flow turbidity, mass wasting, surface erosion and channel stability. **The sub-watersheds that pose the greatest threat to adversely affecting aquatic resources from erosion/sedimentation are: Compass/Crater Creek, Upper Trout Creek, Middle Wind River, Upper Panther Creek, Layout Creek, Upper Wind River, Lower Wind River, Mouse Creek, Lower Trout Creek, and Eightmile Creek. Sub-watersheds generating the highest turbidities and potentially adversely affecting aquatic organisms are: Lower Wind River, Lower Trout Creek, Lower Panther Creek, Mouse Creek, Middle Wind River and then Upper Wind River, respectively (see III-1-1 through III-4).**

The majority of streams that exhibit poor channel stability ratings contain excessive bank erosion. The majority of sediment generated within these areas comes directly from bank erosion. **The stream reaches which show poor bank/channel stability are: Dry Creek 1; Twelve-mile Creek 1; Upper Wind River 1 & 5; Youngman Creek 1 & 2; Middle Wind River 3; Trout Creek 2, 5, 6, 7; Crater Creek 2 & 4; and Layout Creek 1. Impacts of increased sedimentation from a landslide show up in the channel stability rating within reach 2 of Proverbial Creek.**

Subterranean Flows

When logging removes riparian vegetation, stream bank stability is decreased. This can substantially increase sediment delivery into the stream (Everest et al. 1985). In small streams channel aggradation produced by accelerated bank erosion can produce subterranean flows through gravel deposits. These subsurface flows can strand fish and/or block migration in the summer months (Barton et al., 1985).

Currently, there is 0.68 river miles of subterranean stream within Layout and Dry Creeks caused by accelerated bank erosion/sedimentation/aggradation. Every year there are fish stranded in pools within these reaches that die from predation, increased water temperatures or desiccation.

Width to Depth Ratios: Large width to depth ratios (>10) indicate wide shallow streams with poor quality pools; i.e., poor fish habitat. Streams with high width to depth ratios can increase maximum water temperatures by exposing a large surface area of the stream to solar radiation. **The streams that have width to depth ratios >10 are: East Fork Trout Creek 2; Mouse Creek 1; Upper Wind 2, 3, & 4; Cedar Creek 3; Layout Creek 1, 2, & 3; Eightmile Creek 2; Planting Creek 3 & 4; Youngman Creek 1 & 3; Proverbial Creek 2; Dry Creek 1; Crater Creek 1,2,3,4, & 6; Paradise Creek 1; Oldman Creek 2 & 3; and Compass Creek 1 (see Table III-4-9).**

Maximum Water Temperatures

Riparian vegetation provides shade in summer and reduces heat loss in winter. Stream shade prevents water temperatures from becoming stressful or lethal to salmonids. Cumulative effects of excessive sedimentation will fill in pools and other low velocity areas. As the pools are filled in the stream depth decreases and stream width increases. The widening and shallowing causes increase maximum water temperatures (Barton et al. 1985). Many salmonids tolerate temperatures exceeding 18°C, but higher temperatures increase stress and mortality usually occurs around 25°C (Jobling 1981). Bell

(1987) demonstrated that 50% steelhead mortality occurs after 17 hours of exposure at 24°C. Jobling (1981) found that most salmonids tolerate temperatures above 18°C, however, higher temperatures increase stress and mortality typically occurs near 25°C. Many populations of wild salmonids respond to natural temperature fluctuations by moving up or down stream when water temperatures become unsuitable (Bjornn and Mallet 1964, Bjornn 1971, Bjornn and Morrill 1972, and Mabbott 1982).

Water temperature is perhaps the most important element and key indicator to watershed health and condition. Reference water temperatures are scarce and those that were taken were often done once or twice during a survey. This data provides a very limited snap-shot in time that lends little insight as to the historic temperature regimes. Stream water temperatures taken during stream surveys are valuable, however, should not be used to evaluate compliance with dfc's or used for evaluation criteria in habitat analysis. Water temperatures continuously recorded are the best and cheapest way to monitor water temperature over time. Data from continuous recorders provides a quantitative and holistic picture as to the environmental conditions within a stream.

Many streams and tributaries do not have years of temperature data or even a single measurement for the entire watershed. Watersheds within the Wind River were evaluated by four basic watershed attributes; 1) drainage aspect, 2) percent riparian vegetation in early seral, 3) percent of the watershed in late seral and 4) the percentage of low gradient channels (Rosgen C, D, E, F or G) within the watershed. Drainage aspect and its orientation to the path of the sun relate to the duration and intensity of solar radiation exposure. The mainstem Wind River runs North to South with most major tributaries draining East or West exposing these stream courses to the sun all day. The streams with the longest potential solar exposure are those drainage's that have aspects of 67° - 113° (Eastern aspect) and 247° - 293° (Western aspect). Drainage aspects were obtained by using a map and compass and taking the average linear azimuth of the stream. Percent riparian in early seral relates to potential stream shade. Those drainages that contain the highest percentage of early seral vegetation (grass/forbs, seedling/sapling, and pole) within their riparian areas would have the lowest potential for shading a stream. Early seral within riparian areas was derived from GIS. The percentage of late seral vegetation (large tree multi-storied & large tree single storied) within the watershed was used to evaluate ambient air temperature increases. If a watershed has lost a high percentage of its canopy cover then air temperature within the watershed will increase. Narrow buffer strips may provide stream shade but would do little to protect the stream from the affects of ambient air temperatures coming from adjacent clear cuts or burns. The watersheds with higher percentages of late seral vegetation would have lower average air temperatures and thus reduce connective warming of the stream. Hatten and Conrad (1995) found that the proportion of a subbasin classified as later seral forest was the single most influential independent variable in the relation to stream temperature. The final attribute used to evaluate sub-watersheds for water temperature was the percentage of low gradient perennial streams. Rosgen C, F, and E Channels would be the stream types that would have the largest width to depth ratios and lowest gradients and therefore expose the largest amount of stream surface area for the longest period of time. The percentage of Rosgen channel types was derived by using GIS data and map overlays. The watersheds that have the highest potential for increasing water temperature maximums are shown in Table III-6-1.

TABLE III-6-1: Watersheds that have the highest potential for affecting water temperature regimes

Heat Index	Sub-Watershed	Drainage Aspect	% Rosgen "C" Channels	% Rosgen "E" Channels	% Early-Successional w/n Perennial Riparian	% Late Seral Basin
-7	Layout	60	38		49	17
-7	Middle Wind	130	43		25	19
-7	Lower Falls	260	29		23	26
-7	Pete's	250		24	19	27
-7	Compass/Crater	95	33		45	33
-6	Dry	150	38		26	23
-6	Upper Trout	220	30	15	36	38
-5	Lower Trout	115	10		30	21
-4	Eight-mile	110	8		11	30
-4	Little Wind	230			28	31
-4	Lower Panther	190	33		21	34
-3	Upper Wind	200			24	14
-3	HeadwatersWind	240		3	11	19
-3	Paradise	150	22		4	29
-3	Lower Bear	240	20		23	40
-3	Nine-mile	280			22	47
-2	Lower Wind	140		2	9	26
-2	NF Bear	200			2	28
-2	Brush	220	20		13	32
-2	Big Hollow	120	4		22	41
-2	Upper Falls	220	16		21	41
-2	Trapper	120	18		0	46
-2	Mouse	260			11	57
-1	Upper Panther	210			22	43
-1	Cedar	240			11	55
0	EF Bear	190	8		1	51

Highest Risk of Affecting Water Temperatures

Lowest Risk of Affecting Water Temperatures

KEY					
-2 =	248-293 & 68-112	≥25	≥25	≥25	≥40
-1 =	294-315 & 46-68 & 112 - 134 & 226-248	15-24	15-24	20-24	30-39
0 =	134-226 & 315-46	<15	<15	<20	<30

The current riparian and channel conditions have reduced the ability of Wind River watershed to ecologically withstand stochastic events such as drought. The removal of riparian vegetation from past timber harvest and excess sediment from bank erosion enters stream channels the pools fill in and the stream widens and shallows, increasing the stream surface area exposed to solar radiation. Climate and hydrological data for the Wind River basin documents drought conditions for the last ten years. Precipitation from 1985 - 1994 has been on average 71.6"/year which is 23.5"/year less than the 66 year period between 1911 - 1977 and 30"/year below the 10 year cycle of 1971 - 1980 (Table III-6-2, Figure III-6-1).

TABLE III-6-2: Average yearly precipitation for the Wind River Ranger District (1911-1972) and the Carson National Fish Hatchery (1972-Present), Skamania County Washington.

Period	Average Yearly Precipitation
1911-1930	83.7
1931-1940	92
1941-1950	100.1
1951-1960	103.1
1961-1970	96.3
1971-1980	101.7
1911-1950	89.9
1911-1977	95.07
<i>1985-1994</i>	<i>71.6</i>

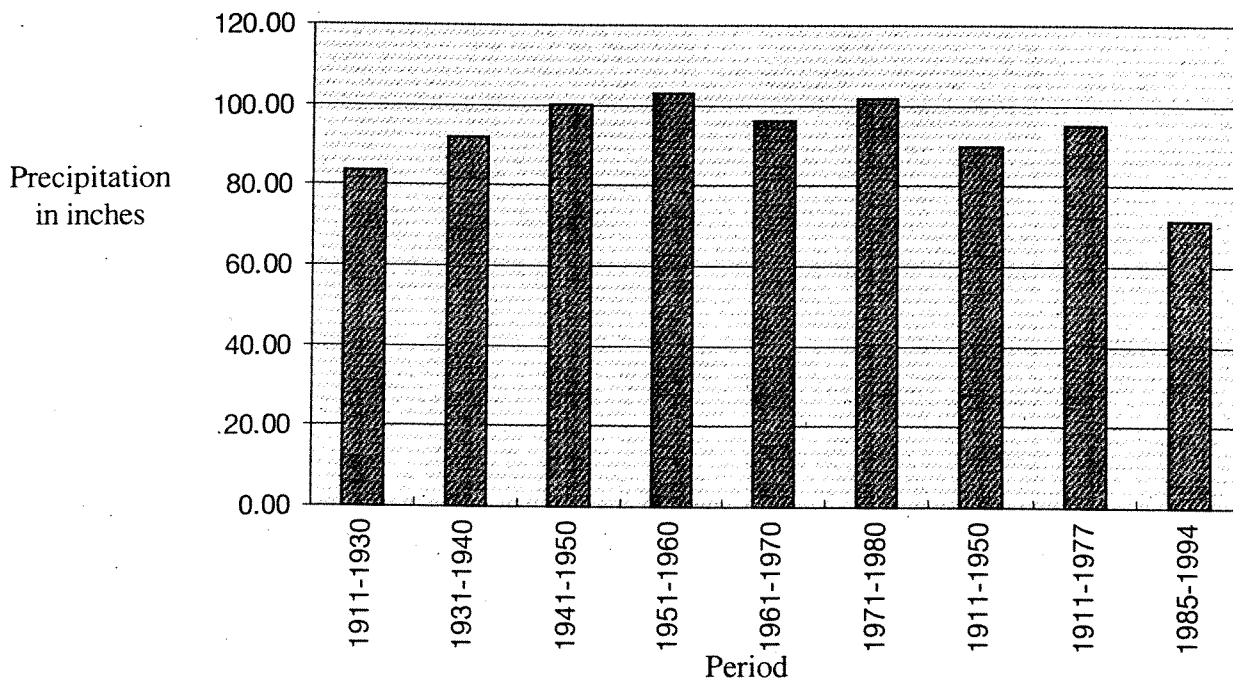


FIGURE III-6-1: Average yearly precipitation for the Wind River Ranger District (1911-1972) and the Carson National Fish Hatchery (1972-Present), Skamania County Washington.

The poor channel conditions combined with low summer flows have produced lethal maximum water temperatures for salmonids ($\geq 24^{\circ}\text{C}$) within the Trout Creek watershed. Bell (1987) demonstrated that 50% steelhead mortality occurs after 17 hours of exposure at 24°C . Jobling (1981) found that most salmonids tolerate temperatures above 18°C , however, higher temperatures typically near 25°C increase stress and mortality. Diurnal fluctuations of temperatures recorded within Trout Creek document 24°C sustained for 9 hours. Lethal water temperatures have been recorded in 1987, 1990, 1991, 1992 and 1994 Table III-6-3.

TABLE III-6-3: Water temperature data 1977 - 1994 for Trout Creek and the Wind River, Skamania County Washington.

Year	Trout Creek	Wind River	Trout Creek	Wind River	Trout Creek	Wind River	Trout Creek	Wind River
	Max. H2O Temp.	Max. H2O Temp.	Days>24C	Days>24C	Days>20C	Days>20C	Days>16C	Days>16C
1977	23	18	0	0	21	0	36	28
1978	21	18	0	0	15	0	33	15
1979	20	17	0	0	7	0	43	25
1980	22	23	0	0	10	12	24	22
1981	22	17	0	0	13	0	34	9
1982	21	15	0	0	11	0	38	0
1983	16	15	0	0	0	0	0	0
1984	18	15	0	0	0	0	10	0
1985	19	21	0	0	0	22	19	44
1986	22	19	0	0	9	0	37	36
1987	24	19	4	0	41	0	65	44
1988	17	17	0	0	0	0	6	1
1989	17	17	0	0	0	0	1	2
1990	25	18	2	0	16	0	54	13
1991	24	15	1	0	2	0	23	0
1992	25	21	11	0	32	10	76	52
1993	21	17	0	0	3	0	30	10
1994		20		0		1		51

Schools of juvenile steelhead have been consistently observed "kegging up" in Hemlock Lake after warm water events, apparently trying to find their way to cooler waters downstream. Snorkel surveys have also documented large congregations of salmonids at cooler tributaries such as Planting Creek (Bair, 1992 Unpublished Data). Many populations of wild salmonids respond to natural temperature fluctuations by moving up or down stream when water temperatures become unsuitable (Bjornn and Mallet 1964, Bjornn 1971, Bjornn and Morrill 1972, and Mabbott 1982). It appears that the juveniles observed in Trout Creek have been out migrating and crowding cool water sources to avoid warm water temperatures coming from the Trout Creek Flats area. Predators such as mergansers have been observed taking full advantage of the congregations of fish within Trout Creek (Bair, 1992 Unpublished Data).

Although the Trout Creek watershed contains only 1/16th of the Wind River's entire acreage it has historically produced nearly 50% of the watershed's steelhead. Since 1987 the percentage of steelhead escapement within Trout Creek vs. the Wind River has dropped significantly (Figure III-6-2). This decline coincides with the appearance of the first recorded maximum water temperatures exceeding 24°C.

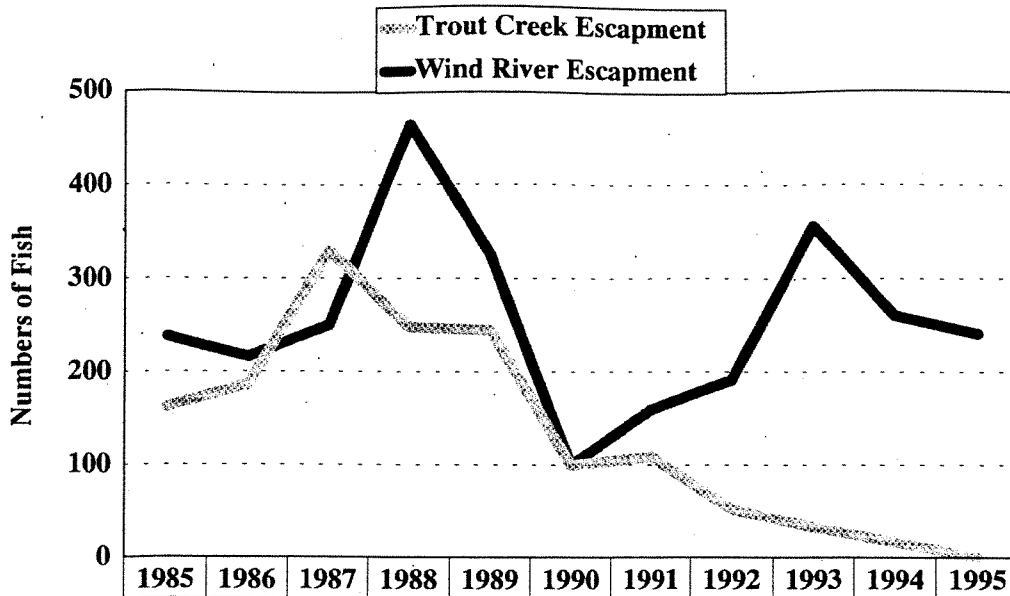


FIGURE III-6-2: Adult steelhead escapement for Trout Creek and the Wind River, Skamania County, Washington (1985 - 1994 Washington Department of Fish & Wildlife Redd Survey Data).

Chemical Conditions Affecting Aquatic Organisms

Conductivity

Conductivity is the ability of a substance to conduct an electric current. The conductivity of water is dependent on the water temperature and the concentration of dissolved ions. The quantity of dissolved material in the water depends mainly on the solubility of rocks and soils the water contacts. Conductivity indirectly relates to productivity. The higher the conductivity's typically means more minerals are available to primary production and aquatic insects which equates to more food for fish which in turn relates to greater numbers of fish. Pacific Northwest streams rate in the low end of the conductivity range (Aumen et al., 1989).

The Wind River watershed is typical of most West side Cascade streams: high precipitation and low conductivity's averaging 57 $m\ mhos/cm$ (Wind River Water Quality Data 1956 - Present). Low conductivity's are characteristic of low productivity lotic systems. Resident fish such as introduced brook trout (*Salvelinus fontinalis*) that spend their entire lives in the Wind River and tributaries rarely exceed 190 mm or 8 inches (Wind River Electrofishing data 1985 - 1995). Salmonid species such as steelhead within watersheds such have evolved an anadromous life strategy which allows the fish to emigrate to the ocean where food is abundant and their full growth potential can be reached.

Out of the four monitoring stations (Trapper Creek, Trout Creek, Bear Creek and the Wind River) **Trout Creek produced the lowest average conductivity's; 31 $m\ mhos/cm$.**

It is interesting to note that the highest recorded salmonid biomasses (g/m^3) occurred in Martha and Planting Creeks. Figure III-6-3 (Crawford 1984). These electrofishing sites were situated along or downstream of the Wind River Nursery fields and the Planting Creek seed plantation. The relatively high biomasses could be attributed to increased nitrogen and other organic nutrients used to fertilize these plantations.

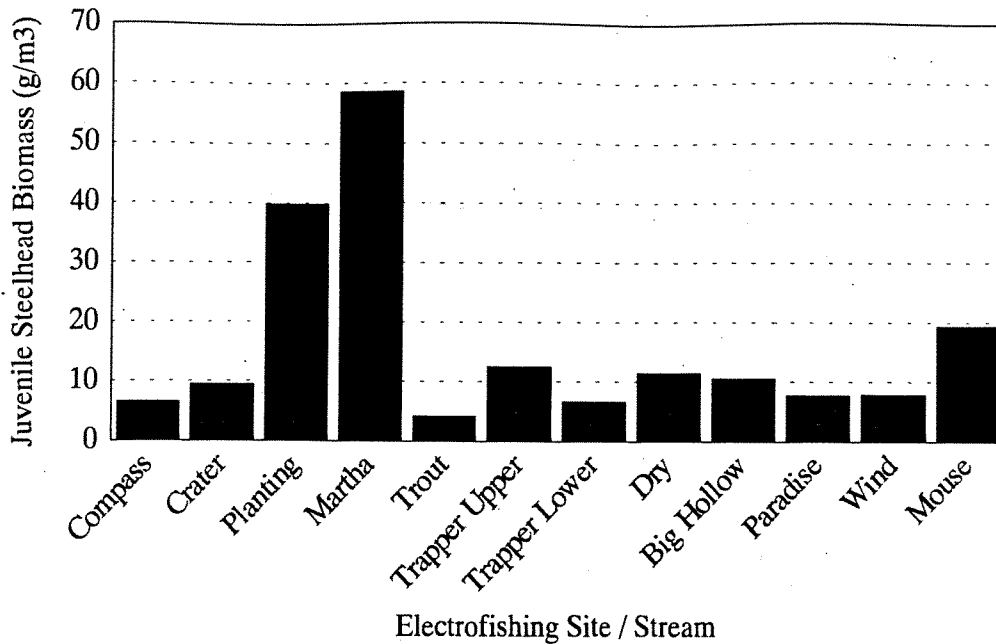


FIGURE III-6-3: Juvenile steelhead biomass (g/m³) for electrofishing sites within the Wind River Watershed, Skamania County Washington.

Bilby, Fransen and Bission (1994) found that up to 40% marine nitrogen and carbon found in the tissues of juvenile coho salmon and steelhead were derived from salmon carcasses. Juvenile coho and cutthroat within these streams increased in abundance and size when carcasses were deliberately placed in a small headwater tributary stream of the Chehalis River, Washington. Decreased availability of carcass material as a result of population declines of salmon and steelhead produce a decrease in fish size and can reduce over winter and marine survival of coho and steelhead, reducing the number of returning adults and perpetuating depressed stream productivity.

pH

pH is the concentration of hydrogen ions in water defined on a logarithmic scale. pH measurements run of a scale from 0 to 14 with 7.0 considered neutral. Solutions with a pH below 7.0 are considered acids, those between 7.0 and 14.0 are considered bases. Aquatic organisms are very sensitive to fluctuations in pH. Acid rain and mining activities can severely alter pH to levels that fish and insects can not tolerate. A pH range from 5 to 9 is not directly toxic to fish but a decline in pH from 6.5 to 5.0 resulted in a progressive reduction in salmonid egg production and hatching success (EPA, 1986b). The emergence of certain aquatic insects also declines below a pH of 6.5. From this and other data, EPA has concluded that pH should range between 6.5 and 9.0 order to protect aquatic life (EPA, 1986b).

Baseline water quality monitoring stations produced pH ranges from 5.3 - 8.2 with the lowest pH value recorded in Trout Creek (5.3). The low pH values are alarming, however, suspect to calibration or equipment errors.

Dissolved Oxygen

The amount of oxygen in the water is dissolved oxygen. Dissolved oxygen is related to water temperature since the water temperature determines the amount of oxygen water can hold. Increased temperature lowers dissolved oxygen concentrations. As oxygen levels decrease, fish restrict their activities to lower their oxygen consumption. Growth and reproduction will be affected during extended periods of reduced oxygen availability. A trout needs five to six times more dissolved oxygen when the water temperature is 24C (75°F) than when the temperature of the water is 4°C. to support increased metabolic rates. Factors that reduce the level of oxygen saturation include: very slow moving streams with low water aeration, areas with high biochemical oxygen demand or fresh organic debris, warm eutrophic streams with high levels of photosynthesis and respiration, and ponded sites (see Map 16).

Due to the extreme maximum water temperatures within Trout and Layout Creek (>24°C), beaver activity and dams, dissolved oxygen levels are expected to be stressful to salmonids during warm water periods especially in Hemlock Reservoir.

Biological Conditions

Riparian Vegetation

Large streamside trees are needed for self-maintaining/potential instream LWD. Roots from trees and shrubs are needed to hold soil and rock together along the stream/bank interface. Salmonid habitat is directly influenced by streamside vegetation. Trees, brush, grasses, and forbs are all important. Each vegetative species plays an important role in forming and protecting aquatic habitat (Platts 1983). Trees in the overstory provides shade and the canopy ameliorates the summer and winter water temperatures. If they fall across streams they may create pools and help to control the slope and stability of the channel. Fallen trees prevent many channels from eroding to bedrock (Platts et al. 1985a). Along with the overstory, the understory provide cover, food (organic detritus and terrestrial insects), bank stability, and shade. Brush protects stream banks from erosion and overhanging plants provide fish cover. Vegetative mats from grass and sod reduces surface erosion and mass wasting. Gradual erosion under vegetative mats creates undercut bank used for hiding cover.

Riparian vegetation was evaluated to determine the subwatersheds that contained the smallest diameter riparian vegetation by querying GIS data. The poorest riparian vegetation exist within the following watersheds: Layout Creek, Compass/Crater Creek, Upper Trout Creek, Lower Trout Creek, and the Little Wind River (see Table II-5-2). Reaches of stream were also evaluated to identify site specific areas that contain poor riparian vegetation. The following reaches have poor riparian vegetation: Crater Creek 1, 2, 3, & 4; Eight mile Creek 1; Upper Wind River 3 & 5; Trout Creek 3, 4, 5, 6, 7; Proverbial Creek 1; Paradise Creek 1; Pete's Gulch II 1; Pete's Gulch 2; Oldman Creek 1 & 2; Middle Wind River 3; Panther Creek 2; and Compass Creek 1 (see Table III-4-9).

LWD

Large woody debris is an important component of fish habitat, especially for salmonids (Koski et al. 1984; Sedall and Swanson 1984; Sedell et al. 1984; Bisson et al. 1987, House and Boehne 1987a), and its function as a physical determinant of stream dynamics has been well documented (Swanson et al. 1976, Bryant 1983, Bilby 1984, Beschta and Platts 1986, Lienkaemper and Swanson 1987). LWD is important to fish in gravel and nutrient collection; island, pool, and shelter creation; bank and side channel protection; and oxygen production. Stream flow energy is reduced when water encounters large woody material. Often the gravel settles in the tails of pools where it can be used as spawning and habitat for emerging fry and insects. Woody material attracts detritus and insects which in turn become fish food.

Islands may form as large woody material collects sediment. The islands increase stream shade and offer protection from water currents. Stream flow scours pools and undercut banks beneath large woody material. The complex spaces between the wood parts gives fish of different sizes a place to hide from predators. Deep pools inhibit ice formation providing winter shelter. Large woody material protects banks and side channels from erosive forces of water and ice by absorbing the water's force.

The streams that contain "Very Low" concentrations of LWD are: Pete's Gulch II 1 & 2; Panther Creek 1, 4, & 5; East Fork Trout Creek 4; Mid Wind River 1, 2, & 3; Pete's Gulch 1 & 2; Trout Creek 4, 5, & 6; Dry Creek 3; Crater Creek 1, 3, 5, & 6; Oldman Creek 1, 2, & 3; Proverbial Creek 1; Planting Creek 1; SF Planting Creek 1 & 2; Trapper Creek 1; and Compass Creek 1, 2 & 3 (see LWD synthesis and Table III-4-9).

Spawning Densities "Biological Hot Spots"

The quality and quantity of spawning habitat often dictates the reproductive success of salmonids. Identifying and protecting areas where fish eggs are incubated will help to increase production within the basin.

The areas that historically produced the highest densities of redds are: the Wind River above Stabler Bridge to Falls Creek, Trout Creek "Flats" (Layout, Compass, Crater, and Trout Creeks), Martha Creek adjacent to nursery fields, Planting Creek, Lower Dry Creek, Upper Wind River adjacent to the Wind River Mine, Panther Creek from Cedar Creek to Mouse Creek, Lower Wind River below Shipherd Falls to the Mouth of the Columbia River, and the Little Wind River, respectively. The sub-watersheds which consistently produced the highest densities of redds in order are: #1 Middle Wind River, #2 Layout Creek, #3 Upper Trout Creek, #4 Lower Trout Creek, #5 Compass/Crater Creeks, #6 Dry Creek, #7 Upper Wind River, #8 Panther Creek, #9 Trapper Creek, #10 Cedar Creek, #11 Lower Wind River, and #12 Little Wind River. (Based on 1983 - 1995 redd survey data)

Competition

Competition occurs when two organisms share a resource that is in limited supply. Competition is frequently cited as a major reason why introduced fish replace native fish but most of the evidence is anecdotal or inferential and does not demonstrate conclusively that there is some limiting resource (Fausch 1988; Ross 1991). Interference competition takes place among territorial salmonids where one species becomes dominant over another. Exploitation competition takes place when one species uses a resource more efficiently than another.

The introduction of spring chinook in 1955 may have reduced the carrying capacity of summer steelhead above Shipherd Falls (Wind 1989:24). Hatchery spring chinook fingerlings (totally 373,714) were released in Trout Creek above the Dam from 1984 to 1987. Stock came from Abernathy Creek or the Wind River. During this population study both chinook and steelhead were of smaller size in Trout Creek (tributary with highest chinook population) indicating the stocking program had an effect on steelhead (Crawford 14).

Brook trout are introduced in the Wind River watershed.

Larson et al. (1995) found that brook trout predominated in steep, coldwater streams over nonnative rainbow trout because of the brook trout's smaller size, higher densities, higher success in pools, and better resistance to detrimental effects of freshets and fishing pressure. Newman (1956) found brook trout to be socially dominant over rainbow trout of similar or slightly larger size (Connolly 1995:3-7). Brook trout have now established populations throughout the Wind River watershed.

Where exotic or non-native salmonid species occur within the watershed competition could be directly or indirectly negatively affecting salmonids. The following list the sub-watersheds that do not contain

populations of exotic or non-native salmonids: Cedar Creek, Dry Creek, Paradise Creek, Mouse Creek, Little Wind River, Big Hollow, Brush Creek, and Headwaters Wind River (see Map 16).

Diseases

Bacterial kidney disease or BKD occurs in the Wind River. Bacteria enter a fish and multiply in the bloodstream and attack the kidney and other organs such as the liver and heart. Blisters and ulcers filled with pus and cellular debris are visible on infected tissues as the disease progresses. Infected fish may externally appear normal. Infectious hemopoietic necrosis (IHN) is caused by a virus and is fatal in 90% of infected fish. IHN originally was diagnosed in rainbow trout but is also seen in chinook. Infected fish are anemic, darkly pigmented, and with pronounced exophthalmia (popeyed). Bleeding may occur at body openings.

We don't know whether these diseases were introduced or indigenous to the watershed. Brook trout are known carriers of BKD and now exist throughout the watershed. IHN is known to occur in the Skamania hatchery fish now stocked in the Wind River. **The following list the sub-watersheds that *do not* contain populations of exotic or non-native salmonids that could spread disease: Cedar Creek, Dry Creek, Paradise Creek, Mouse Creek, Little Wind River, Big Hollow, Brush Creek, and Headwaters Wind River.**

Genetic

Shipherd Falls formed a natural "genetic barrier" to all anadromous fish except steelhead. Even among steelhead Shipherd Falls "weeded out" the weak and athletically inept. There Wind River bore legends of a "super race" of steelhead. However, fish stocking and the completion of the Shipherd Falls fish ladder have probably diluted the gene pool of any native strain that may still exist.

Fish stocking has occurred from the late 1800's to present. Almost every genera of salmonid has been stocked within the Wind River watershed. Forest Service records show steelhead stocked in Paradise Creek in 1935 and in the Wind River in 1938. Winter steelhead were released in 1951, 1956, 1959, and 1963 in the Wind River Basin (Connolly 1995:2-3). The Washington Department of Game (DWG) began introducing hatchery steelhead smolts in 1956 to compensate for angling and logging habitat losses (Everest 103). These fish were from the Skamania Hatchery--descendants of wild steelhead returning to the Washougal and Klickitat Rivers in the late 1950's (Wind 1989:20). Some of the Skamania stock fish probably escape harvest and spawn in the river; but how much they contribute to the wild gene pool is unknown (Wind 1989:20). Some feel these introductions may have imposed constraints on the wild stock and/or genetics of the Wind River steelhead as a result of natural interbreeding with hatchery origin fish (Wind 1989-16).

It has long been a concern that wild Wind River stock(s) of steelhead may be adversely affected by releases of hatchery fish in the Wind River System (Lucas and Nawa 1985). The degree of introgression by hatchery fish with the wild stock and possible changes in the stock as a result are simply unknown. Currens and Schreak (1995) reported that the data on genetic relationships among Trout Creek, Wind River, Panther Creek and Skamania Hatchery steelhead did not provide a clear picture of whether the wild stocks had been definitively introgressed with the hatchery stocks (Connolly 1995:3-4,5).

An adult fish trap was installed at the Trout Creek fish ladder in 1992. A partnership between the Wind River Ranger District, Washington Department of Wildlife, and the Clark-Skamania Fly fishers formed to provide a genetic reserve and monitor the steelhead. From January 1, 1992 to November 30, 1994, 60 wild steelhead were trapped and passed, five hatchery steelhead were returned to the Wind River, and one spring chinook was returned to the Carson National Fish Hatchery and one was returned to the Wind River. Fish were typically trapped during or after freshets (periods of rain or snow melt). Figure III-6-4

below shows a break down by year (Bair 1995). In 1995, the trap was removed because of possible trap avoidance by adult steelhead.

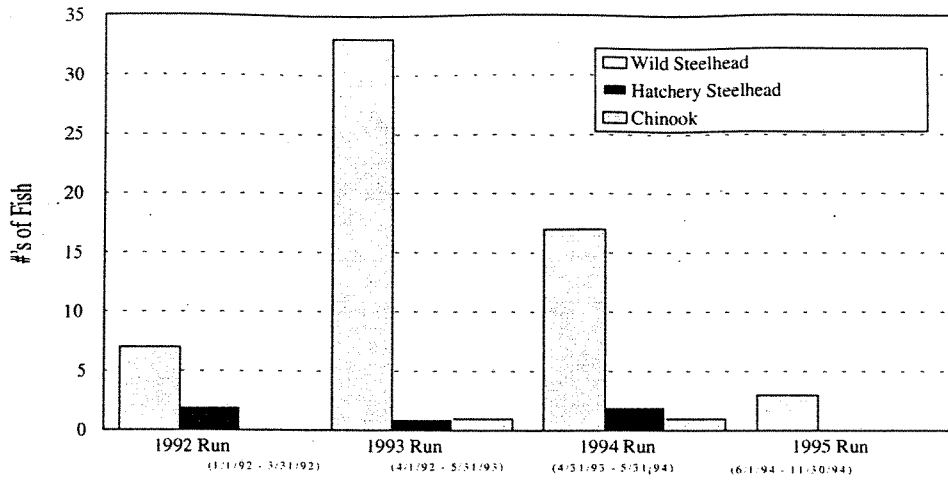


FIGURE III-6-4: Adult steelhead and chinook trapped at the Hemlock Fish Ladder 1992 - 1994, Trout Creek, Skamania County, Washington.

As the native populations continue to decline and the numbers of escaping hatchery steelhead remains static or increases and introgression becomes more of an issue. Peak flows during most years probably inflict significant mortalities on the progeny of spawning hatchery steelhead. However, low flow years or late spawning hatchery steelhead present a significant risk of interbreeding (Figure III-6-b and Table III-6-5).

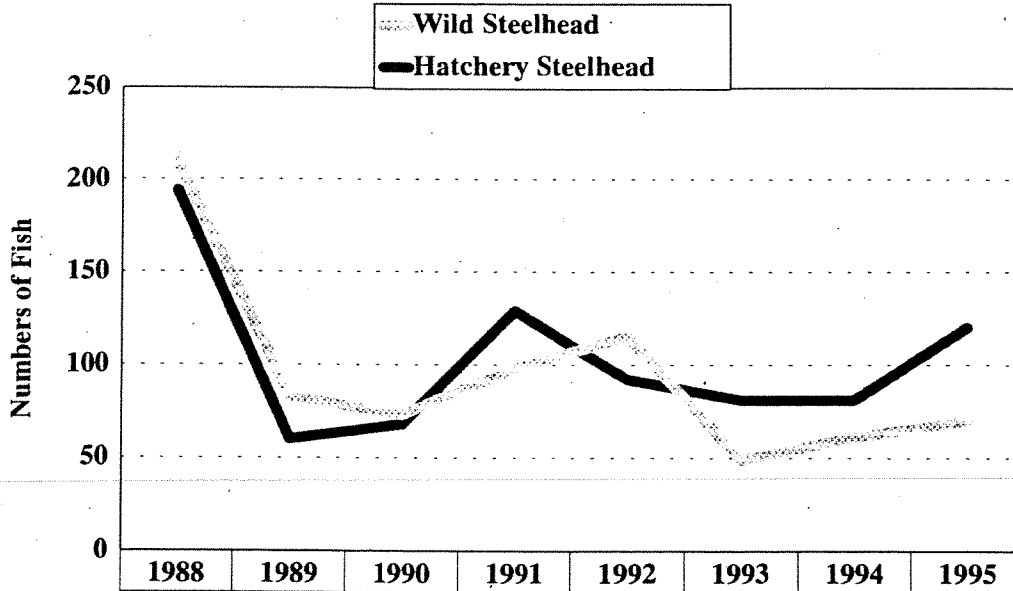


FIGURE III-6-5: Steelhead escapement for wild and hatchery steelhead for the Wind River, Skamania County, Washington. Snorkel Survey data, unadjusted.

Fishing Pressure

Increased access to streams increases fishing pressure. The combined effects from hooking, harvesting and releasing fish can influence the size and species composition of fish populations (Clark and Gibbons, 1991). Fishing can have major adverse effects on fish populations. Hooking fish can result in injury or death even if they are released. The handling of a hooked fish removes the protective slime layer or coat which protects fish from disease.

Excessive sport harvest negatively impacted wild steelhead populations in the past (Wind 1989:24). Present Washington state fishing regulations for the Wind River requires the immediate release of wild steelhead. Wild release increases the escapement of the native run and decreases the possibility of hybridization with hatchery steelhead. There is a risk to wild steelhead even with catch and release. Released fish may sustain injuries during handling and may be susceptible to disease which may lead to death. Using flies or artificial bait decreases the mortality to 30% of bait-caught fish. Catch and release mortality is estimated at 4-6% with each capture with artificial bait (Griffith 1993:421). Juvenile steelhead are protected through the release of 12-14 inch minimum size and a two fish bag limit for rainbow trout. No fishing is allowed 400 feet below or 100 feet above Shipherd Falls, Trout Creek Fish ladder and Carson National Fish Hatchery. Tyee Springs is closed to fishing. Trout Creek requires barbless hooks.

The Wind River area is part of the land ceded to the Yakima Indian Nation in the Treaty of June 9, 1855. The Yakima Indian Nation harvests fish on the west bank of the mouth of the Wind River. The area is an in-lieu fishing site set aside for compensation for tribal fishing grounds flooded by the Bonneville Dam reservoir. Some years harvest is also occurs below the Carson National Fish hatchery intake. The tribe has the right to take no more than 50% of the harvestable fish resources.

Columbia River salmonid management requires cooperation in international waters and an agreeable allocation of fish resources by federal, state, and tribal agencies. Management of fish in the state of Washington and the Wind River are co-managed by the Washington Department of Fish and Wildlife and the Yakima Indian Nation. The management entities are responsible for it's own fishery regulations, enhancement activities, and licensing .

There is no commercial fishing presently on the Wind River but spring chinook may contribute to commercial off shore fishing. Species become commercially extinct or unprofitable before actual extinction.

Most all steelhead harvested by Wind River anglers are assumed to be summer-run. A few fish caught in winter may be winter-run (Wind 1989:27). Most sports catch of Columbia River summer steelhead occurs in tributaries. Most tributaries above the Bonneville Dam are limited to hatchery steelhead only (ODFW 1991:50).

From 1977 to 1981, catch summaries made no distinction between wild and hatchery fish. In the ten years before 1983, mean punch card catch per smolt planted was 1.4 percent. (Lucas 1985:5). A linear regression analysis of data from 1963 through 1983 found that only 33 percent of the annual variation in catch could be attributed to differences in number of smolts planted (Lucas 1985:5). Data from 1961 through 1992, 45 percent of the annual variation in catch could be attributed to differences in number of smolts planted (Faler, Bair, Wieman). From 1983-1985 sports catch went down which may be attributed to no smolt plants in the two previous years. When planting resumed sport catch went up (Wind 1989:22). Wind River steelhead sports catch by month is shown in Appendix E, Figure 1. Most fish are caught in June, July, August, and September. Marked and unmarked (hatchery and wild) steelhead punch card summer run totals are shown in Appendix E, Figure 2. Steelhead plant and punch card data is shown in Table 2 and Table 9 in Appendix E.

A creel census was conducted on the Wind River from May 29 to November 21, 1982. Angler effort was highest from June through mid-July, then declined rapidly and remained low throughout the fall. In June effort was concentrated below Shipherd Falls. The upper canyon and stretches above Stabler were most popular in July and August. As fish moved out of the canyon with fall rains, most fishing effort shifted to the area above Stabler. Although difficult to determine wild contribution to the catch because of a wild-release regulation in effect above Shipherd Falls, Cho (the census taker) felt many fish caught in October and November were wild. A 1981 creel check during August and September by Schuck (1981) reported 26 percent of the fish kept by anglers were wild. Analysis of scales from 19 fish caught by an angler in November 1984 revealed a wild component of 68 percent (Lucas, 1985:5).

The entire Wind River is snorkel surveyed annually to acquire population estimates for wild and hatchery steelhead, spring chinook, and whitefish. The survey results from 1983 to 1995 show that 34% of steelhead reside in one particular reach of stream that consist of less than 9% of the survey length. This particular area is not accessible to anglers because of posted private lands and/or inhibiting terrain. This area is a vital refuge for adult steelhead within the Wind River.

The Wind River was evaluated by sub-watershed to identify areas that could negatively impact wild populations of steelhead via fishing; i.e. mortality inflicted during catch and release of wild steelhead, parr or smolt and/or poaching. The following variables were considered: Access to fishable waters, known fishing access sites, and dispersed and developed recreational camping sites adjacent to streams. **Fishing pressure within the following sub-watersheds could adversely impact wild steelhead and resident trout populations : Lower, Middle, Upper and Headwaters Wind River, Lower Bear Creek, Lower and Upper Trout Creeks, Lower Panther Creek, Trapper Creek, Paradise Creek, and Dry Creek.**

SUMMARY

Table III-6-4, summarizes aquatic impacts in the Wind River watershed and presents an "aquatic impacts index." The aquatic impacts index is a way to show which sub-watersheds are most severely impacted. Values presently range from "O" (least impacted to "8" (most impacted). This index is the basis for prioritizing and recommending restoration activities.

TABLE III-6-4: Aquatic impacts index for the Wind River Watershed, Skamania County, Washington

Aquatic Impacts Index	H2O ID	Sub-Watershed	Biological "Hot Spots" "Ranked"	Potential Disease and Competition	Risk of Interbreeding / Hybridization	High Fishing Pressure	High Risk of Increased Peak flows	High Risk of Sedimentation Impacts	High Risk of Increased Maximum Water Temperature	Extremely Poor Habitat Conditions (Riparian Veg, LWD, Pools, W/D)	Migration Barriers Subterranean Flows, Dams or Culverts
8	N	Lower Trout	4	X	X	X	X	X	X	X	X
7	M	Layout	2	X	X		X	X	X	X	X
7	I	Upper Trout	3	X	X	X	X	X	X	X	
7	H	Compass/Crater	5	X	X	X	X	X	X	X	X
6	J	Middle Wind	1	X	X	X		X	X	X	
6	B	Headwaters Wind				X	X	X	X	X	X
5	C	Lower Falls		X	X		X	X	X	X	
4	W	Pete's		X	X				X	X	
4	T	Lower Panther	8	X	X	X					
4	V	Upper Wind	7	X	X	X		X			
4	Z	Lower Wind	11	X	X	X		X			
3	G	Nine-mile		X	X		X				
3	A	Paradise		X	X	X					
3	D	Trapper	9	X	X	X					
3	F	Dry	6		X	X					
3	L	Upper Panther		X			X	X			X
3	K	Eight-mile		X	X		X				
3	O	Lower Bear		X		X	X				
2	R	Mouse			X			X			
1	P	Upper Falls		X							
1	Q	NF Bear		X							
1	S	Cedar	12		X						
1	U	Little Wind	10		X						
1	X	EF Bear		X							
1	Y	Brush					X				
0	E	Big Hollow									

KEY

X = Sub watershed Negatively Impacting Aquatic Resources

"Aquatic Impacts Index" = the sum of X's

Restoration should be prioritized on the relative biological importance (*the spawner density rankings*) and the potential adverse impacts to salmonids (*Aquatic Impacts Index*). Table III-6-4 summarizes the findings of this watershed analysis. **The following watersheds are priority for restoration: #1 Lower Trout Creek, #1 Layout Creek, #1 Upper Trout Creek, #1 Compass/Crater Creeks, and #2 the Middle Wind River (see Map 17).**

Within these sub-watersheds, the following stream reaches will be priority for restoration: #1 Trout Creek 2, 5, 6, and 7; #1 Layout Creek 1; #2 Middle Wind River 1; #3 Compass Creek 1; and #3 Crater Creek 1. Other reaches of stream that will be targeted for future restoration are: Panther Creek 5; Paradise Creek 1; Dry Creek 1; and Trapper Creek 1 (see Map 17).

The goals for reach 2 of Trout Creek are to increase adult and smolt migration around Hemlock dam, restore the natural sediment regime, decrease maximum water temperatures and prevent angler inflicted mortality of juvenile and wild steelhead. **Actions associated with these goals would be: dam removal or modification.**

The goals for reaches 5,6 & 7 of Trout Creek; reach 1 of Layout Creek; reach 1 of the Middle Wind River; reaches 1 of both Compass and Crater Creeks; reach 5 of Panther Creek; reach 1 of Dry Creek; reach 1 of Trapper Creek; and reach 1 of Paradise Creek are: to restore lateral stability, LWD, width/depth ratios, channel/bank stability, sediment regime and pools within the range of natural variability. The objectives to meet these goals are to: reduce the width to depth ratios within identified reaches to less than 10 (2 years), increase channel stability to the "good" Pfankuck ratings (10 years), restore the conifer component along these reaches to eight trees per acre greater than 24" in diameter (60 years), increase in-stream large woody debris >75 pieces per river mile (1 year), and increase pool quantity and quality. These goals will be accomplished by constructing large woody revetments (engineered log jams) and soil bio-engineering (bank stabilization methods incorporating native plants/grasses, wood, and rock, riparian Silviculture, and under-planting deciduous dominated riparian stands with native conifers.

Martha Creek diversion dam should be evaluated for removal or modification.

Poaching was witnessed by Gifford Pinchot National Forest Employees during the 1994 snorkle survey. Poaching is probably more prevalent than suspected. Law enforcement should be supplemented on the Forest and on private lands. ***Special emphasis should be placed on the Little Soda Springs/Hatchery Complex area and dispersed recreation sites.***

Fishing regulation recommendations should be made to the State of Washington to defer trout fishing within the anadromous sections of the Wind River and tributaries. Resident trout fishing should be confined to the areas occupied exclusively by brown and brook trout. The current fishing regulations require release of fish under 14." Electrofishing and snorkel survey data indicates that 14" resident trout are not a common occurrence within the Wind River and do not warrant a trout fishery.

Stream fertilization to increase aquatic productivity should be evaluated and tested to improve marine and freshwater survival of anadromous salmonids.

Slides that occurred during and prior to the February floods of 1996 should be evaluated for treatment using soil bio-engineering techniques. The priorities for slide rehabilitation at this date are: #1 Tyee Springs and Panther Creek, #2 Nine-mile, #3 Wind River and #4 Proverbial slides.

Fish of the Wind River

Historic Conditions

Anadromous fish are found in all sub watersheds except Bear Creek, Pete's Gulch, and Brush Creek. The Wind River watershed has anadromous and resident fish with overlapping areas of use. All anadromous habitat is used by various resident species. Steelhead/rainbow and cutthroat trout are believed to have historically accessed 143 river miles. Shipherds Falls was a natural barrier to all anadromous summer and fall chinook, coho, and chum salmon used the lower 4 miles of the Wind River. The Bonneville Dam flooded the mouth after 1938, eliminating the majority of summer chinook, coho, and chum salmon. Shipherd Falls fish ladder was constructed in 1956, giving spring chinook access to the Carson Hatchery at river mile 23. Brook trout were introduced into the watershed for a sport fishery. Early stocking records (Table 3) and 1936 stream condition records (Table 9) are included in Appendix E.

TABLE III-6-5: 1984 electrofishing survey. Wind River watershed. Skamania County, Washington. (Crawford 4).

Stream	Steelhead	Eastern Brook	Chinook	Cutthroat
Big Hollow	X			
Compass	X	X	X	
Crater	X	X	X	
Dry	X			
Lower Trapper	X		X	
Martha	X		X	
Mouse	X			
Paradise	X			
Planting	X		X	
Trout	X	X	X	
Upper Trapper	X		X	
Wind	X		X	

In 1995, spring chinook used 38 river miles with hatchery and natural reproduction. Steelhead are found in 84 miles of river, cutthroat in 31 miles, and brook trout in 68 miles of river (Figure III-6-5). Rotary screw traps were installed at three locations during the spring of 1995. Five foot traps were located on Trout Creek above Hemlock Lake, and on Panther Creek below Cedar Creek. An eight foot trap was located on the mainstem Wind River below Shipherd Falls. Eight different fish species were collected in the three screw traps between April through June. The mainstem Wind River trap captured wild and hatchery steelhead (*Oncorhynchus mykiss*), hatchery and naturally produced spring chinook (*O. tshawtscha*), fall chinook, pacific lamprey (*Lampetra tridentata*), threespine stickleback (*Gasterosteus aculeatus*), sculpin (*Cottus spp*), redbelt shiner (*Richardsonius balteatus*), and an unidentified species of sucker. The Trout Creek trap collected wild and hatchery steelhead, resident rainbow trout, sculpin, a possible brook trout (*Salvelinus fontinalis*) and a beaver. The Panther Creek trap collected wild steelhead, sculpin, and several unidentified salmonid fry (Steelhead Smolt Inventory 1995:2).

Anadromous Fish

Management of wild stocks in the Wind River is difficult because of the gauntlet of natural and man-related hazards these fish must negotiate during their migration to and from the ocean. Some mortality of Wind River smolts occurs passing over Bonneville Dam. Returning adults, in addition to natural predation, must survive the Columbia River sport fishery and lower river gill nets, locate and pass over the Bonneville fish ladder, weave through a maze of Indian nets in Bonneville Pool, then finally evade the sport fishery in the Wind. (Lucas 1985:6).

Steelhead

Steelhead (*Oncorhynchus mykiss*), were the only anadromous fish able to ascend Shipherd Falls until 1956 when a fishway was built around the falls. The falls naturally selected the larger and stronger individuals capable to continuing to the reaches beyond the falls. Historic information suggests 2,500 fish returned to the watershed annually (Wind 1989:16). Steelhead are named for the time of year when they return to fresh water from the ocean. Most winter steelhead return to tributaries below the Bonneville Dam but some Bonneville Pool tributaries (Wind River) have a small run (ODFW 1991:46).

Steelhead enter the Wind River watershed throughout the year but the summer steelhead run is larger than the winter run. The majority of summer steelhead return to the Wind River as four and five year old adults. Fish enter the river from March through December with a peak between July and October. Spawning usually occurs from February to May with peaks in March and April.

Juveniles probably emerge sometime between March and September and rear for at least two years before emigrating in April and May. There is no data available for determining egg to smolt and smolt to adult survival specific to the Wind River.

Spawning surveys have been conducted in the basin since 1984. Spawning occurs throughout the basin.

However, spawning escapement to the Upper Wind River was limited . . . It was hypothesized that since escapement in the Wind River is low, and suitable habitat is available in the lower river, fish had no incentive to move further upriver (Wind 1989:17).

Smolt-to-adult survival for fish returning to streams of the Bonneville Pool is estimated at 7.1 percent (Lucas 1985:19). Steelhead, unlike Salmon, and can live to be repeat spawners. Less than 1% of summer steelhead in the Columbia survive to spawn again (ODFW 1991). A realistic summer steelhead carrying capacity for the Wind River subbasin is estimated to be 23,498 smolts, and 1,668 adults (Wind 1989:18).

The Clark-Skamania Flyfishers began doing early and late season snorkle surveys on the Wind River in 1983. Each year since 1984 the CFS has attempted to snorkel the upper Wind River near Beaver Camp shortly after higher water flows have stimulated a movement of wild steelhead that had oversummered in the canyon upstream into the "flats." In the past it had seemed that early November was a good time period to expect that such a movement had occurred, although a waiting game can then ensue in the hope of finding water low an clear enough to encourage a snorkel count (McMillan 1988:6).

In 1987, the CSF snorkelers surveyed two miles above the Carson Hatchery on Dec. 20.

TABLE III-6-6: Adjusted early and late season wild steelhead counts from Clark Skamania Flyfishers surveys.

	1983	1984	1985	1986	1987
Early			14	10	11
Late	0	23	13	42	29

The Wind River Snorkel Survey is now an annual August event occurring when summer steelhead are in holding pools. Teams of several snorkelers and recorders collect data for sections of up to three river miles. Team members include: state and federal fisheries professionals, angling and/or conservation groups, and other volunteers. Wild and hatchery fish were differentiated by presence or absence of adipose fins.

TABLE III-6-7: Snorkle count and population numbers for summer steelhead from 1988-1995, Skamania County, Washington.

Year	Hatchery	Wild	Total
1988	251	274	525
1989	84	116	200
1990	126	123	249
1991	156	129	285
1992	132	161	292
1993	129	113	220
1994	155	136	291
1995			241

The Washington Department of Fish and Wildlife conducts steelhead spawning surveys to estimate population size. Hatchery and winter steelhead also spawn in the Wind so redd count numbers may include these fish.

TABLE III-6-8: Redd survey population estimates for summer steelhead from 1985-1995, Wind River, Skamania County, Washington.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Redd counts	434	N/A	608	826	464	228	294	286	250	N/A	N/A

Surveys were done on foot or air. (Macmillan 1988:15 In 1987, Trout Creek accounted for 54 percent of total Wind River redds (Lucas 1987:12). A Clark-Skamania Flyfishers report notes unequal effort put into

surveys. Trout Creek was more thoroughly surveyed than other streams in the Wind River so appears to be supporting more spawning. (Macmillan 1988:14).

Undoubtedly because of the GPNF habitat work and the GPNF/WDW electroshocking work that has occurred on Trout Creek over the past 7-8 years, the Trout Creek system is more familiar to surveyors and the more predictable spawning reaches are well identified which can't help but stimulate more effective and focused spawning surveys. Because of the more extensive spawning survey work that has been done on Trout Creek, the resulting data is likely the most reflective indicator as to what the actual escapement trends are regarding Wind River wild steelhead (Macmillan 1988:15-16).

Since 1992, the Washington Department of Fish and Game and the Wind River District have standardized stream survey efforts. Every 12 to 14 days through spawning season Dry, Falls, Nine Mile, Panther, Paradise, Trapper, and the Wind are surveyed by foot. Martha Creek was included in 1995. A table on Redd surveys by year is included in Appendix E, Table 10.

Forest Service records show steelhead stocked in Paradise Creek in 1935 and in the Wind River in 1938. Early stocking records are included in Appendix E, Table 3. A Wind River 1935 stream survey reported large numbers of steelhead entered the Wind during the fall and winter though only seven were seen during the five day survey. Poor visibility because of high water conditions may have contributed to the low numbers seen (Survey 1935:3-4). The June 1937 survey reports abundant fingerlings to the falls and numerous above the falls. Numerous redds were seen but no adult steelhead, salmon, or trout. Gravel deposits above log jams and debris made up most of the available spawning area.

Winter steelhead were released in 1951, 1956, 1959, and 1963 in the Wind River Basin (Connolly 1995:2-3). The Washington Department of Game (DWG) began introducing hatchery steelhead smolts in 1956 to compensate for angling and logging habitat losses (Everest 103). Summer steelhead were released in 1957 and on an annual basis from 1961 (Connolly 1995:2-3). The program continued for 17 years. (Bryant 1981:51). These fish were from the Skamania Hatchery--descendants of wild steelhead returning to the Washougal and Klickitat Rivers in the late 1950's (Wind 1989:20). Tables in the appendix summarize the number of fish stocked and the cohort adult fish caught by anglers. During the late 1970's, the Wind River steelhead populations declined sharply (Connolly 1995:2-3).

To eliminate or reduce competition between wild and hatchery stocks, the Washington Department of Game returned the Wind River to a wild-only, single-stocked, steelhead fishery in 1980 (Everest 103). The plan included:

1. Protecting and improving aquatic habitat in the upper Wind River basin to increase carrying capacity for juvenile wild summer steelhead. The Gifford-Pinchot National Forest participated in the program.
2. Reestablish wild fish stocks through eyed-egg planting programs using Wind River stock wherever possible.
3. Stopping stocking hatchery smolts in the basin.
4. Protect juvenile and adult summer steelhead through angling regulations (Everest 103).

The Wind is the only river in the state designated as a "wild steelhead" river. Requirements for a "wild steelhead river are no regulatory dams along its length, a healthy watershed, adequate spawning areas and gravel, and moderate to limited road access.

The Wind River was surveyed in 1980 by forest service personnel to evaluate fish habitat. Summer steelhead and resident rainbow trout were using the area (Everest 104). Spawning and rearing habitats were in fairly good condition and appeared to be improving because of substantial amounts of large woody debris (Everest 104). The Gifford Pinchot National Forest, Fish and Wildlife Service, and Washington Department of Fish and Wildlife developed a salmon and steelhead habitat improvement plan for the

Wind River subbasin. The plan objective was to improve habitat and increase runs of native anadromous fish Wind 1989:5).

Steelhead eyed eggs and fry were released instead of smolts in 1982 and 1983 (Connolly 1995:2-4). In 1982, Skamania stock summer steelhead hatchery fry were released in Trout Creek (above the Hemlock Dam), Layout Creek, and Compass Creek. The estimate ranged from 10,988 (BPA) to 119,000 (WDW) (Connolly 1995:2-4). Wild adults were collected from Trout Creek in 1983 and spawned at the Skamania Hatchery. The eyed eggs and fry were released in Trout Creek (Connolly 1995:2-4).

The Washington Department of Wildlife began a steelhead wild-fish catch release program in 1983. The recorded harvest decreased by 80% the first year but increased to about half of the pre-1983 harvest level by 1988 (Connolly 1995:2-4).

Wind River smolt release started again in 1984 because the number of wild steelhead spawners returning was not adequate to continue future populations and provide for viable sports fishing. The level was reduced from previous releases. The planned current release is 25,000 to 40,000 smolts (Connolly 1995:2-4). All hatchery smolts are adiposid clipped prior to release. In 1995, hatchery steelhead smolts were released above the Trout Creek dam to testing the efficiency of downstream traps (Connolly 1995:2-6)

A 1984 population survey sampled 11 creeks in Wind River watershed (Crawford 4). Steelhead, the dominant species, were found in all sampling sites. The stream appeared to approach its carrying capacity for producing smolts in the fall of their second year (Crawford 12). All sites but Big Hollow had more 0+ age fry than 1+. This was used as evidence that adequate numbers of spawners were reaching the watershed to fully seed the system (Crawford 5). Steelhead parr larger than 10 inches were only found in the canyon and downstream of Soda Springs. Lack of fish in the upper watershed may be caused by illegal harvest or migration or larger fish down stream (Crawford 13). A table of Wind River juvenile salmonid biomass grams per cubic meters is included in Appendix E, Table 4.

Chinook Salmon

Historically, fall chinook (*O. tshawytscha*) were found near the mouth of the Wind. Fall chinook lost their spawning area when with the completion of the Bonneville Dam. The fall chinook run is composed of strays from the Spring Creek National Fish Hatchery and naturally produced fish (Wind 1989:37).

TABLE III-6-9: Adult fall chinook escapement, sports catch and total return to the Wind River, 1977-1986 (Wind 1989:30).

Year	Escapement ¹	Sport Catch ²	Total Return
1977	922	16	938
1978	1322	3	1325
1979	884	42	926
1980	355	11	366
1981	197	0	197
1982	361	0	361
1983	442	0	442
1984	126	0	126
1985	168	0	168
1986	403	10	413

¹ Estimated from WDF spawning surveys.

² Sports catch information based on WDF punch card surveys

A Washington State salmon hatchery was established near the mouth of the Wind River in 1899. Fall chinook were raised from eggs taken from the Wind River. The Bureau of Fisheries (presently the USDI Fish and Wildlife Service) took the hatchery over in 1926. Washington State again took over operation in 1927. The hatchery was rebuilt and run until 1938 when Bonneville Dam backwater flooded the lower 1.5 miles of the Wind River, immersing the buildings and covering the hatchery grounds (1951:6). The November of 1935 survey reports the fall chinook run entering the Wind were all taken and spawned by the Wind River Hatchery. Table 5 in Appendix E, shows the fall chinook egg-take at the Wind River Hatchery from its opening until closing.

Shipherd Falls was a barrier to upstream chinook migration. Spring chinook are introduced and mostly hatchery produced. Adults out migrate from April to August with the peak in May, June, and July. Spawning takes place in August to September. Smolts out-migrate in March and April.

The only hatchery still operating in the Wind River basin is the USDI Fish and Wildlife Service Carson National Fish Hatchery (NFH). The hatchery is located at river mile 18.0 on the Wind River. Stocks raised between 1938 and 1950 included: spring chinook salmon, sockeye salmon, and coho (silver) salmon; rainbow trout/steelhead, brook trout, and cutthroat (black spotted) trout. A chart of eggs handled at the Carson Hatchery between 1938-1950 is included in Appendix E, Table 6. The early emphasis was rearing fall chinook from the Wind River and other streams. Most of the fry and fingerlings were released into Tye Creek (Bryant 1951:9). The Carson hatchery released spring chinook fingerlings twice during the spring of 1938 but there was no spring chinook run of consequence in the Wind River in 1940 (Survey 1940:7). None returned to the hatchery or were found by the stream surveys at or below the falls in 1941. No coho were noted at the time of survey, but it may have been too early for them to be migrating (Survey 1940:6).

In 1952, spring chinook from upriver (Snake River) stock were produced for transplanting to lower Columbia River tributaries (Connolly 1995:2-3). The early 1950's operations plan called for the hatchery to provide a variety of fish needed for current demand. The fish were to develop natural production of the basin and contribute to the fishery. No more than one-half the fish in any run would be artificially spawned, except for blueback, (kokanee), salmon which would be handled by the hatchery (Bryant 1951:13). Cold water and lack of facilities hampered early production (Bryant 1951:9). Hatchery improvements and the Shipherd Falls fishway made it possible to expand operations (Bryant 1951:14). Hatchery operations are funded through the Mitchell Act (Wind 1989:28).

To mitigate the loss of Columbia River habitat (see DAMS) the hatchery concentrated on salmon production. A study to determine the feasibility of introducing spring chinook salmon into the Wind River began in 1955. In 1956, fishways (see NATURAL BARRIERS) were built around Shipherd and a smaller falls on the lower Wind allowing anadromous fish to return to the hatchery (McMillan 1981:8).

From 1955 to 1961, artificial propagation of 3,221 adult spring chinook trapped at the Bonneville Dam took place at the Carson National Fish Hatchery. This artificial spawning resulted in 5,078,800 fingerlings released into the Wind River. In 1959, 107 of these fish returned to the Carson Hatchery. In 1960, 854 spring chinook passed Shipherd Falls and 552 returned to the hatchery. In 1961, 1,032 spring chinook passed Shipherd Falls and 610 returned to the hatchery (Zimmer 1). Carson Hatchery spring chinook returns from 1975-1995 is included in Appendix E, Table 7.

Carson stock spring chinook return to the hatchery primarily as four and five year old adults with a mean size of 29.5 in and 36.2 in., respectively (Howel et al. 1984). Adult immigration is from mid-May to mid August and adults are held from May to the first week in September. Fish are spawned from August to mid-September. Eggs are incubated from August to the end of December and emerge in January. Juveniles are reared in raceways for approximately 25 months (January to the following April) and released into the Wind River the latter part of April. Smolt to adult survival for Carson NFH spring chinook has averaged approximately 0.3 percent. Based on recoveries of coded wire tags and on genetic stock identification studies, harvest of Carson stock spring chinook occurs almost exclusively in freshwater (Wind 1989:29).

TABLE III-6-10: Hatchery escapement, natural escapement, and sports catch of adult spring chinook in the Wind River (Wind 1989:30).

Year	Hatchery Escapement ¹	Natural Escapement ²	Sport Catch ³	Total Return
1977	2953	126	1579	4658
1978	2964	243	1627	4834
1979	2537	154	776	3467
1980	3336	91	0	3427
1981	2545	155	0	2700
1982	1635	79	0	1714
1983	2485	266	0	2751
1984	2074	213	0	2287
1985	4681	192	0	4873
1986	5608	111	1797	7516
1987	4371	87	779	5237

¹ Counts at Carson NFH
² Estimated from WDF spawning surveys
³ Sports catch information based on WDF punch card surveys.

Coho Salmon

The 1935 Wind River survey notes a small run of coho (*O. kisutch*) was established (Survey 1935:3).

No coho were noted during the 1940 survey, but it may have been too early for them to be migrating (Survey 1940:6). Coho were handled by the Carson Hatchery in 1944 (Bryant 1981:8). There were no silver (coho) or chum salmon in the Wind River in 1951 although silver salmon formerly spawned near the mouth before Bonneville Dam flooded the area (Bryant 1951:8-9). Steelhead did complete with introduced coho stocked between 1959 to 1973. Unpublished manuscripts of the Columbia River Fisheries Development Program make reference to the potential for both early and late coho in original surveys (Wind 1989:39). Biological data for Wind River natural coho is assumed to be similar to coho returning to the Little White Salmon Fish Hatchery--returning from the ocean after 1 to 2 years usually at 3 years of age (Wind 1989:39-40). No hatchery production or harvest currently takes place on the Wind.

Sockeye or Kokanee

Sockeye (*O. nerka*) are anadromous and kokanee are non anadromous. Sockeye eggs were handled at the Carson Hatchery in the 1940's. In 1949, six blueback salmon, or kokanee, were observed below Shipherd Falls but no natural run of bluebacks exists in the area. (Bryant 1981:8).

Sea-run Cutthroat

Sea-run cutthroat are listed as extinct in the Wind River basin in the 1991 *Pacific Salmon at the Crossroads: Stocks at risk from California, Oregon, Idaho, and Washington*.

Pacific lamprey

Pacific lamprey (*Lampetra tridentata*) larvae are filter feeders that inhabit fine silt deposits in streams. It is not known how long lamprey live in fresh water before migrating to the ocean in spring to early summer. Adult lampreys return to fresh water in late spring and early summer to spawn.

Resident Fish

Rainbow

Resident rainbow trout (*O. mykiss*) are widely distributed through out the watershed. These may be native rainbow trout, residualized steelhead, or descendants of stocked fish. A 1935 survey states rainbows occurred in "goodly numbers" throughout the system. (Survey 1935:3). Rainbow stocking was discontinued in 1980 except for Hemlock Lake. Up to 10,000+ catchable rainbow trout a year were released for the "put and take" fishery in Hemlock Lake until 1986. The stocking numbers decreased to about 1,000 in 1994. No stocking was done in 1995 (Connolly 1995:2-5).

Cutthroat

It is assumed cutthroat (*O. Clarki*) historically occupied more river miles in the Wind River watershed than other fish. Cutthroat were reported below the falls (Survey 1935:3). Cutthroat eggs were handled by the Carson Hatchery in 1939, 1941, and 1942. No cutthroat were caught in Trapper or Bear Creek during the Clark-Skamania Flyfishers angler sampling in August of 1980. The Clark-Skamania Flyfishers conducted angler sampling in August of 1980. No cutthroat were found during a 1984 population survey which sampled 11 creeks in the Wind River watershed (Crawford 4). Cutthroat are found above and below barriers and in association with mountain whitefish. Rainbow and cutthroat are known to interbreed in areas where populations and habitat use overlap. Introductions of nonnative salmonids, habitat degradation, and over exploitation have lead to their demise.

Brook Trout

Brook trout (*Salvelinus fontinalis*) are not indigenous to the Wind River watershed but now occupy about 45 river miles. Present brook trout are descendants previously stocked fish. Brook trout prefer cool water and are fall spawners. Both males and female defend redds. Aquatic insect larvae is the principal stream food. Growth of brook trout may be stunted in infertile streams of the Wind River watershed. Brook trout stocking was discontinued in 1980.

Brown Trout

Brown trout can live in more turbid, warmer water with less oxygen than other trout. Brown trout in Soda Peaks Lake were feeding on crayfish.

White fish

Whitefish (*Prosopium williamsoni*), a resident salmonid, reside in the main steam of the Wind River. Whitefish were reported below the falls in the 1935 Wind River Stream Survey (Survey 1935:3) but there no mention of them above the falls. White fish are late fall spawners. They can live up to 11 years and reach 12 inches in length.

Threespine Stickleback

Threespine stickleback (*Gasterosteus aculeatus*) are small bottom dwelling fish. Spawning takes place during their first year. The males build a nest of algae and debris. Several females may eggs in the same nest. The males guard the nests until the eggs hatch in about 7 days. He also guards the young for a short time. It appears most sticklebacks in Washington die shortly after spawning, living just one year.

Sculpin

Sculpin (*Cottus spp*) are small bottom dwelling fish. Local species mature at 2 years and are spring spawners. Sculpins live up to 5 or six years.

Benthic Macroinvertebrates

No information on specific macroinvertebrates for the Wind River streams is available. Macroinvertebrates were surveyed at 20 sites throughout Washington during the summer of 1993. Trapper Creek, a wilderness stream, was used as a reference site. Trapper Creek ranked best on visual assessment of the Cascade streams. Out of ten Cascade streams Trapper Creek ranked 2 in riffle taxa richness (total number of species in the sample) and 5 in pool taxa richness. In the EPT index of sensitive taxa (Ephemeroptera, Plecoptera, and Trichoptera), Trapper Creek also ranked 2 for riffles and 5 in pools. Generally, taxa richness indicates the "quantity" of a particular habitat type and the EPT Index elaborates on the "quality" of habitat. Ranking lower in pools may be because of low pool quality or pool habitat may be transient. Generally, species richness decreased with water quantity but Trapper Creek was sampled during low flows but was still species rich (Plotnikoff 1995:3-8).

A lake survey was done on Soda Peaks Lake in 1991. Soda Peaks Lake is located in the Trapper Peaks Wilderness. A Copepod zooplankton, *Diatomus sp.* was identified along with trichoptera (caddisfly) diptera (black fly and mosquito) and Odenata (dragonfly) insect orders. Crawfish (Decapoda) were numerous. The Washington Department of Wildlife has no stocking record for crayfish. Lake brown trout were feeding on the crayfish, while the brook trout feed on crayfish, insects, and zooplankton.

Fish Stocking

Forest Service records show steelhead stocked in Paradise Creek in 1935 and in the Wind River in 1938.

Winter steelhead were released in 1951, 1956, 1959, and 1963 in the Wind River Basin (Connolly 1995:2-3). The Washington Department of Game (DWG) began introducing hatchery steelhead smolts in 1956 to compensate for angling and logging habitat losses (Everest 103). These fish were from the Skamania Hatchery--descendants of wild steelhead returning to the Washougal and Klickitat Rivers in the late 1950's (Wind 1989:20). Some of the Skamania stock fish probably escape harvest and spawn in the river; but how much they contribute to the wild gene pool is unknown (Wind 1989:20). Some feel these introductions may have imposed constraints on the wild stock and/or genetics of the Wind River steelhead as a result of natural interbreeding with hatchery origin fish (Wind 1989-16).

It has long been a concern that wild Wind River stock(s) of steelhead may be adversely affected by releases of hatchery fish in the Wind River System (Lucas and Nawa 1985). The degree of introgression by hatchery fish with the wild stock and possible changes in the stock as a result are simply unknown. Currens and Schreak (1995) reported that the data on genetic relationships among Trout Creek, Wind River, Panther Creek and Skamania Hatchery steelhead did not provide a clear picture of whether the wild stocks had been definitively introgressed with the hatchery stock.

The potential for hatchery fish affecting wild fish occurs when hatchery released juveniles compete with wild fish for food and space, when exploitation of wild fish increases because of presence of hatchery fish, and when returning adults of residualized adults interbreed with wild fish. Behavior and survival rates may be adversely altered with interbreeding. Johnson and Abrahams (1991) found that hybrid steelhead and rainbow trout were more likely to risk perdition while foraging than were wild steelhead. The difference in the risk taken was attributed to genetics rather than hatchery experience (Connolly 1995:3-4,5). No rainbow stocking was done in Hemlock Lake in 1995 to protect young steelhead that may be caught by anglers.

The historically introduced hatchery fall chinook out migrate early so habitat competition with steelhead was minimal. Returning chinook adults staged in the pools from Tyee Springs to Beaver Camp where they were illegally snagged, netted, and speared by greedy sports enthusiasts. Wild steelhead summered in the canyons below Hemlock and usually moved upstream after the chinook harassment was over. The hatchery has had adverse affects on native steelhead. Some years, up until to 1977, diverted water caused a quarter mile stretch of the Wind River to be dry from fall through winter. Diverted water cut steelhead off from upstream movement to spawning areas (Bryant 1981:9).

Spawning adult summer steelhead may compete with the winter steelhead race but winter tend to use just the lower 11 miles of the mainstem Wind (Wind 1989:23). Hatchery steelhead in the Wind River spawn earlier than wild fish so interbreeding may not be a problem.

Steelhead did complete with introduced coho stocked between 1959 to 1973 (Bryant 1981:8). Hartmen (1965) found that the microdistributions of juvenile steelhead and coho were similar in winter but different in summer. Coho actively defended pools and steelhead defended territories in riffles during summer when densities and aggression levels were high (Connolly 1995:3:9).

The introduction of spring chinook in 1955 may have reduced the carrying capacity of summer steelhead above Shipherd Falls (Wind 1989:24). Hatchery spring chinook fingerlings (totally 373,714) were released in Trout Creek above the Dam from 1984 to 1987. Stock came from Abernathy Creek or the Wind River. During this population study both chinook and steelhead were of smaller size in Trout Creek (tributary with highest chinook population) indicating the stocking program had an effect on steelhead (Crawford 14).

Brook trout are introduced in the Wind River watershed. Larson et al. (1995) found that brook trout predominated in steep, coldwater streams over nonnative rainbow trout because of the brook trout's smaller size, higher densities, higher success in pools, and better resistance to detrimental effects of freshets and fishing pressure. Newman (1956) found brook trout to be socially dominant over rainbow trout of similar or slightly larger size (Connolly 1995:3-7)

The affect of fish stocking on native amphibians is unknown.

Agriculture and Aquaculture

Steep slopes limit agriculture in the watershed. The Wind River Nursery uses water impounded by the dam on Trout Creek for irrigation. The nursery water right requires 8cfs to pass down Trout Creek. Runoff from the Wind River Nursery may be a chemical barrier for fish in Martha Creek.

The Carson National Fish Hatchery is at the confluence of Tyee Creek and the Wind River. The hatchery controls about 230 acres of land in the Gifford Pinchot National Forest. The facilities consists of 2 earthen rearing ponds, 2 concrete adult holding ponds, 46 raceways, 24 starting tanks, and 21 trough-type incubators (Wind 1989:29). The Carson Hatchery withdraws large quantities of water during the mid to late summer months (Wind 1989-13). The hatchery has water rights for 53 cfs from Tyee Creek (Wind

1989:29). The hatchery also has water rights for 42 cfs from the Wind River. Wind River water use is limited because resident rainbow trout and steelhead located above the hatchery intake are known to carry Bacterial Kidney Disease (BKD), (Wind 1989:29). The hatchery also faces the problem of introduced brook trout in Tye Springs carrying BKD. Past hatchery problems with BKD which lowered fry to smolt survival. Returning adults are injected with erythromycin and obvious BKD carriers are culled to keep the disease under control (Wind 1989:30). Infectious Hematopoietic Necrosis (IHN), another fish disease, was detected in 70 percent of returning adults in 1987. Only eggs from non-infected adults were used and eggs were water hardened and treated with iodine for disease control (Wind 1989:30). During the winter high flow, sediment may cause problems. Stream restoration in the "hatchery reach" of the Wind River have been ongoing since the early 1990's.

Habitat Conditions

Pools

The first stream surveys were conducted in 1935, 1936, 1937 and 1940 by the United States Bureau of Fisheries to inventory streams for prospective "fisheries enhancement" as mitigation measures for the construction of Bonneville dam. These surveys are interesting and lend insight into the general habitat conditions and species distribution. These same sections or reaches of stream were surveyed again in 1992 using the same criteria for pools. The results of these "re-surveys" are a bit misleading due to the differences in season and water levels in which the surveys were conducted. The 1930's surveys were carried out in November, June and September. Tables III-6-11 and III-6-12 indicate an increase in pools per mile for the Wind River, Trout and Panther Creek and a decrease in pools per mile for Trapper Creek.

TABLE III-6-11: Oregon State University analyzed changes for intermediate size pools in the Wind River, Trout, Panther, and Trapper Creeks from 1935 to 1992, Skamania County Washington. Intermediate pools were defined as >25 yd² area and > 3 feet deep.

Stream	River Miles	1935-1945 # Pools	1935-1945 Pools/mi	1987-1992 # Pools	1987-1992 Pools/mi	% change
Trout	6.8	20	2.9	144	21.2	+203
Wind	20.4	67	3.3	204	10.2	+631
Panther	6.2	39	6.3	65	10.5	+67
Trapper	2.0	36	18.0	18	9.0	-50
Total	35.4	162	4.6	431	12.2	+165

TABLE III-6-12: Oregon State University analyzed changes for large size pools in the Wind River, Trout, Panther, and Trapper Creeks from 1935 to 1992, Skamania County Washington. Large pools were defined as >25 yd² area and > 6 feet deep.

Stream	River Miles	1935-1945 # Pools	1935-1945 Pools/mi	1987-1992 # Pools	1987-1992 Pools/mi	% change
Trout	6.8	6	0.9	10	1.5	+67
Wind	20.4	55	2.7	63	3.1	+15
Panther	6.2	10	1.6	4	0.6	-63
Trapper	2.0	7	2.0	1	0.5	-75
Total	35.4	75	2.1	80	2.3	+10

When the Wind River, Panther, and Trapper Creek surveys are scrutinized the differences can be attributed directly to the 1935 surveys being conducted during the fall freshets in November and the 1992 re-surveys conducted during low flows in the late summer. The streams were transporting distinctly different volumes of water and therefore, had different observable pool regimes. The inverse is true for Trout Creek. When the survey was taken in 1935 there were two water diversions; one hydroelectric and the other irrigation. The surveyor commented "Water is exceptionally low and no water is flowing through the fish ladder..." and "At the time of the survey the creek was abnormally low, the discharge of water being 4 c.f.s." Probably a very significant portion of the water was being diverted to the nursery fields for irrigation and pools that were recorded in 1992 were not counted in 1935 because they were dry.

LWD

Work plans in 1951 included removing debris and log jams in Cedar Creek, Holes Creek, Cold Creek, and Trapper Creek (Bryant 195:12). Early habitat restoration was in an experimental stage. The Forest Service cleaned Trout Creek and probably other streams of large woody debris (lwd) during the 1970's (Connolly 1995:2-3). Not everyone in the 70's supported stream cleaning. A Washington Department of Game employee, C. E. Stockley sent a letter to the Gifford Pinchot National Forest in June of 1970 regarding removing a log jam in T4N, R6E, Section 11 of Trout Creek.

[They] . . . netted the area for fingerlings. We caught coho fry and rainbow and eastern brook trout fingerlings in the vicinity and observed steelhead spawning redds on nearly every good riffle. Later on June 17 I returned to the area and hiked upstream from the log jam for over a mile seeing steelhead reads on nearly every prominent riffle. I took rainbow trout from most sizable pools on flies. Going downstream from the log jam 1 1/2 miles, more steelhead nests were seen and pools fished yielded rainbows 6-9 inches total length. The spawning redds ran about 12 to the mile in this area indicating rather important usage by the steelhead this spring.

Paying particular attention to the pool-riffle relationship and the cover establishing where the stream is now located, indicates that a nearly ideal spawning and rearing situation now exists.

Further examination of the log jam area leads me to believe that removal of the jam would not effect change in the stream channels. The extent of beaver workings indicates that minor channel changes will continue in the area unless the beaver are thinned out.

A good portion of the stream is shielded by its proximity to the old growth timber along its margin affording light cover.

We recommend that the stream be left undisturbed.

From 1980's to the present, the Forest Service stream improvement projects took the opposite approach-- putting large woody debris back into the streams. Four areas on Layout Creek and one area on Trout Creek had large woody debris and vegetation treatment to restore bank stability during the summer of 1994. Wind storms and rain on snow events during the winter of 1995-1996 added to the large woody stream debris.

Spawning Habitat

In 1981, it was estimated that Trout Creek contained enough spawning habitat for 1,500 pairs of anadromous salmonids but the habitat had not recovered from the early century degradation (Everest 103).

The Everest report stated Martha Creek served as a spawning and short-term rearing area for summer steelhead but logging and road construction have disturbed the stream. Since 1978, several road cut, fill, and culvert failures occurred in this area. Nutrient and sediment-rich irrigation water from the Wind River Nursery entered the stream in summer (Everest 104).

Historically the most productive spawning areas were: the Wind River above Stabler Bridge, Trout Creek "Flats" (Layout, Compass, Crater, and Trout Creeks).

Natural Migration Barriers

Shipherd Falls is located in T3N,R8E, NW4 of Sec 21 at RM 2.1. Summer steelhead were the only anadromous fish able to ascend the falls segregating most of the river from other salmonids. The Wind River assistant hatchery manager and other old settlers stated chinook did not travel the 3/4 mile to the hatchery let alone the falls. He considered it unlikely chinook would travel up past the falls if a passage way was made (Survey 1936:2). A 1936 WPA project blasted a partial channel around the falls. The federal funding ended before the State Department of Fisheries completed the job (Bryant 1951:10).

In 1940, the spawning run was earlier than usual because of heavy early fall rains. The September stream survey party found a fairly good run of fall chinook at the falls.

The lower falls, being only from 3 to 5 feet in height, were easily jumped. The salmon then swam into a small pool below the second falls which was from 13-15 feet in height, and of bed rock sloping up stream so that the top of the falls is from 3 to 8 feet back of the foot of the falls. Seasonal rains had occurred, and the falls had at least the reported normal flow, mostly of white water. The falls were watched for nearly an hour late in the afternoons of the two days and this was enough to determine that the second falls alone is a complete barrier to fall chinook, and undoubtedly to spring chinook as well. An estimated 200 chinook were continually jumping at the second falls, and none were able to jump but little over half the distance to the top, or about 8 feet. They landed in the few inches [of] falling white water, hit the bed rock of the barrier and were hurled back into the pool below. Several fish were often in the air at one time, and a real accurate count was impossible. Movies were taken by Bryant.

These fall chinook were fine bright fish, most retaining their silvery ocean appearance. None were very badly fungused or bruised, most in fact having no visible blemishes of any sort. Only two or three were seen to have small fungus patches or fresh bruised not over 2 inches in area, probably from the thumping they had taken on the rocks while jumping. (Survey 1940:5).

The chinook would jump at the falls until exhausted then die without spawning or drop back downstream and attempt to find an adequate place to spawn (Survey 1940:6). Very little fall chinook spawning area, perhaps enough for 200 fish, remained after flooding and scouring (Survey 1940:6). Eggs deposited by more salmon would be washed away or inadequately covered (Survey 1940:6). To maintain the fall chinook run, the 1940 survey report suggested building a fish ladder around the falls, blasting the falls, or blasting a bypass (Survey 1940:6). Another survey was done in the spring of 1941 to determine if the spring freshets might allow passage for spring chinook--even though there was apparently no wild run of spring chinook (Survey 1940:7). The survey concluded salmon could not make it past the falls but spring steelhead could with considerable difficulty (Survey 1940:6).

The 1951 estimate to construct a fishway over Shipherd Falls was \$400,000 with \$2,500 for operation and maintenance (Bryant 1951:10). Chinook and coho salmon, along with winter steelhead, could access the upper Wind River after 1956 when the Falls was laddered.

Dams

Splash Dams

Streams and rivers became transportation routes for timber mills. Streams were cleared of large woody debris, boulders, and undercut banks. Splash dams were built to impound water, creating artificial freshets, so logs could be sluiced downstream. Splash dams could turn a small stream into a torrent. If fish were spawning, the increased flows would drive them downstream. Repeated log drives had disastrous channel widening, flushing, and scouring effects on the salmonid spawning and rearing habitats below the dam (Everest 102). Splash dams blocked up stream migration of summer steelhead to spawning and rearing habitat (Everest 102). Logging dams built on Trout and Panther Creek in the late 1890's blocked upstream fish passage to spawning and rearing habitat until 1914 (Everest 104). Tree bark removed from the logs during the down river drives would sink, covering spawning area and the shelter used by fry.

In 1901, the Skamania Boom Company attained a charter from Washington state that permitted artificial flooding the Wind River (Tolfree 1984:4). The company strategically purchased land located in areas where there was a river constriction for damming. Splash dams were built on the Wind River (T4N, R7E, Sec 15), Trout Creek (Wind River Administrative Site) and Panther Creek (just below the confluence with Cedar Creek). In 1910, the Wind River Lumber company took over the Skamania Boom Company holdings (Tolfree 1984:4).

The first logging activity of the Wind River Lumber Company centered around the splash dams on the Wind River and Trout Creek. Logging Camp 1 was the location of the splash dam on Wind River. It was located in the area where the Wind River Logging Company is based, ten miles north of Carson. The splash dam on Trout Creek was located where the Civilian Conservation Corps dam is located at Hemlock Lake.

The company's Camp 3 was constructed near that dam on the north side of the creek. At both locations a pond (referred to as a log pond) was created as a result of the damming. Logs were placed in the ponds until the dam gates were opened releasing them to drive to the mouth of the Wind.

The dams on Trout and Panther Creek were timed to release as the logs in the Wind were driven by their confluence's. This gave the additional impetus needed to drive the logs to the Columbia.

One of the improvements the Skamania Boom Company had made was blasting areas of the river banks to enable logs to move more easily through restricted areas. The exposed gray basalt boulders along the Wind where Trout Creek enters, seen from the road south

of Stabler, are examples or remnants of the blasting along the river. When a log jam was created along the river, the logs were blasted apart by dynamite if they could not be spawn apart (Tolfree 1984:5).

In those days the policy seems to have been that if two boxes of powder should suffice, four were used. . . . Great numbers of salmon and steelhead trout were reported killed by this blast. Dam operators have stated that fish runs reaching the dams were reduced within 3 to 4 years after the initial construction, and they recognized that splashing deleteriously affected spawning below the structure (Meehan, 1991:331).

The Wind River continued to transport logs even after railroad logging was used to access the upper valley. Railroad cars hauled timber to the log pond behind the original Wind River Splash dam. When several hundred thousand board feet accumulated in the pond, the logs were released to floated down to the mouth of the Wind (Mack 1995:20).

An eight foot mill dam with a 14 foot apron dam blocked upriver migration to much of the main river spawning and rearing habitat past RM 14. The 1931 stream survey report remarks the long (30 foot) down-stream apron made it a barrier to anything other than steelhead who also could not pass it during low water (Survey 1935:3). Splash dams were temporary, abandoned after the local timber had been removed. At the writing of the 1935 stream survey report, the Mid Columbia Lumber Company dam was condemned (Survey 1935:3). The dam was removed in February of 1947 with funding from the Washington State Fish and Game Department. The lumber company was compensated for its removal (Bryant 1951:11). Removal of the Carson Lumber Company's mill dam allowed the first upstream passage above "about RM 14" of the Wind River since the early 1900's (Connolly 1995:2-3). Sources give different ownership of the dam.

Prior to 1935, the Forest Service had two diversion dams on Trout Creek (Everest 104). In 1934 and 1935 a concrete arch dam was constructed by the Civilian Conservation Corps to provide electricity. The location is about 2 miles from the mouth of Trout Creek at the site of the 1902 splash dam (Connolly 1995:2-2). The dam is 26 feet high and 183 feet wide with wooden flash boards to adjust the head. The second dam, .7 miles up stream was a four foot dam used for a water supply (Bryant 1981:4). Up stream fish passage at the dams was completed in 1941 according to Everest, but Bryant states in his 1951 report the water supply was screened but not laddered. A 1951 report noted during low-water periods the stream may be nearly dry below the dam (Bryant 1951:8). Presently only the concrete dam remains on Trout Creek. It is no longer used to generate electricity but continues to impound water for Wind River Nursery irrigation. The dam was constructed with a cleanout opening at the base that was used to keep sediment from building up behind the dam. The practice has been minimized since 1977 because of concern for downstream fisheries (Wind 1989:70).

A large amount of sediment is presently filling in the forebay. The reservoir has a normal storage capacity of 120-acre feet of water. In 1977 a study was conducted to determine the depth of the reservoir's sediment. Estimates measured the sediment at an average of five feet and the total volume of sediment was estimated to be 45,000 cu.yds. There have been no new sediment core samples measured but aerial photo interpretation and bathometric mapping completed in 1995 indicate that sediment the level has increased by several feet (Wieman, 1994).

Hydropower Dams

The 1935 concrete Trout Creek dam adjacent to the USDA Forest Service site originally provided electricity for the Civilian Conservation Corps Camp the Wind River Nursery, and the Wind River Ranger Station (see discussion above).

The Wind River is upstream from only one mainstem dam. The Bonneville Dam was built on the main stem Columbia in 1938. A Wind River result was a three to four week delay in the spring return of fish. Loss of 20 percent of down migrating smolts and 20 percent of returning adults was attributed to the dam

(McMillan 1981:8). The dam also flooded prime summer steelhead holding water and salmon spawning areas (Everest 102). Fall chinook were virtually eliminated because spawning areas were inundated with backwater (1995:2-2). The Bonneville Dam Second Powerhouse was completed in 1982. The fish guidance system operations were restricted but improvements have been made and more are planned. (Connolly 1995:2-4).

Fishing Pressure

Wind River has historically been known for its steelhead fishery resource. A 42 foot falls segregated the river from other salmonids except summer steelhead. Bill McMillan recalls stories of local anglers describing pre World War II fish populations on the Wind River.

It's evident that the Wind had a remarkable run of summer steelhead that made initial river entry in March and continued to build below the falls until sometime in June. Common estimates were 500-1000 springers compressed into the main falls pool alone with over 100 steel head in each of the six to eight pools below! It seems probable that the spring run was a minimal 1500 steelhead.

By July they spread out in the canyon pools above, and with continued summer entry were at least 2,000 strong by late summer as fly fishermen explored 20 to 30 main pools with estimates of 100-300 steelhead in many, perhaps even more in the Rock (or Lake) Pool. In September a run of late summer arrivals made entry to the Wind that includes Idaho strays seeking temporary cool flows. The Wind's own fall run was substantial and probably consisted of a minimum 500 fresh entries in September and October.

It would seem a safe estimate that the Wind, at its best had a historic summer run of no less than 2,500 steelhead with perhaps as many as 5,000-dependent on individual angler pool counts estimates. (With no scientific data available, this is a "rough," in-the-ballpark figure seeming in accord with angling history.) Per volume and watershed length the Wind must have ranked among the most prolific of any summer steelhead rivers. This remarkable carrying capacity was largely due to the immediate lower river barrier of Shipherd Falls and the ideal breakdown of extensive canyon protection above the equally extensive spawning and rearing flats beyond Hemlock. The only anadromous fish capable of entry into this Mecca-like habitat were summer steelhead of an especially renowned and robust race who had to meet the awesome athlete demands of Shipherd Falls with leaps at the uppermost limits for the species (McMillan 1981:7).

After W.W.II anglers noticed a decrease in fish numbers attributed to habitat changes and increased sport fishing pressure. New fishing tackle developed after W.W.II changed the scope of steelhead fishing. The European spinning reel allowed fishing success without extensive learning time and transparent nylon line became available. Fishing expanded from just the lower Wind in high spring flows to year round fishing (McMillan 1981:9).

The 1951 Lower Columbia River Fisheries Development Program states

There is no commercial salmon fishery in the vicinity of Wind River, but the stream does contribute fall chinook to the sport and commercial fisheries below Bonneville Dam as well as to the off shore troll fishery.

Operation of the racks at the mouth of Wind River for the purpose of taking salmon eggs has provided a means of counting the spawning escapement of fall chinook salmon. The average run during the past 5 years has been approximately 1,500. It is calculated that the Wind River provided 64,700 pounds of fall chinook salmon to the commercial troll and river catch annually and 4,500 pounds to the sport catch, with a combined catch of

69,200 pounds worth about 2,500 fish which contributes 56,2000 pounds to the fishery and 7,500 pounds to the sports catch, with a combined weight of 63,700 pounds and a value of \$38,400 a year. The contribution of other species is slight, and for the present is considered negligible.

Hatchery smolt plants were discontinued in 1982 when the Wind was designated a "Wild Steelhead River." Most organized fly-fishing clubs were in favor of the change while many local residents opposed the change on the basis the population was too low to support a viable fish harvest. Smolt plants began in 1984 because of public demand (Lucas 1985:6). See anadromous fish and steelhead section.

7. TERRESTRIAL SPECIES AND HABITATS

A. ANIMALS

The following groups of species are addressed in this section:

- Threatened, Endangered and Sensitive (TES) Species,
- Management Indicator Species,
- Raptors and Herons,
- Bats, Great Gray Owl, Larch Mountain Salamander,
- Survey and Manage Species

Additional information on species and habitats is included in Appendix D - Wildlife Tables.

Table III-7-7-1, Appendix D, shows land allocations and habitat provided under the NW Forest Plan and the GP Forest Plan.

Table III-7-7-2, Appendix D, is as list of potential wildlife species by life history guilds for the Wind River Watershed.

Threatened, Endangered and Sensitive (TES) Species:

TES species documented or suspected to occur within the Wind River watershed are listed in Table III-7-7-1; Regional Forester's List - A Listing of USF&WS Endangered, Threatened, and USDA-FS Sensitive Species. These species are addressed in biological evaluations for Forest activities. Sensitive species are identified with guidance from USF&WS candidates for Federal listing and Washington State listings.

Although sensitive and candidate species are defined differently, most of the sensitive species in the following table do meet both definitions. There are many State listed and Federal candidate species that are not on the Regional Forester's List; consequently, they are not required to be addressed within Forest Service NEPA or ESA documents.

TABLE III-7-1: Regional Forester's List of Threatened, Endangered, & Sensitive (TES) Species Documented or Suspected to Occur within the Wind River Watershed (FSM 2670 -1992)

Endangered	Threatened	Critical Habitat	Sensitive
--gray wolf --grizzly bear --peregrine falcon	--bald eagle --Northern spotted owl	--Northern spotted owl	--North American lynx --California wolverine --Townsend's big-eared bat --common loon (uses lakes during migration) --Northwestern pond turtle --Larch mountain salamander

- **Endangered species:** A species which is in danger of extinction throughout all or a significant portion of its range (Sec. 3, ESA).

- **Threatened species:** A species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
- **Critical Habitat:** Special areas within a geographic range with physical or biological features essential to the conservation of species which may require management considerations or protection.
- **Sensitive species:** Those species identified by a Forest Service Regional Forester for which population viability is a concern, as evidenced by significant current or predicted downward trends in population and in habitat capability that would reduce a species' existing distribution (FSM 2600-91-3).
- **Candidate species:** A species under review by the USF&WS for listing as an endangered or threatened species. It is prudent to consider in the event a candidate becomes proposed and listed.

Management Indicator Species:

The GP Forest Plan identifies a number of species as Management Indicator Species (MIS). MIS are selected because their welfare is presumed to be an indicator of the welfare of other species using the same habitat and whose condition can be used to assess the impacts of management actions on a particular area (GP Forest Plan GL-12).

TABLE III-7-2: Management Indicator Species & Reason Selected (GP Forest Plan III-7-3)

Species	Reason Selected
spotted owl	requires large areas (2,200 ac.) of mature & old-growth forest
pileated woodpecker	requires moderate areas (300 ac.) of mature & old-growth forest
pine marten	requires smaller (160 ac.) areas of mature & old-growth forest
cavity excavators	use or require snag and coarse woody debris habitat
Roosevelt elk and black-tailed deer	high human demand for hunting and viewing
mountain goat	human value for hunting and viewing; populations small and declining; sensitive to disturbance including: timber and fire management, roads, recreation, and illegal hunting
wood duck	requires mature riparian hardwood habitat
goldeneye duck	requires mature and old-growth coniferous riparian habitat
bald eagle and peregrine falcon	Federally listed threatened and endangered species

Raptors and Herons:

TABLE III-7-3: Habitat Management Objectives for Raptors & Herons (GP Forest Plan Amend 2-75 & 76)

Species	great blue heron	osprey, Swainson's hawk, ferruginous hawk, Northern goshawk, great gray owl
Seasonal Closures for Nesting	Mar 1-Aug 31	---
Protective Area	660 ft around each rookery site	660 ft around each identified nest (except great gray owl)
Management Plans	When colony no longer active or occupied, all management activities may be removed	*State specific requirements for each nest site & feeding areas *Provide direction on silvicultural methods allowed which do not significantly change the vegetative character of nest site
Activities Restricted w/in Protective Area during Nesting	Management & human	Management & human road & trail closures

TABLE III-7-4: Habitat Management Objectives for Raptors (GP Forest Plan Amend 2-75)

Species	bald eagle	golden eagle	peregrine falcon
Seasonal Closures for Nesting & Wintering	Nest site: Jan 1-Aug 31 Winter roost: Nov 15-Mar 15	Mar 1-Aug 1	Apr 1-Aug 1
Activities Restricted during Seasonal Closure Periods	Noise, human, & harvest w/in 1300 ft horizontal & 2600 ft line-of-sight of active sites	Mgt & human road & trail closures	
Surveys	Annual survey of known nest territories to determine presence & recruitment		Survey historic & potential nest sites by 1995
Management Plans	Bald Eagle Recovery Plan	--	*Peregrine Falcon Recovery Plan *Cooperate w/ WA State Dpt F&W to establish Forest pop'ns
	Site-specific conservation strategies for each nest site, roost site, & feeding area		

Findings:

- Surveys have not occurred on a consistent basis within the Wind River watershed for over five years due to the reduction and high turn-over in personnel, lack of funding, and 1990 listing of the Northern spotted owl.

- Management plans have not been developed for any of the raptors and heron nesting sites.
- WA Dpt F&W is concerned with our inconsistent survey effort within planned timber sales where harvesting poses the most serious threat to Northern goshawks.
- The 660 ft buffer around great gray owl nests conflicts with Amend 2-79 which requires a 1/4 mile buffer (1320 ft). Amendment 11 coordinator, John Roland, stated the 1/4 mile buffer protection is the correct one and the change will be made to the document.
- Seasonal closures are not specified for raptors and silvicultural direction is not specified for heron rookeries. This information has been forwarded to the Forest Wildlife Biologist.

Bats, Great Gray Owl, Larch Mountain Salamander:

TABLE III-7-5: Summarizes Habitat Management Objectives for Bats, Great Gray Owl, & Larch Mtn. Salamander (GP Forest Plan Amend 2-77, 79 & 81)

Species	bats	great gray owl	Larch Mtn. salamander
Applicable Land Allocation	Matrix Adaptive mgt areas	All allocations	All allocations
Habitat Protected	Caves, mines, abandoned wooden bridges, old buildings, snags & decadent trees	Meadows & natural openings \geq 1 acre	Key habitat is mossy talus with overstory canopy
Protection Area	No harvest w/in 250 ft of sites containing bats	*No harvest 300 ft around above habitat *Establish 1/4 mi protection zone around known nest sites	*Maintain \geq 40% canopy cover w/in known site & buffer *Buffer \geq 1 site-potential tree or 100 ft horiz distance, whichever is gr --lgr widths upslope appropriate *Partial harvest okay by helicopter or highlead logging systems to avoid disturbance of talus layer

Findings:

- These are to be implemented as a result of the 1994 President's Plan; however, no survey work has occurred yet.
- Under "Protection Area" for the Larch Mountain salamander, **highlead** system should actually read **skyline** system. A highlead system creates ground disturbance (is unable to fully suspend logs yarded) which is in direct conflict with the protection objective. This has been brought to the attention of the Amendment 11 coordinator, John Roland.

Survey and Manage Species:

Survey and Manage Strategies for Animal Species Suspected or Documented to Occur on the Gifford Pinchot National Forest (Amend 2-63 thru 71 & 2-79):

These measures apply within all land allocations. They apply to a species and the habitat it is known to occupy. Surveys must precede the implementation of ground-disturbing activities occurring in or after the year listed.

TABLE III-7-6: Summarizes habitat Management objectives for Survey and Manage Strategies for Species Suspected or Documented to Occur

Species	Survey & Manage Strategy			
	Manage Known Sites	Survey Prior to Activities & Manage Sites	Conduct Extensive Surveys & Manage Sites	Conduct General Reg'l Surveys
Salamanders: Riparian=VanDyke's salamander Terrestrial=Larch Mtn salamander	X ≥1995	X ≥1997	--	--
arthropods (herbivores)	--	--	--	X ≥1996
Bats: silver-haired bat; long-eared myotis; fringed myotis; long-legged myotis	X ≥1999	X ≥1997	--	--
great gray owl	X	X ≥1995	--	--
lynx			X ≥1996	
Land Snails: Puget devia; Columbia oregonian; Dalles sideband; Dalles hesperian	X ≥1999	X ≥1997	--	--
Freshwater Snails: tall juga; Columbia duskysnail	X	X ≥1997	--	--
Slugs: evening fieldslug; Malone jumping slug; warty jumping slug; panther jumping slug; papillose tail-dropper	X ≥1999	X ≥1997	--	--

Size and Arrangement of Habitat:

Many terrestrial forest-dwelling organisms are adapted to larger-sized patches than currently exist. Arrangement and size of forest patches have changed greatly over a short time.

Current and Historic Landscape Composition, Patch Size, and Patterns: Subregional Ecological Assessment Project (USDA May & July 1993) and Fire Ecology and History (Crump 1995):

The REAP report provides a reference condition for the forests within the Wind River watershed. Reference year 1890 is used because stand data is available, and this is before major European influences occurred on landscape alterations and natural fire cycles. Forest working groups (Western hemlock, Pacific silver-fir, and mountain hemlock) were selected because they represent a range of stand replacement fire regimes. The Western hemlock group has a more frequent fire history than the Pacific silver-fir or mountain hemlock groups. A small amount of the watershed is in the mountain hemlock zone (<1%). These acreages were added under the Pacific-silver fir group,

REAP analysis quantifies and compares features within the historic (natural) and current landscape patterns. The same REAP assumptions used to develop percentages for the reference condition were used to derive current conditions: early-successional forests are 0-20 years old and late-successional forests are ≥ 200 years old for all working groups. When age was not in database, used tree class and size. Shelterwood harvest cuts were placed under the early-successional stage because they function as such (recommended in the REAP report).

Additional information on species and their associated use of habitats is in Appendix D, Table III-7-1, title. "List of Potential Wildlife Species by Life-History Guild" (Mellen 1995). Species are grouped into life-history guilds based on how species will respond to different amounts and distributions of habitats across the landscape.

TABLE III-7-7: Wind River Watershed Comparison of Historic & Current Landscape Condition by Forest Working Group

Landscape Condition	Historic Condition Range of Natural Variation		Current Condition w/o snags	
	Western hemlock	Pac-silver fir	Western hemlock	Pac-silver fir
Late-success'l (%)	46 - 72	48 - 69	16	8
Late-success'l Avg Patch Size (acres)	≥ Early success'l patch size		133	102
Early-success'l (%)	10 - 17	12 - 17	7	3
Early-success'l Avg Patch Size (acres)	Either very small <10 ac or large 1000-3000 ac		24	27
Fire Return Interval (years)	50-200	170-300	Possibly longer due to successful fire suppression efforts	
Species Diversity	Diverse vegetative species		Douglas-fir (single species) planted	
Patch Description	<ul style="list-style-type: none"> * Less uniformly spread across the landscape * More transit'l, low contrast edges * Irregular edges * Boundaries follow topography & landforms 		<ul style="list-style-type: none"> * Uniformly distributed across the landscape * High contrast edges & abrupt contrast changes * Straight, uniform edges * Boundaries defined by human 	
Fragmentation	<ul style="list-style-type: none"> * Did exist at times - more localized * More areas where large patches dominated * Early-success'l stage longer: time +50 yrs for soil & seed source conditions to develop 		<ul style="list-style-type: none"> * Definitive pattern across the landscape - cut blocks w/ adjacent leave blocks * More areas where small patches dominate * Early-success'l stage shorter - plant 1-3 yrs after harvest 	

Findings:

- The amount of late-successional forests today ranges 30-40 % lower than historic conditions.
- Historic patch size was most likely even larger than historic early-successional patches. In comparison, current patch size is severely small.
- There is approximately 1 patch per 100 acres of late-successional forest.
- Late-successional patch size is smaller than historic levels and may be less effective due to the large number of small isolated islands and "stringers."
- The islands and stringers (narrow bands of late-successional forest) may not support large intact habitats. Furthermore, these smaller patches may have less capability to moderate daily temperature extremes during critical periods such as winter.
- As a result, species associated with these small or narrow patches might be vulnerable to predation from high-contrast species.
- Current conditions may favor species guilds using contrast or generalist patch configurations. Species within contrast patches use two different seral stages in close proximity while generalists use a variety of seral stages (see Appendix D, Table III-7-1).
- Current conditions may not adequately support species guilds associated with mosaic, large tree structure. A mosaic configuration comprises aggregate patches of similar habitat (see Appendix D, Table III-7-1).
- The percent early successional forests is less than but closer to historic levels; however, current patch size is again small in comparison to reference conditions.
- There are approximately 4 patches per 100 acres of early-successional forest well-distributed across the watershed except where unroaded areas occur.
- High contrast edges, especially in the Pacific-silver fir group associated with wet soils, have created chronic windthrow (Pete's Gulch, Upper Falls Cr, and Headwaters Wind subwatersheds).
- The current condition of the remaining forested land (65%) is in the mid-successional stage of development (pole to small sawtimber) as a result of successful fire suppression efforts and regeneration planting which has accelerated forest growth from early to mid-successional forests. Some of the small sawtimber stands are the result of early-settlement fires.

Northern Spotted Owl and suitable habitat:

TABLE III-7-8: Summarizes Habitat Management Objectives for the Northern Spotted Owl for Planned Forest Activities (Endangered Species Act & GP Forest Plan Amend 11)

Seasonal Closure for Nesting	Mar 1 - Sep 30
Activities Restricted during Seasonal Closure Period	Noise, human, & harvest w/in 1/4 mi of nest or activity center
Surveys	*Annual survey of known nest territories to determine presence & recruitment *For large-scale activities: survey 1.82 mi radius about the project areas w/ 3 visits each year for 2 years followed by strict survey protocol
USF&WS Thresholds	* ≥ 500 ac at 0.7 mi radius from center * >2663 ac at 1.82 mi radius from center
Management Plans	*1994 NW Forest Plan
Mgt w/in NW Forest Plan-Matrix +	*Owls known \leq Jan 1, 1994 receive 100 ac core of best available habitat around nest or activity center * Riparian reserves will be managed & restored to meet dispersal quality habitat or better

+ The USF&WS's Biological Opinion has agreed to the NW Forest Plan ROD, Alternative 9. It states, "any site-specific considerations of critical habitat in the Matrix are considered minimal and will be evaluated through watershed analysis and site-specific plans, as appropriate" (USDI-F&WS 1995).

Spotted Owl Suitable Habitat - A Basis to Evaluate Habitat Integrity for Late-Successional Associated Species:

Under the 1994 President's Plan, spotted owl nest and activity centers, known on or before January 1, 1994 and found in Matrix, receive 100 acres of the best available habitat around their centers. These unmapped late-successional reserves will remain uncut and Matrix lands adjacent to these cores will be designed to reduce risks of natural disturbance. Owls found after this date receive no 100-acre core within Matrix land allocation.

The USF&WS evaluates forest activities which may affect spotted owls and their suitable habitat. This process occurs through written biological evaluations and assessments as required under Section 7 of the Endangered Species Act.

USF&WS threshold levels used to estimate the risk of incidental take from degrading or destroying suitable spotted owl habitat are 500 acres at a 0.7 mile radius and 2663 acres at a 1.82 mile radius from the nest or activity center.

Suitable habitat acres less than these threshold levels may place spotted owl individuals or the population at risk. This risk is evaluated by USF&WS, and that agency determines whether or not the Forest Service may proceed with project activities. If USF&WS allows activities to proceed, a permit is issued (known as a Biological Opinion) for incidental take of spotted owl(s).

Thirty-nine spotted owl home ranges fall entirely or partially in the watershed. Extensive survey work was conducted from 1987-1989 and 1994-1995 with smaller project surveys in between. The 87-89 surveys covered the entire watershed. The 94-95 survey focused around timber sale planning areas but included the most intensive coverage to date. Areas not covered or surveyed in recent years include the south watershed and southwest Trapper Creek Wilderness.

Suitable Habitat Defined:

Suitable habitat for spotted owls can also help evaluate the habitat condition (overall health) for other late-successional associated species. It is defined specifically: forest stands >16 inch dbh; 4 trees per acre \geq 30 inches dbh; \geq 2 snags per acre; multi-layered canopy; >40% canopy cover; and >15 tons of down logs. Suitable habitat can be further qualified by its structural attributes. Old-growth stands historically exhibited the finest nesting-quality habitat for the spotted owl.

The following series of tables display suitable habitat levels for known spotted owls with recommendations for those owls falling below threshold levels.

TABLE III-7-9: Spotted Owl Nests or Activity Centers within Matrix in the Wind River Watershed

Spotted Owl #	0.7 mi Threshold (\geq 500 ac)	1.82 mi Threshold (\geq 2663 ac)
804	268*	1952*
806	619	3877
807	922	4603
832	519	3938
843+	789	4586
844+	348*	2904
846+	422*	3144
3222	820	3789
8208+	674	4500
8209+	503	3314
(* = below threshold) (+ = found > Jan. 1, 1994) + Owl centers found after Jan. 1, 1994 receive no 100-acre core of best available habitat within Matrix land only.		

Findings & Restoration Opportunities:

Owl #	Subwatershed	Findings & Restoration Opportunities
832 & 8209	Headwaters Wind	* Near the threshold level at 0.7 mile radius, keep an eye on this.
804	Layout	* Core isolated but within nesting-quality habitat; encourage connectivity (ground-truth) to the W-SW in pole-sized stands. Widen connectivity to the N where riparian restoration opportunities exist in pole-sized stands. Retain old-growth stand to S until riparian reserves recover.
844	Upper Wind	* Activity center is in small-sized timber but nesting quality habitat lies to the N, meaning actual nest may be in that area. Some nesting habitat is also in riparian reserve. Connectivity opportunities lie more on the west side of Hwy 30.
846	Upper Wind	* Keep nesting-quality habitat to the NW intact & look at opportunities to improve habitat at the center's location. Also look at pole-sized stand to N for opportunities to develop stand into dispersal quality habitat. To the W is a rock-floodplain area but still surrounded by forage quality habitat.

TABLE III-7-10: Spotted Owl Nests or Activity Centers within Late-Successional Reserve in the Wind River Watershed

Spotted Owl #	0.7 mi Threshold (>500 ac)	1.82 mi Threshold (>2364 ac)	Spotted Owl #	0.7 mi Threshold (>500 ac)	1.82 mi Threshold (>2663 ac)
326	431*	1988*	825	590	4837
800	599	3659	831	541	3313
802	543	3298	834	688	3550
805	606	3715	837	490*	2756
808	424*	3542	841	658	3578
817	580	3850	842	687	3921
818	220*	2670	8202	662	3720
819	573	3156	8204	614	3877
821	668	4347	8205	817	4218
822	743	3448	8207	618	2794
824	361*	2463*			

(* = below threshold)

Findings and Restoration Opportunities:

Owl #	Subwatershed	Findings & Restoration Opportunities
326	Lower Falls Cr	* Center w/in nesting-quality habitat. Riparian reserve work will improve connectivity. Look at thinning opportunities in pole-sized stands to the west where connectivity is broken.
808	Lower Falls Cr	* Center inside nesting quality habitat. Connection is there but riparian reserve work will improve it to the N-SE-S.
818	Dry	* Center inside nesting-quality habitat. Connections present but could use riparian reserve work in pole-sized stands in NW.
824 priority	Compass-Crater	* Center is in nesting-quality habitat but is a completely isolated island. Focus on riparian reserves to west since stands pole-sized. Other riparian areas in seedling-sapling stage. Terrestrial pole-sized stands will also improve connections. Lava bed to NE.
837	Ninemile	*Center in nesting-quality habitat. Riparian reserve work to the N-NW will help connectivity. Work also needed in 9-mile mainstem.

TABLE III-7-11: Spotted Owl Nests or Activity Centers outside Wind River Watershed but Radii Falling within

	0.7 mi	1.82 mi
Spotted Owl #	Threshold (>500 ac)	Threshold (> 2663 ac)
814	NA	2947
836	NA	3072
845	518	2604*
8206	NA	2104*

(* = below threshold)
NA = radius outside watershed boundary

TABLE III-7-12: Spotted Owl Nests or Activity Centers within Congressionally or Admin withdrawn Areas in the Wind River Watershed

	0.7 mi	1.82 mi
Spotted Owl #	Threshold (>500 ac)	Threshold (> 2663 ac)
810	773	2892
811	955	5051
823	803	4382
826	774	4618

Findings:

Owl #	Subwatershed	Findings & Restoration Opp's
845	Head Wind & Pete's Gulch Layout & Compass-Crater	* Has connectivity-watch carefully.
8206		* Look for restoration opportunities in terrestrial & riparian pole-sized stands.

Dispersal Habitat - A Basis to Evaluate Connectivity across the Landscape for Late-Successional Associated Species:

Dispersal habitat provides late-successional associated organisms with enough protection for short-term use or movement across the landscape. Dispersal habitat includes forest stands ≥ 11 inches and < 16 inches dbh and 40% canopy cover. It is the minimally acceptable habitat level. Forest stands less than this definition may not meet late-successional associated species' requirements.

We evaluate landscape connectivity by ensuring 50% of every 1/4 township has forest stand conditions which average ≥ 11 inches dbh and $\geq 40\%$ canopy cover. This is called the 50-11-40 rule.

The 50-11-40 rule serves as a benchmark but is no longer required to be analyzed under the 1994 NW Forest Plan as it was for lands between Habitat Conservation Areas (HCAs). Identifying where the 1/4 townships fall below and looking at their locations determine breaks in connectivity and potential restoration opportunities.

TABLE III-7-13: Wind River Watershed % Distribution of Dispersal Habitat Quality or Better By Quarter Township (50-11-40 Rule)

Township & Range	Qtr Township				*=% Vegetative Data Known w/in Qtr Township
	NE	SE	SW	NW	
T3N R7E	72*	--	--	38*	NE=43 NW= 6
T3N R8E	75	46*	29*	63	SE=69 SW=66
T3N R9E	--	--	--	62	
T4N R6E	39	57	46	48	
T4N R7E	66	67	67	72	
T4N R75E	69*				81 (includes T3N R75E)
T4N R8E	53	75	88	73	
T4N R9E	--	--	65	--	
T5N R6E	82	80	45	53	
T5N R7E	49	56	84	67	
T5N R75E	49	--	--	--	
T5N R8E	58	24	40	64	
T6N R6E	--	58	--	--	
T6N R7E	63	67	77	64	
T6N R8E	--	68	79	--	

Total Number Qtr Townships: 41 (100 %)

Number Qtr Townships between 24-39%: 4 (10 %)

Number Qtr Townships between 40-49%: 7 (17 %)

Number Qtr Townships >50%: 30 (73 %)

Findings:

- 27% of the 1/4 townships fall below the 50% cover class condition ≥ 11 inches dbh and $\geq 40\%$ canopy cover.

This indicates connectivity for late-successional associated species is both deficient and not well-distributed in the highlighted 1/4 townships.

These areas turn out to be the same places where the most concentrated harvesting activities have occurred.

- Of these, the subwatersheds not meeting the 50-11-40 rule include:
 - Compass-Crater Creek
 - Lower Wind River
 - Headwaters Wind River
 - Upper Falls Creek
 - Layout Creek
 - Upper Panther Creek
 - Lower Falls Creek
 - Upper Trout Creek
 - Upper Wind River

Restoration Opportunities:

- Connectivity breaks in landscape: riparian reserves within Matrix (* = priority areas)

Compass-Crater *: riparian reserve broken with some terrestrial connectivity; keep terrestrial system intact until riparian reserve recovers;

Headwaters Wind: riparian reserves transecting roads 6700-121 & 124 most concern; connectivity is present but not in all reserves---may want to keep terrestrial connections available in places where riparian reserves are recovering;

Layout *: opportunity to improve connectivity in pole-sized stands;

Lower Falls *: connectivity altogether lacking to the east (both riparian and terrestrial);

Pete's Gulch: work needed east side of McClellan Meadow SE and in Pete's Gulch proper, southeast of bend;

Upper Falls: surrounding wetland adjacent to road 65, keep connectivity intact along terrestrial south edge while riparian reserve recovers.

- Connectivity breaks in landscape: riparian reserves within LSR (* = priority areas)

Dry: river segments along the main stem;

Lower Falls *: connectivity poor, keep Red Mountain inventoried roadless area intact until LSR recovers;

Little Wind and Lower Panther: mainstem but other terrestrial connections present.

Lower Trout *: help in both terrestrial and riparian reserve in southwest;

Middle Wind: restoration opportunity in both terrestrial and riparian pole-sized stands;

Upper Panther *: both terrestrial and riparian reserves have poor connectivity, retain Red Mountain roadless until LSR recovers;

Upper Trout: pole-sized stands within riparian reserves may respond to silvicultural treatment.

Pileated Woodpecker and American Marten Administratively Withdrawn Areas

An issue of special concern, analyzed during this watershed analysis was the change in management allocations for pileated woodpeckers and pine marten populations.

Under the 1990 GP Forest Plan, habitat areas were set aside across the Forest to support pileated woodpeckers and pine marten populations. They were spatially distributed to provide connectivity across the landscape. The network included late-successional forest areas 300 acres and 5 miles apart for the pileated woodpecker and 160 acres and 3 miles apart for the pine marten.

Under the NW Forest Plan, these areas are returned to the matrix unless local knowledge indicates that other reserve allocations will not meet the management objectives for these species. This watershed analysis considered the results of this change.

- Matrix land within Compass-Crater and Layout Creek subwatersheds: There is only one pine marten area.

The marten area directly overlaps with an unmapped late-successional reserve (ULSR) for the spotted owl; although, connectivity is currently inadequate within the riparian reserves.

- Matrix land within Panther, Headwaters Wind, and Pete's Gulch subwatersheds: There are three pine marten and three pileated woodpecker areas.

Half of one pileated woodpecker area overlaps with a wildlife special reserve area (McClellan Meadows) and half of another pileated area falls within both an ULSR and allocated winter range for elk & deer.

One pine marten area falls inside an ULSR.

The remaining areas and portions thereof fall within intact riparian reserves.

- Based on the above findings:

All pileated and marten areas outside of NW Forest Plan reserve areas may be dropped.

Connectivity of riparian reserves in the Compass-Crater and Layout Creek sub-watersheds could be improved by restoration projects.

Ideally the old-growth stand in west-central Compass-Crater sub-watershed should be retained until the riparian reserves provide dispersal quality habitat.

Special Habitats:

Special habitats and special habitat components are infrequent and play a key role in the life-history of many organisms.

Special Habitats:

Special habitats have unique or significant value to many species and include one or more of the following attributes (WA State Dpt F&W 1995):

- high fish and wildlife density or diversity;
- important fish and wildlife breeding habitat, seasonal ranges, or movement corridors;
- limited availability;
- high vulnerability to habitat alteration;
- unique or dependent species.

Special habitats are further described by unique vegetation type, dominant plant species that is of primary importance to fish and wildlife, and successional stage.

Additional information on species and their associated use of special habitats is in the Appendix titled, "List of Potential Wildlife Species by Life-History Guild" (Mellen 1995).

Historic and Current Condition of Special Habitats:

The historic and current condition of special habitats are similar for all except those discussed below.

Differences exist where catastrophic events occurred to dramatically alter the habitats. Splash-damming along Trout Creek may have attributed to eliminating the wetland meadow complex that existed at the confluence of Compass Creek, Crater Creek, and Trout Creek (1917 USGS topographic map).

In current history, wetland meadows may have been planted with conifers to promote forests. This practice happened on the Mt. Adams Ranger District, and I assume it was a common philosophy throughout the Forest Service for a period of time. Most of the wetlands today have clear evidence of logging operations, for instance, east Black Creek Swamp has tree stumps at the edge of its waterline. Harvest units usually were cut to the edge of all types of wetland areas, particularly rivers and streams.

Beaver and their activities in current times are probably more prevalent than historic times. Historic trapping pressure was intense and not sustainable. In fact, a 1936 range allotment map shows where beaver naturally occurred and where the State planted them. I assume planting was done to compensate for over-harvests and not to create more watering holes for sheep. Beavers create ponds which make excellent habitat for certain amphibians. These ponds may also be free of stocked fish which prey on amphibians.

Changes in size and distribution of old-growth forests resulted from harvesting and logging-related fires. Current old-growth forest stands are isolated from one another and smaller in size when compared to historic conditions. Old-growth differences are further explained under "Historic and Current Condition of Composition, Patch Size, and Patterns."

The large number of sheep (1900 estimate ranged from 100,000 to 150,000) and the grazing intensity (Mack 1995) under the Big Huckleberry Range Allotment may have created more grass meadows or made current meadows larger than historic levels around Grassy Knoll. While in other areas with deeper soils,

forest succession progressed rapidly. For example, a 1700 foot airstrip decommissioned in 1946 below Red Mountain (originally a natural meadow) is now a 50 year old lodgepole stand (Mack 1995).

Bridges have increased today from historic levels, and have created more roosting and foraging habitat for bats; however, this additional habitat may be offset by the loss of large streamside snags and decadent trees from logging operations. These types of trees provided the habitat that bridges now support.

Caves are receiving intense human use unlike historic levels. This pressure is causing damage to the cave interiors and disturbance to bats using the cave to hibernate, rear young, and roost. High road densities provide easier access to caves.

Trend for Special Habitats:

In the long term, the NW Forest Plan's protection measures and restoration opportunities will improve the quality of living within special habitats, particularly for wetland-related and old-growth associated species. In the short term, the old-growth associated species are likely to continue experiencing population declines due to current conditions as discussed under Issue 1: landscape composition, patch size, and distribution.

Special Habitats Defined (WA State Dpt F&W 1995 and USDA-FS 1979):

1. **Old-growth forest:** Stands greater than 300 years old; trees large in diameter; multiple tree species and canopy layers with occasional small openings; presence of snags and large down logs.
2. **Cliffs:** greater than 25 feet high and occurring below 5000 feet elevation.
3. **Talus:** homogenous areas of rock rubble ranging 0.5- 6.5 ft in diameter, composed of basalt, and site, or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs.
4. **Caves, lava tubes, lava beds:** naturally formed or man-made cavity, recess, void, or system of interconnected passages which occurs under the earth in soils, rock, ice, or other geological formations, and is large enough to contain a human.
5. **Oregon white oak woodlands:** pure or mixed stands of oak greater than one acre.
6. **Grass meadow:** relatively undisturbed areas as indicated by dominance of native plants where grasses and forbs form the natural climax plant community.
7. **Bridges:** concrete or wooden bridges with rough surfaces to which bats can attach to roost or forage.
8. **Wetland, swamp, lake, pond, seep, stream, river, spring, and riparian zones:**

Standing water (lentic) habitats: lakes, ponds, seeps, swamps, and wetland meadows.

Wetland: lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.

Running water (lotic) habitats: rivers, streams, and springs.

Riparian zone: the area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems that mutually influence each other.

Presence of special habitats is taken from the GIS database, aerial photographs, and WA Department of Fish & Wildlife habitats list.

TABLE III-7-14: Wind River Watershed Known Locations of Special Habitats

Subwatershed (* = w/in matrix)	Special Habitats							
	1	2	3	4	5	6	7	8
Big Hollow	X					X		
Brush								
Cedar					X			
Compass-Crater *	X						X	
Dry	X		X					X
East Fork Bear					X	X		X
Eightmile	X		X					
Head Wind *			X	X				X
Layout *	X		X					X
Little Wind	X		X					
Lower Bear			X					
Lower Falls Cr *	X	X	X	X		X	X	X
Lower Panther	X		X		X		X	
Lower Trout	X		X	X			X	X
Lower Wind	X		X					X
Middle Wind	X		X				X	X
Mouse	X				X			
Ninemile		X					X	
North Fork Bear					X			
Paradise *								X
Pete's Gulch *			X					X
Trapper	X		X			X	X	X
Upper Falls *				X				X
Upper Panther *	X		X	X	X			X
Upper Trout *	X			X			X	X
Upper Wind *	X	X		X				

X = Present

1 = old-growth forest	5 = Oregon white oak woodland
2 = cliff	6 = grass meadow
3 = talus	7 = bridges
4 = cave, lava bed & tube	8 = wetland, swamp, lake, pond, seep, river, stream, spring, & riparian zone (Note: rivers & streams are excluded in chart because they occur in every subwatershed)

Note: The following subwatersheds have negligible Matrix acres ranging from 0.13 to 12.37: Little Wind, East Fork Bear, Lower Trout, and Dry.

Findings:

- Old-growth forests: Most stands lie within late-successional reserve.

One west-central island that falls within the Layout subwatershed (Matrix land) is critically important for connectivity right now because the riparian reserves are not functioning as effective dispersal corridors.

Retain this island until thinning treatments are done on adjacent mid-seral pole stands and they begin to meet dispersal quality habitat.

- Wetland (all categories): The NW Forest Plan will provide for these areas.

However, restoration opportunities are needed in riparian reserves to provide connectivity across the landscape, and are addressed in detail under the 50-11-40 rule, Issue 1.

Wetland meadows are well-distributed across the watershed and are important elk calving areas.

Black Creek Swamp is important habitat for elk and other wetland associated species.

Data gap: wetland surveys for organisms.

Monitor amphibian rearing areas (where egg masses, hatchlings, and tadpoles are) on lakes with associated human use to determine compatibility. Include this on survey form. Coordinate concern areas with recreation planner.

Black Creek Swamp Management Plan (Claggett, Flick, Linde, Blythe, and Interagency)

Determine habitat objectives and road closure recommendations.

There is some overlap with Winter Range Management Plan-Habitat and Roads.

- Caves: The greatest concern to caves result from human visitation:

Lack of maintenance resulting from human use is a problem- removing litter, breaking-up evidence of campsites, and removing painted wall graffiti;

Protecting bat caves during critical seasons.

Data gaps: no trend information on bat species present in caves; limited survey information on bats and other cave-adapted invertebrates; and no information on how the lava bed functions for species.

- Bridges: Little is known about the use of known bridge sites by bats and what type of use occurs.

Key Species Groups Associated with Special Habitats and Components:

Special habitats and their components provide one or more of the following life-history functions: roosting, feeding, breeding, denning, nesting, and calving.

TABLE III-7-15: Key Species Groups Associated with Special Habitats and Components

Special Habitat	Key Species Groups Associated
caves & lava tubes	bats & adapted organisms
lava bed	raptors, bats, fisher, woodpeckers
bridges	bats
talus	pika & fisher
cliffs	raptors
dry meadows	raptors
wetland, lake, pond, seep, river, stream, spring, & riparian zone	amphibians, mustelids, common loon, ducks, elk, & mollusks
OR white oak woodlands	Western gray squirrel & deer
old-growth forest	spotted owl, goshawk, woodpeckers, marten, fisher, & mollusks
unroaded areas	gray wolf & grizzly bear
snags	cavity-dependent species: woodpeckers, mustelids & many songbirds
coarse woody debris	woodpecker, salamanders, rodent & rabbit prey base, mustelids, & felids

Species occurrences come from the WA Heritage database, USDA-Forest Service WILOBS database, and recent survey field notes. Most of the occurrences are associated with research projects or timber sale surveys and thus, do not capture all known locations.

TABLE III-7-16: Known Breeding Occurrences of NW Forest Plan, TES, & MIS Species by Subwatershed in the Wind River Watershed

Subwatershed (* = w/in matrix)	Species																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Big Hollow	X			X	X			X			X				X		
Brush															X		
Cedar				X				X									X
Compass-Crater *				X											X	X	
Dry				X			X	X			X						
East Fork Bear																	
Eightmile				X	X		X								X		
Head Wind *				X	X	X				X	X				X		+
Layout *		+		X		X									X		
Little Wind				X											X		
Lower Bear				X													
Lower Falls Cr *				X	X	X	X				X	X	X	X	X		
Lower Panther			+		X		X	X			X				X		
Lower Trout			+	X	X	X	X	X	X	X	X		X		X	X	
Lower Wind		+	+				X				X		X		X	X	
Middle Wind			+	X	X	X	X	X			X				X	X	X
Mouse								X			X						
Ninemile				X	X		X				X				X	X	
North Fork Bear					X										X	X	
Paradise *	X			X	X	X					X						
Pete's Gulch *	X																
Trapper	X			X	X	X	X	X			X				X		
Upper Falls *	X					X	X					X					
Upper Panther *				X					X		X	X		X	X		
Upper Trout *					X										X	X	X
Upper Wind *			+	X							X		X		X		

X = breeding occurrence
+ = sighting record only

1 = gray wolf	7 = Northern red-legged frog	13 = harlequin duck
2 = peregrine falcon	8 = tailed frog	14 = three-toed woodpecker
3 = bald eagle (winter roosts)	9 = Larch Mountain salamander	15 = pileated woodpecker
4 = spotted owl	10 = Cope's giant salamander	16 = osprey
5 = American marten	11 = Northern goshawk	17 = great blue heron
6 = Cascades frog	12 = Townsend's big-eared bat	

Findings and Recommendation:

- Much of the information is dated and requires follow-up surveys to determine current condition of breeding sites.
- Begin survey work with currently planned Forest projects.

Elk and Deer Winter Range:

Elk and deer winter range is included in the analysis of special habitats because of its intricate management requirements for these key game animals.

Biological Winter Range (BWR) is usually at lower elevation and used by migratory elk and deer during the winter months.

Biological winter range is evaluated using the following habitat components. These components are estimated using the GIS vegetative database:

- **Optimal Cover (OC):** Provides thermal protection, hiding cover, and forage. 71-100% canopy cover, ≥ 2 tree layers, and tree sizes range from mixed small trees (9-20.9 inches dbh) and medium trees (21-31.9 inches dbh) to giant trees (≥ 48 inches dbh).

A 44% threshold level is based on the amount of optimal cover condition required to sustain populations of elk and deer over winter during the stress period (the period of time elk and deer cannot use openings for forage areas because the snow depth is ≥ 18 inches and temperature is ≤ 20 degrees F for an average of 30 days). (Scharpf)

During the stress period, optimal cover conditions must sustain elk and deer populations.

- **Thermal Cover (TC):** Provides thermal protection and hiding cover.
71-100% canopy cover, ≥ 1 tree layer, and tree sizes range from sapling (1-4.9 inches dbh) to giant trees (≥ 48 inches dbh).
- **Hiding Cover (HC):** Provides vegetative cover capable of hiding 90% of a standing elk or deer at ≤ 200 feet (also called security cover) and lesser amounts of forage as canopy cover closes.

41-70% canopy cover and tree sizes range from sapling (1-4.9 inches dbh) to poles (5-8.9 inches dbh).

- **Open Forage (OF):** Provides forage.

0-40% canopy cover and tree sizes range from seedlings (< 1 inch dbh) to mixed seedlings and saplings (1-4.9 inches dbh).

- **Open Road Density:** Open roads (this includes roads with ineffective barricades) have serious effects on animal due to displacement from preferred habitats and harassment by intermittent travel.

Current Condition of Elk & Deer Biological Winter Range:

The current condition of elk and deer winter range is summarized in Table III-7-7-17 below.

TABLE III-7-17: Current Condition of Elk & Deer Biological Winter Range by Subwatershed (Threshold Levels in Parenthesis) in the Wind River Watershed

Subwatershed * = w/in Matrix	BWR Acres - %	Road Density w/in BWR (<1.7 mi/sqmi)	Optimal Cover Condition (>44 %)	Optimal & Thermal Cover Well-Distributed (Yes)	Open Forage Well- Distributed (Yes)
Big Hollow	993- 2	2.7	30	Yes	Yes
Brush	1236- 2	1.3	4	No (77% HC)	No (1% OF)
Cedar	1508- 3	1.5	43	Yes	Yes
Compass-Crater *	481- 1	4.6	17	Yes (55% HC)	Yes
Dry	2640- 5	2.5	11	No in ctrl & south (TC dominates)	Yes
East Fork Bear	1989- 4	0.2	17	Yes but HC dominates riparian reserve	No (2% OF)
Eightmile	1624- 3	2.3	42	Yes	Yes
Head Wind *	2353- 4	3.9	7	No, TC heavy in SW & NW; HC heavy in SE cmr	Yes
Layout *	1127- 2	2.8	2	No (46% HC)	Yes
Little Wind	2048- 4	1.3	32	Yes	No (1% OF)
Lower Bear	1605- 3	3.0	22	Yes	Yes
Lower Falls *	5075- 9	3.1	8	No (47% HC)	Yes
Lower Panther	5367- 9	2.2	38	Yes	No in SE
Lower Trout	4935- 9	3.7	28	Yes	No in SE
Lower Wind	1182- 2	1.7	20	Yes (51% TC)	Yes along edges of BWR
Middle Wind	9367-16	3.1	29	Yes	Yes
Mouse	466- 1	4.6	79	Yes	Yes
Ninemile	1386- 2	2.3	15	Yes	Yes
North Fork Bear	1200- 2	0.1	28	No (52% TC & clumped)	No (OF negligible)
Paradise *	463- 1	1.5	22	Yes	No
Pete's Gulch *	6-NA	NA	NA	NA	NA
Trapper	1888- 3	1.0	55	Yes, excellent OC	No
Upper Falls *	176- NA	5.7	17	Yes	Yes
Upper Panther *	3120- 5	3.4	26	Yes but TC dominates in north	Yes
Upper Trout *	2709- 5	3.4	34	Yes except HC dominates in south finger	Yes
Upper Wind *	1793- 3	3.1	9	No (65% TC)	Yes
Watershed Totals	56,737-100	2.5	25	--	--

Legend: NA=not applicable; OF=open forage ; HC=hiding cover ; TC=thermal cover; OC=optimal cover
 Note: The following subwatersheds have negligible Matrix acres ranging from 0.13 to 12.37: Little Wind, East Fork Bear, Lower Trout, and Dry.

BWR Cover Conditions and Distributions (Optimal, Thermal, and Open Forage):

- The fragmented landscape lends itself toward elk and deer habitat; however, optimal cover has been heavily harvested while open forage conditions (clearcuts) are replanted and quickly move into mid-seral, closed canopy conditions.
- Mid-seral forests dominate the watershed as evidenced by the amount of hiding and thermal cover distributed by subwatershed.
- Subwatersheds (SE part of winter range and comprising 7% of BWR) in good shape within all cover conditions and distributions are Cedar, Eight-mile (best shape within watershed), and Mouse. Trapper (3% BWR) also falls within this section even though open forage is lacking due to the excellent distribution and amount of optimal cover conditions.
- Subwatersheds (SE part & 8% of BWR) which have a combination of seriously low optimal cover percentages, low open forage distribution, and predominate hiding or thermal cover are:
 - Brush
 - North Fork Bear
 - East Fork Bear (included due to hiding cover condition within the riparian reserve)
- Focus on these subwatersheds (23% BWR) which meet the open forage distribution but fall below the optimal cover threshold and lack adequate optimal-thermal cover distributions:
 - Dry
 - Headwaters Wind
 - Layout
 - Lower Falls
 - Upper Wind

Under the NW Forest Plan, the Bear Creek drainage will be managed as a late-successional forest rather than as deer winter range. This new management philosophy will likely maintain similar population levels as currently exist for black-tailed deer due to the natural occurrence of scattered small openings throughout the range and to the deer's adaptation to this type of habitat condition (Bender 1996).

The area west of Road 65 is managed primarily for elk (GMU 572, Siouxon) while the area east focuses on deer (GMU 574, Wind River) under Washington Department of Fish and Wildlife's game management units. The west-side area has prime elk habitat, including Black Creek Swamp and Trout Creek Flats, with scattered large wetlands. Several elk herds reside year-round in the west-side area.

Estimate of Carrying Capacity

Habitat conditions within biological winter range can be used to estimate carrying capacity. Population figures for elk and deer were estimated using a model developed by Raymond W. Scharpf, 1986.

TABLE III-7-18: Biological Winter Range Habitat by Acres & % in the Wind River Watershed

Habitat Cover Condition	Acres	%
Optimal Cover	14,340	25
Thermal Cover	17,803	31
Hiding Cover	15,582	28
Open Forage	7166	13
Non-Habitat	1846	3
Total BWR	56,737	100

Using the above acres, Scharpf's habitat capability model determines that the biological winter range in the Wind River watershed can support 1109 elk and 4436 deer for 5 1/2 months (Dec - Apr). These numbers represent reference points from which we can evaluate effects to habitat conditions resulting from Forest activities or catastrophic events.

Open Road Density

Open roads on winter range have a serious effect on animal survival because of animal displacement from preferred habitats and harassment by intermittent travel (Scharpf 1986). Optimal cover dissected by roads creates less effective habitat than undisturbed blocks of cover. An estimate of the reduction of capable habitat from open roads within BWR is based on the following information:

Open Road Type	Open Road w/in BWR (miles)	Influence Area on Each Side of Road (feet)
Primary	40	400
Secondary	193	200

These numbers determine the acres of ineffective habitat from the influence of roads. The current road density reduces the winter range habitat capability from the above mention levels to a population level of 955 elk and 3819 deer,(Scharpf 1996).

Optimal cover within biological winter range is below the 44% threshold; therefore, standards and guidelines do not allow regeneration harvest within allocated winter range (ES and EM allocations). Silvicultural treatments such as thinning may be desirable to speed up the development of stand conditions that provide thermal and hiding cover.

Road densities within BWR exceed the threshold level of 1.7 miles per square mile. As well, winter sports activities are increasing directly adjacent to critical elk winter range, particularly snowmobile traffic. This is a special concern.

The Effectiveness of Road Closures:

In closing a road, the placement and location of the closure device is of critical importance. To be effective, the closure must be difficult to get around. Vehicle access around many existing closures is possible because the ground is flat and the coarse woody debris is deficient. Ineffectively closed roads also results from lack of maintenance, failure to close gates, lack of signing, and not implementing mitigation measures prescribed during project planning.

Road decommissioning and obliteration are less costly in the long term (does not require replacing gates, checking gates, changing locks), and may most effectively close roads. Effectiveness monitoring is just beginning. Using large rock boulders to block roads may be the next most effective deterrent, provided location has been carefully selected.

Findings on Road Density within BWR:

- BWR road density is in good shape within the southeast part of the watershed (Brush, Cedar, East Fork Bear, North Fork Bear, Little Wind, and Lower Wind).
- Low road miles in Trapper are attributed to Trapper Creek Wilderness. Low mileage in Paradise is due to the drainage's steep sideslopes.
- Subwatersheds with extremely high mileage greater than 2.8 mi/sqmi include-
 - Compass-Crater, Headwaters Wind, Lower Bear, Lower Trout, Middle Wind, Mouse, Upper Falls, Upper Panther, Upper Trout, and Upper Wind.

Reference Condition of Elk and Deer Biological Winter Range:

Historically, large open areas provided forage. Openings resulted from windthrow, fire, root disease, and insect outbreaks. Surrounding the open forage areas were large expanses of mid and late-successional forests. Roosevelt elk numbers may have been lower than current levels due to larger-sized openings and less uniformly fragmented landscape.

The black-tailed deer has evolved within late-successional forests and is adapted to closed-canopy conditions (Bender 1996). Winter range like the Bear Creek drainage with its extremely steep topography and natural openings (dry meadows, oak woodlands, springs, seeps, and high gradient streams) provides ideal habitat for deer. This area is most likely prone to catastrophic events like fire. Interestingly, range records from 1917 state that deer and bear were abundant within the Wind River watershed; however, the presence of elk was not mentioned even though the range allotments overlapped with current prime elk habitat.

Special Habitat Components:

Special habitats components discussed in this section include snags (dead trees), coarse woody debris, and unroaded areas.

Special Habitat Components - Current Condition

Special habitat components within the Wind River watershed include snags (dead trees), coarse woody debris, and unroaded areas. One or more of these habitat components play a crucial role in the life-history requirements for several species groups: woodpeckers, mustelids, birds of prey, woodland salamanders, bats, and large low-density carnivores.

Forest practices through 1991 favored economical and efficient logging operations, reducing fire risks or insect epidemics, and creating plantable spots for seedlings. These practices converted complex forest structure to simpler ecological systems. Harvest units lacked snags which were safety hazards under OSHA standards; green tree replacements were placed on the perimeter of cutting units; and prior to mid-1980's all adjacent forest snags within 200 feet of harvest unit boundaries were cut to reduce the risk of fire spreading, (Hunt 1996).

Additionally, current forest practices encouraged slash clean-up. Clean-up was done by implacing log utilization standards in timber sale contracts, machine-piling slash and burning the piles to reduce fire risk, and yarding logs to landings for firewood gatherers. Consequently, the remaining coarse woody debris today is cull (decay so prevalent that wood cannot even go for pulp) material bucked out of merchantable logs and is often large in diameter but lacks the NW Forest Plan decay class, distribution, and length requirements.

The primary logging systems used within the Wind River watershed included highlead and tractor. Skyline was used to a much lesser extent. Highlead cable yarding system has a short span length (500-800 feet) which requires more temporary road construction to log harvest units. Tractor systems build skid roads in a network throughout the harvest unit to yard logs.

Road density's current condition is a direct result of these two logging systems. Generally, temporary roads constructed under these systems have not been closed after contract closure. Today, most of these old temporary roads remain accessible to 4-wheel drive vehicles. Generally, some sort of road (primary, secondary, temporary, or skid) occurs every 660 feet.

Where salvage logging has occurred within gently-sloped areas, CWD is lacking which has created another avenue for 4-wheel vehicles to drive through the forests to access closed roads; thus, many road closures have become ineffective. Road concerns are further addressed and identified under elk and deer BWR winter range.

Analysis and Summary of Special Habitat Components:

A table displays the current condition of the special habitat components by subwatershed. How these different components were analyzed is explained below.

- Snag Habitat Component: this is analyzed by evaluating the forest's ability to support species of cavity-nesting birds at $\geq 40\%$ of their potential population levels. Subwatersheds with capable forest land meeting $< 40\%$ of the population potential for these species are deficient in snag habitat.

TABLE III-7 19: Snag Habitat Current Condition. The % Population of Cavity-Nesters Supported by Forest Seral Stage

Forest Seral Stage	% Population Potential
Late-success'1 multi-storied forests ≥ 21 inches dbh	100
Late-success'1 single-storied forests ≥ 21 inches dbh	80
Small sawtimber forests 9-21 inches dbh	40
All other forest seral stages (pole, sapling, seedling, shelterwood, hardwood, wet/mesic)	0

The total acres of each forest seral stage by subwatershed is multiplied by the corresponding % population potential. The sum of these acres is divided by the total subwatershed acres capable of producing forest.

Wet/mesic sites are included under capable forest land because they contain large scattered trees. Administrative sites are also included because they contain the most fertile land capable of producing forest even though they are managed for other objectives. Most of the hardwood stands occur within the river valleys where large old-growth stands once dominated. The majority of harvest units under the pole, sapling and seedling stages have no interior hard snags or green trees standing. Shelterwood harvest units currently contain large green trees but do not meet snag requirements at the 40% level; although, they may in a few years when girdled and blasted green trees begin to decay.

Rock, water, and floodplains are excluded from capable forest land.

- Coarse Woody Debris Habitat Component: this is evaluated by looking at harvest acres where former forest practices encouraged slash clean-up and thus lack CWD. If the capable forest land area in the managed forest categories is >30%, then CWD is deficient.

The % area CWD deficient by subwatershed is the sum of managed forest categories: hardwood, seedling, sapling, pole, shelterwood, and administrative acres divided by the total capable forest acres.

Capable forest land assumed to have sufficient CWD include small sawtimber and late-success'1 single and multi-storied forests.

Subwatersheds with gently-sloped areas are noted because firewood gathering opportunities have increased the CWD deficiency, even in the late-success'1 stands.

- Unroaded areas present are listed by subwatershed. These include three "roadless areas:" Big Hollow Creek, Red Mountain, and Bear Creek.

TABLE III-7-20: Current Condition of Special Habitat Components by Subwatershed in the Wind River Watershed(Threshold in Parenthesis)

Subwatershed (* = w/in matrix)	Acres - % Basin	Snag Population Potential (>40 %)	CWD Deficient Landbase (>30 %)	Unroaded Areas (X or Location Name=Present)
Big Hollow	4121 - 3	55	21	South part adjacent to Trapper Cr Wilderness; Howe Ridge north to Big Hollow Cr Inventoried Roadless Area
Brush	1876 - 1	49	15	
Cedar	3974 - 3	66	14	X
Compass-Crater *	3790 - 3	36	55	
Dry	5754 - 4	46	17	West of Dry Cr along Rd 64
East Fork Bear	3751 - 3	60	15	
Eightmile	2356 - 2	42	38	
Head Wind *	8363 - 6	37	34 +	
Layout	3552 - 2	31	41	
Little Wind	5929 - 4	45	21	
Lower Bear	2045 - 1	46	26	
Lower Falls Cr *	8109 - 6	36	43 +	
Lower Panther	7184 - 5	51	12	Jimmy Cr to N Fk Bear
Lower Trout	8244 - 6	42	21 +	
Lower Wind	9464 - 7	36	16	
Middle Wind	13051 - 9	42	20 +	
Mouse	2579 - 2	72	7	
Ninemile	3501 - 2	39	39	
North Fork Bear	3709 - 3	63	7	Bear Cr Inventoried Roadless Area
Paradise *	5416 - 4	47	22	Paradise Cr
Pete's Gulch *	3496 - 2	45	20	Indian Heaven Wilderness
Trapper	7417 - 5	65	4	Trapper Cr Wilderness
Upper Falls *	5776 - 4	55	14 +	Indian Heaven Wilderness
Upper Panther *	10349 - 7	49	37	Red Mtn Inventoried Roadless Area & Edge of Indian Heaven Wilderness
Upper Trout *	6146 - 4	48	43 +	
Upper Wind *	3509 - 2	43	9	
	--	Average	Average	
Watershed		47	24	

+ = gently-sloped areas w/ addit'l CWD deficiency from salvage logging

Note: The following subwatersheds have negligible Matrix acres ranging from 0.13 to 12.37: Little Wind, East Fork Bear, Lower Trout, and Dry.

UNROADED AREAS

Findings and Recommendations for Currently Unroaded Areas:

- Unroaded areas are associated with wildernesses, roadless areas, or extremely steep drainages (which are the most difficult areas to log using conventional systems).
- Alternative logging systems which avoid road construction within remaining unroaded areas in the matrix should be selected.

Unconfirmed wolf sightings are recorded in some of these areas.

Wolves are known to exist in areas with high open road densities (despite high human-caused mortality) provided adjacent unroaded areas exist where they can disperse (Tucker 1990). The main problem with roads and wolves is human access and closely-associated wolf mortality.

- Defer logging the Paradise Creek unroaded area (in Matrix land) until after the rest of the matrix is cut. It is one of two remaining large, intact parcels of unroaded late-successional forest within Matrix;
- Keep Red Mountain inventoried roadless area intact until LSR recovers in Upper Panther and Upper Falls Creek.

Findings and Recommendations for Snags and Coarse Woody Debris:

- Areas with deficient snags and CWD are the same areas where other resource concerns occur.
- Work with the silviculturist and presale forester to develop specific guidelines for snag and CWD selection. Focus more on identifying hazard tree areas so some hard snags can be retained. Assist with training crew.
- Where CWD is deficient, provide well-distributed slash piles with the largest logs available.
- Use the following guidelines for tree selection:

Types of tree and forest patches to retain (Communique 1995):

Largest, oldest live trees; decadent or leaning trees; hard snags (Amend 6-3).

Take advantage of patches of intact forest (defined as having more mid-level canopy and understory cover):

- To provide additional nesting and denning habitat not found in highly disturbed clumps of trees;
- To maintain individuals or clumps of natural snags that would be safety hazards if left within a zone of logging operation.

Anticipate blowdown in wind-prone areas of watershed:

- Select windfirm tree characteristics such as shorter, larger-diameter trees with good root systems on drier soil and avoid trees with greater height to diameter ratios, or
- Where it is desired to leave trees as future CWD, choose trees of the size desired (≥ 20 inches large end) that are likely to blow down.

Other types of tree and forest patches to retain:

Find "hard snags" and build leave tree patches around these OSHA safety hazard trees. This will increase the chances a faller will leave these snags standing;

Leave patches of large hardwoods (these often have cavities in them);

Look at existing use by wildlife: witches brooms; mistletoe clumps; stick platform nests; cavities; epicormic branches; wallows; woodpecker use;

Leave trees with loose bark: bats, swifts, woodpeckers, and brown creepers roost and nest under bark.

Place patches within harvest unit so they connect to riparian reserves or provide connection between two adjacent late-successional stands;

On flat ground, avoid leaving patches too close to secondary roads (<350 feet) where firewood gatherers look for opportunities.

Historic Condition of Special Habitat Components

Snags and coarse woody debris circa 1890 most certainly occurred in higher quantities due to stand replacement fires, root disease, and insect outbreaks. These events provided forest structure: standing dead trees and coarse woody debris. Denning, hiding, foraging, and cavity-nesting habitat must have been abundant for both prey species like snowshoe hares and predator alike.

As late as 1917, topographic maps within the Wind River watershed show no roads outside of the Lower Wind, Middle Wind, and Lower Trout subwatersheds. Horse trails were present at this time. Thus, the large volume of human traffic through the watershed did not occur compared to the current condition. However, sheep range allotments were well-established: Mowich, Black Creek Swamp, Red Mountain, and Indian Race Track, and horses provided a fast way to travel.

The most significant reductions to large carnivores actually occurred on horse trails, before roads even made a stronghold on the landscape. The 1700s brought a change to the Pacific Northwest, with the introduction of the horse (Laufer 1989). The practices of over-trapping, bounty hunting, and poison-baiting affected particularly the grizzly bear, gray wolf, wolverine, and fisher. As transportation systems made human access easier and weaponry improved, wildlife mortality also increased. Without other checks and balances, these interactions appear directly proportional even today

Trend for Special Habitat Components:

- Although road density will decrease from decommissioned specified and temporary roadbeds, large unroaded areas will most likely remain similar to the current condition.
- The trend under the NW Forest Plan will promote snag and coarse woody debris habitat.

Undesirable Organisms Affect Native Flora and Fauna.

One introduced species that is undesirable to native amphibians and turtles is the bullfrog, found in lower elevational lakes and ponds. No sightings are within the watershed, but are found in areas adjacent to the watershed.

The effects of fish stocking on amphibian and turtles is unknown and considered a data gap.

The California ground squirrel has naturally expanded its range north from Oregon by way of bridges. This species carries mange which has infected and killed native Western gray squirrels. Currently, it is a game species while the Western gray is protected. Unfortunately, these two species look very similar.

Survey data on the presence of Western gray squirrel within the oak woodlands does not exist and is considered a data gap.

B. PLANTS

Current and Historic Conditions:

Plant occurrence in the watershed is a product of geologic and climatic history. The watershed includes the crest of the Cascades and west. The maritime climate brings much moisture to the watershed from the west, dumping between 50-80" of precipitation as the systems rise up and over the Cascades. Steep hillsides, with incised, cascading creeks are typical. Soil from volcanic parent material is often limiting to plants in minerals and nutrients. While **vascular plant** diversity may be naturally relatively low, plant and fungi communities contribute vital nutrients to the Wind's biological systems, as well as provide shelter, growing substrate, control erosion and flooding, regulate air quality, and produce an array of forest products.

The Wind River drainage feeds into the Columbia River basin west of the crest of the Cascade Mountains. The Columbia River provides the only geologically recent east-west sea-level passage for plants, animals, and people in all of Oregon and Washington. Because of this, it has a high degree of **endemism** (e.g., *Corydalis aqua-gelidae*), and has been an important migratory route for plants, some of which have found suitable micro-niches outside their normal range. Some of the survey and manage plants listed by name are endemic, others are **disjunct populations**. Yet others (e.g., *Montia diffusa*, *Chrysolepis chrysophylla*, *Orobanche pinorum*), reach the northern periphery of their range in the watershed, and may be important genetically for the species as a whole, in the event of global warming or to indicate warming trends. A combination of plant dissemination and large-scale natural disturbances, particularly fire, has allowed for the occurrence of an array of sensitive plants in the Wind watershed as well.

Rare Plants

Threatened, Endangered and Sensitive Plants:

The Washington Natural Heritage Program and Gifford Pinchot National Forest list 59 populations of **sensitive plants** in the Wind River basin, of eight different species. All potentially occurring TES plants are listed in tabular format (Tables 1 and 2), and additional information is provided for the eight species of known occurrence. In most cases, historical data on these species do not exist. Although much current information has accumulated since 1991, prominent data gaps exist for all TES plants. These data gaps may result in an irretrievable lowering of the species viability, leading it toward federal listing. More knowledge of the plants, on the other hand, would be instructive for specific management actions, and lead toward recovery of the populations.

It is the intent of the Forest Service to have a Species Management Guides (SMG), also known as Conservation Strategies (CS), for all sensitive species. Currently, two SMG's are active for sensitive plants in the Wind watershed, these are for *Corydalis aquae-gelidae* and *Pleuricospora fimbriolata*. Draft CS are currently underway for *Orobanche pinorum* and *Chrysolepis chrysophylla*.

Cold-water corydalis (*Corydalis aquae-gelidae*)

This rare aquatic wildflower is an endemic species known only from northwest Oregon and southwest Washington. It's habitat is near seeps and streams in forested lands from 1220' to 4260' elevation. In the Wind watershed, several populations occur alongside lavabeds. Plants are often growing within the stream channel. Natural threats to the species include warmer than normal water temperatures, sedimentation, beaver activity, grazing by deer and elk, and competition from other vegetation (USDA 1983). Competition from other vegetation is a threat when new habitat is not being formed, such as where natural disturbances like flooding, stream deposition, and forest fire are not allowed to occur. Human-related threats are road construction, timber harvest, mining, hydroelectric projects, herbicide use, and some recreation activities. Because dissemination probably occurs from headwaters, it is important that entire tributaries be managed to reduce threats to this rare plant.

There are 28 populations of cold-water corydalis in the watershed. Of these, seven have been managed through the SMG (USDA 1983) and its Review (1990) (Table III-7-22). Photo-point monitoring has been established for roughly half the monitor populations outlined in the original SMG. This type of monitoring is believed to be the most effective means of tracking individuals within the populations. None of the previously established points have been revisited since 1992. In order to comply with the SMG, all photo-points must be established and periodically revisited.

TABLE III-7-21: Potentially Occurring T.E.S Species

Documented?	Scientific Name	Common Name
N	<i>Agoseris elata</i>	tall agoseris
N	<i>Botrychium lanceolatum</i>	lance-leaved grapefern
N	<i>Botrychium lunaria</i>	moonwort
N	<i>Botrychium minganense</i>	Mingan's grapefern
N	<i>Botrychium montanum</i>	mountain moonwort
N	<i>Botrychium pinnatum</i>	pinnate-leaved grapefern
N	<i>Carex densa</i>	dense sedge
Y	<i>Carex interrupta</i>	green-fruited sedge
Y	<i>Chrysolepis chrysophylla</i>	chinquapin
N	<i>Cicuta bulbifera</i>	bulb-bearing water-hemlock
N	<i>Cimicifuga elata</i>	tall bugbane
Y	<i>Corydalis aqua-gelidae</i>	cold water corydalis
N	<i>Cyperus rivularis</i>	shining flatsedge
Y	<i>Epipactis gigantea</i>	giant hellebore
N	<i>Eryngium petiolatum</i>	Oregon eryngium
N	<i>Githopsis speculariodes</i>	common bluecup
N	<i>Howellia aquatilis</i>	howellia
N	<i>Liparis loeselii</i>	twayblade
N	<i>Luzula arcuata</i>	curved woodrush
N	<i>Microseris borealis</i>	bog apergidium
N	<i>Montia diffusa</i>	branching montia
N	<i>Ophioglossum vulgatum</i>	adder's tongue
Y	<i>Orobanche pinorum</i>	pine broomrape
N	<i>Parnassia fimbriolata</i>	fringed grass of parnassus
N	<i>Platanthera sparsiflora</i>	few-flowered bog orchid
Y	<i>Pleuricospora fimbriolata</i>	fringed pinesap
N	<i>Poa nervosa</i> var. <i>nervosa</i>	Wheeler's bluegrass
N	<i>Polemonium carneum</i>	salmon polemonium
N	<i>Polystichium californicum</i>	California swordfern
N	<i>Sullivantia oregana</i>	Oregon sullivantia
Y	<i>Utricularia intermedia</i>	intermediate bladderwort

If maintained, riparian reserves established in the Northwest Forest Plan, adequately protect all 28 populations in the Wind watershed. However, at least the seven populations shown in Table III-7-22 should continue to be monitored for ongoing validation of the effectiveness of the riparian buffers.

Giant helleborine (*Epipactis gigantea*)

This large orchid grows in rocky seeps, often those with geothermally heated water. Populations of this species are small and widespread, and therefore, each population may be genetically isolated and significant. The population in the Wind watershed is the only extant population known in southwest Washington. One population, reported on the Gifford Pinchot NF, near Packwood, WA, has not been relocated, and it believes no longer exists. The Wind watershed population does not occur on National Forest land and it is in an area that receives heavy recreational activity as it is near a road, near a popular fishing spot, and near hot springs. It is important to work with the land owner (Carson Hot Springs?) to protect the viability of this population.

TABLE III-7-22: Cold-water corydalis monitor sites in the watershed

Site Name	WNHP	#TRS
Crater Creek	008	T04N R06E S09
Puny Clearcut	018	T05N R06E S28
Lava	019	T04N R06E S33
Trout Creek Beaver	021	T04N R06E S02
Compass Creek	024	T04N R06E S22
Layout Creek	029	T04N R06E S22
Upper Trout Creek	035	T05N R05E S31

Golden chinquapin (*Chrysolepis chrysophylla*)

The range of golden chinquapin extends south to California. It often grows on drier areas, ridges, and where other canopy species can not compete. The occurrences of golden chinquapin on the Gifford Pinchot NF represents the only major population center in Washington. Two or more individuals occur farther north on the Olympic Peninsula. In the Wind watershed this broad-leaf evergreen tree occurs sporadically. Most of these chinquapin are immature plants of seedling and sapling size.

Damage to individual trees has been observed. Black pustules on the leaves may result from a defoliating fungus. Other threats that have been noted are proposed logging, post-logging activity, and herbicides applied to roadsides.

Golden chinquapin is the host to Herr's golden hairstreak (*Habrodais grunus herri*), a rare butterfly extremely limited in its range. In the larval stage, the butterfly feeds upon the new leaves of golden chinquapin. The first sighting for golden hairstreak in Washington was near Willard in 1978 (Pyle 1980). This population is unique and a range extension for the species. The butterfly is little known, and probably dispersed through the stand of chinquapin. Habitat protection is advisable for protecting insects. Nectar resources near chinquapin groves need to be protected also (particularly goldenrod and pearly everlasting). The butterfly has never been seen in the Wind watershed, however, the chinquapin populations have not been thoroughly searched.

A Conservation Strategy for golden chinquapin and the golden hairstreak is currently underway. Except for one population on the Olympic peninsula, the Wind watershed houses all chinquapin that are the furthest north and west. Completion of this report, therefore, should be funded and executed to better determine the genetic significance of these occurrences.

Pine broomrape (*Orobanche pinorum*)

Pine broomrape is a parasitic plant, completely dependent on its host, oceanspray (*Holodiscus discolor*). There are 5 locations in the watershed. Here, pine broomrape is generally found on gravely, south-facing slopes that may have been associated with fires. This species realizes its most northern range in Washington state.

It is not clear whether or why this species is decreasing in vigor across its range. Protection of existing populations is recommended until further evidence can be gathered to support a management regime. The populations that occur in the watershed have not been revisited. Periodic visits to sensitive plant sites are always recommended.

Fringed pinesap (*Pluericospora fimbriolata*)

Fringed pinesap is a plant that depends on hypogean fungi in order to obtain carbohydrates. It grows in older coniferous forests, from 100 years old and older, with a dense canopy, and is indicative of natural biological diversity above and below ground in that habitat (see discussion on late successional forest habitat).

There are 37 documented populations of fringed pinesap in the watershed. This species realizes its northernmost extremity in Washington state. A Conservation Strategy for this species on the Gifford Pinchot NF has been in place since 1983. Protected sites have been established and are monitored regularly. Three of those 25 acre sites occur in the Wind watershed (Table III-7-23).

TABLE III-7-23: Fringed Pinesap Areas in the Wind watershed.

Site Name	WNHP #	TRS
South Butte	037	T05N R07E S23
Oldman Creek	094	T06N R07E S27
Paradise		T05N R07E S10

Intermediate bladderwort (*Utricularia intermedia*)

This is a carnivorous aquatic plant, that occurs in shallow water (wetlands). It is not rooted and can only tolerate slow-moving or standing water. It appears to withstand a range of temperatures, however, water quality must be high in order for the plant to filter its food, microorganisms, through its sophisticated traps or bladders.

Three populations are known on the forest. One of these populations is in McClellan Meadows, in the Wind watershed. Other populations are likely to occur north of McClellan, and further surveys should be conducted. Eleven other likely habitats on the south of Gifford Pinchot NF were surveyed for intermediate bladderwort in 1994 without success. Most of these areas are not heavily managed, however, water quality should be monitored in all potential habitat and threats to water quality curtailed.

Green-fruited sedge (*Carex interrupta*)

Green-fruited sedge grows in rocky banks and streambeds, as well as other wet, low places. There are two known populations on the Gifford Pinchot NF. This sensitive species is easily overlooked. The one population in the analysis area is large and found along the Wind River. It may not have been revisited since first reported in 1979.

This population is close to, but not on, National Forest land. The site should be revisited, and other areas along the Wind River surveyed.

Monitor Species:

The following monitor species, tracked by the Washington Natural Heritage Program (WNHP), are on the State Monitor Group 3 List and probably occur in the Wind watershed. Group 3 is for those taxa more abundant and/or less threatened in Washington than previously assumed. Information on these taxa is still gathered and stored in the WNHP information system known to occur or are highly suspected to occur in the watershed.

- *Balsamorhiza deltoidea* - (outcrops, meadows) Documented
- *Cimicifuga laciniata* - (moist woodlands) Documented
- *Dodecathion poeticum* - (grassy slopes, seeps) Suspected
- *Douglasia laevigata* -
- *Garrya fremontii* (drier woodlands) Suspected
- *Happlopappus hallii* (grassy slopes, outcrops) Suspected
- *Hemitomes congestum* - (old growth) Documented
- *Hieracium longiberbe* -
- *Isopyrum hallii* - (moist woodlands) Documented
- *Synthesis stellata* - (
- *Utricularia minor* - (wetlands, bogs) Documented
- *Viola sheltonii* - (oak woodlands, grassy slopes) Documented

Other Rarities:

The WNHP has begun tracking rare lichens. Because the Wind watershed is moist with ideal growing conditions for lichens, the complete list of lichens rare to Washington is on file at the Ranger District. Several species of lichens that are known to occur in the watershed are protected if they are on National Forest land, by the Northwest Forest Plan. Other species, also discussed under "Survey and Manage Species" occur off-forest on CRGNSA land. Oregon has also added fungi and bryophytes to their lists of rare species. It is anticipated that Washington will follow suit with this national trend.

Survey and Manage Species:

The Northwest Forest Plan included in its assessment the viability of life forms that may not be listed as threatened, endangered, or sensitive. These are species associated with late-successional and old-growth forests and called "survey and manage species." There are four treatments of survey and manage species called Strategies 1-4 (see Table III-7-24). Survey strategies and management requirements have not been developed for these species but are expected to be developed in 1996. Strategy 1 species carry management restrictions and require the enforcement of a management strategy prior to any ground disturbance.

The "Standards and Guidelines" for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (USDA, USDI, 1994) addresses those species.

The survey and manage species lists are generally divided into guilds of organisms that will be discussed at two levels: function and occurrence. Limited information on fungi, mosses and liverworts, and lichens is available for the Wind watershed. Species and guilds that are known to be in occurrence will be discussed as will those that probably occur but have not been documented because full surveys have not been conducted.

TABLE III-7-24: Survey and Mange Species known to occur in the Wind watershed.

Species	Type	Strategy	Species	Type	Strategy
Albetrellis skamaniensis	F	-	Hydrotheria venosa	L	1, 3
Aleuria rehenana	F	1, 3	Leptogium rivale	L	1, 3
Cantharellus cibarius	F	3, 4	Leptogium saturninum	L	4
Cantharellus subalbidus	F	3, 4	Leptogium teretiusculum	L	4
Cantharellus tubaeformis	F	1, 3	Lobaria hallii	L	1, 3
Clavulina cinera	F	3, 4	Lobaria oregana	L	4
Clavulina cristata	F	3, 4	Lobaria pulmonaria	L	4
Cordyceps captata	F	3	Lobaria scorbiculata	L	4
Gomphus clavatus	F	3	Nephroma bellum	L	1, 3
Gomphus floccosus	F	3	Nephroma laevigatum	L	4
Gomphus kauffmanii	F	3	Nephroma occultum	L	1, 3
Helvella compressa	F	1, 3	Nephroma resupinatum	L	4
Hydnum repandum	F	3	Nephroma scrobiculata	L	4
Polyozellus multiplex	F	1, 3	Pannaria saubinetii	L	4
Ramaria abietina	F	3	Pseudocephalaria anthraspis	L	4
Ramaria araiospora	F	1, 3	Pseudocephalaria crocata	L	4
Sarcodon fuscoindicum	F	3	Pseudocephalaria anomala	L	4
Sparassis crispa	F	3	Pseudocephalaria rainierensis	L	1, 2, 3
Thaxterogaster pingue	F	3	Sticta fuliginosa	L	4
Bryoria pseudocapillaris	L	1, 3	Sticta limbata	L	4
Calicium abictinum	L	4	Sticta limbata	L	4
Calicium adaequatum	L	4	Usnea longissima	L	4
Calicium gancellum	L	4	Antitrichia curtipendula	M	4
Calicium sp.	L	3, 4	Diplophyllum albicans	M	1, 3
Calicium viride	L	4	Douinia ovata	M	1, 3
Cetrlia cetrarioides	L	4	Ptilidium californicum	M	1, 2
Chaenotheca furfuracea	L	4	Tetraphis geniculata	M	1, 3
Chaenotheca spp	L	4	Ulota megalospora	M	4
Collema nigrescens	L	4	Allotropa virgata	P	1, 2
Cyphelium inquinans	L	4	Corydalis aqua-gelidae	P	1, 2
Dendriscoaulon intricatum	L	1, 3	Pleurocospora fimbriolata	P	1, 2

LICHENS

Function

Lichens play a major role in forest ecosystem function by contributing largely to terrestrial and aquatic nutrient cycling and biomass production. Lichens, like fungi and mosses, are often overlooked in their critical role in the food chain of mammals and invertebrates who depend on large quantities of them. Many lichens fix atmospheric nitrogen, and are an important source of nitrogen to the ecosystem.

Two factors above all make lichen viability an issue in forestry in this area: 1) they are slow growing taking up to several hundred years to re-establish after disturbance, and 2) lichens do not recognize well over gaps, and are thus dispersal-limited (FEMAT). Lichens are sensitive to air quality and thus are particularly good indicators of overall environmental health.

Historically, lichen communities experienced fewer disturbances; older, larger patches of trees existed as stable micro-climatic habitat and the air quality was higher. Because of this, the abundance of lichens in the Northwest is presumed to have been greater before large-scale timber operations and industrialization.

Occurrence

The lichen flora in the Wind watershed is diverse. The high moisture and range in elevation, especially low-elevation, in the watershed, contribute to the diversity and abundance. The lichen flora here has been relatively well-studied compared to lichen flora in other Northwest watersheds. A 1995 survey done by John Davis, USFWS, of the lichens of TTMunger RNA revealed 74 species, and many other areas of the watershed have been searched by Davis and other botanists. Still, only limited occurrence records for certain species have been reported. Thirty-five survey and manage lichens are known to occur in the watershed, of which 8 are Strategy 1 species (Table III-7-4).

Pseudocephalaria rainierensis and *Nephorma occultum* are very rare endemic nitrogen-fixing lichens. Occurrences of these species in the Wind watershed indicate habitat conditions with trees over 400 years old. *Pseudocephalaria rainierensis* occurs in the canopy of Pacific silver fir forests (usually) and lower tree boles in Government Mineral Springs and Falls Creek. These are two of the eight known sites for this species mentioned in FEMAT. *Nephorma occultum* in Government Mineral Springs is one of five occurrences in the U.S. and British Columbia (FEMAT). It grows in the upper canopy.

Hydrotheria venosa is a rare aquatic lichen restricted to clear streams. According to Draft Interim Guidelines, it appears to be sensitive to water pollution and sedimentation. It is also an indicator of stream flow constancy and probably contributes to the nitrogen budget of the streams it inhabits. About 25 sites are known in the Pacific Northwest. There are two known sites in the Wind watershed requiring protection. One is on an unnamed tributary flowing through Government Mineral Springs. The other is near Carson National Fish Hatchery. Riparian reserve buffers appear to be adequate in the vicinity of the population, but management activities upstream should be curtailed to maintain pristine stream conditions. Such precluded activities would include logging, mining, and certain types of recreation that may result from summer inhabitants of cottages at Government Mineral Springs.

FUNGI

Function

The Pacific Northwest has a large fungal diversity that profoundly affects forest ecosystem functioning. Fungi are essential for plant nutrient and water uptake; they protect roots from pathogens and environmental extremes, and maintain soil structure and forest food webs. While no historical reference conditions exist, there are concerns over decline of fungal diversity in the region due to effects of pollution, habitat alteration, and over-harvest of mushrooms (Amaranthus and Luoma 1995). Some concern stems from Europe where populations of fungi have declined over the last three decades (Amaranthus and Luoma 1995).

Occurrence

A survey of the fungi in the Wind River drainage was conducted by Janet Lindgren. Ten areas, ranging from 1,000' to 4,000' elevation, were surveyed between August 3 and October 31, 1995. A total of 246 fungi were identified during the 1995 survey of the Wind River drainage. This survey was not extensive and many more fungi species undoubtedly exist. No digging and scratching was done to expose truffles; special inventories are needed to determine if these rare taxa exist here.

The eighteen survey and manage fungi are listed below. *Albetrellis skamaniensis*, having been overlooked for listing under the Northwest Forest Plan, is the rarest fungus on the Gifford Pinchot NF. The Wind River drainage supports the only known occurrence of *A. skamaniensis* in the world. Described in 1946 from a type specimen near Trout Creek, *A. skamaniensis* is found in old-growth western hemlock with Pacific yew.

Four Strategy 1 fungi taxa (*Aleuria rehenana*, *Helvella compressa*, *Polyzellus multiplex*, and *Ramaria araiospora*), are presently known to occur in the Wind River basin.

BRYOPHYTES

Function

Mosses, liverworts, and hornworts are collectively called bryophytes. Commonly seen as epiphytes and growing on decaying wood, bryophytes are abundant in damp, older forests. Similar to lichens, these small organisms are sensitive to slight changes in humidity and heat in their microenvironment. A marked reduction in their biomass is found in stands less than 95 years age (FEMAT), because of insulation. And, like lichens, they can be best developed in stands of 400 or more years (Neitlich 1993, Norris 1987). Forestry practices are cited as the leading cause for the decline in world bryophytes (FEMAT), with increased collecting and air pollution also leading to their demise.

Bryophytes are among the highest plants in productivity and can comprise 95 percent of the photosynthetic tissue in the understory (FEMAT). Not only are these organisms important in the food chain, bryophytes help maintain soil structure and stability and retain runoff. Mosses make excellent nesting material for some animals.

Occurrence

In 1995, Judith Harpel, PhD candidate, completed surveys of the mosses on Grassy Knoll BSIA and Thorton T. Munger Research Natural Area. A total of 52 moss species were found within the RNA, and 82 were found on Grassy Knoll. For a complete list of survey and manage bryophytes expected to occur in the Wind watershed, see Table III-7-24.

Two survey and manage bryophyte species are verified to occur in the watershed: *Ulota megalospora* and *Antitrichia curtispindula*. *A. curtispindula* is not uncommon, however, in Europe it is nearly extinct due to air pollution. This species is a viable part of the forest community and is important nesting material for spotted owls and marbled murrelets (Harpel, unpublished). *Ulota megalospora* is widespread on twigs and branches in the canopy exterior of old-growth forests at middle and low elevations, especially forests along ridgetops and slopes. It is rarely found on rocks, and prefers alder and big leaf maple. This species does not appear to be restricted to old-growth (Harpel, unpublished).

VASCULAR PLANTS

Function

Most plant species are vascular. They contribute greatly to the biodiversity and structure of ecosystems. Survey and manage vascular plants listed here are uncommon, and are known from old-growth forests and habitat undisturbed by humans. Several are mycotrophs, that is they receive growing energy from mycorrhizal fungi that are associated with old-growth.

Occurrence

Vascular survey and manage plant species known to occur in the Wind watershed are: *Allotropa virgata*, *Corydalis aqua-gelidae*, and *Pleurospora fimbriolata*. The latter two species are also rare and have been discussed previously, but additional information on management will be forthcoming.

Survey and manage guidelines for corydalis will likely be to establish further botanical reserves for the species, including complete hydrologic condition, and update the SMG on the Gifford Pinchot NF. It is also recommended for this species to maintain a canopy closure of 70-90% for all known populations, which may entail thinning or planting to augment canopy growth.

Similarly, survey and manage guidelines for fringed pinesap will entail regional reserves, some of which will overlap with populations already protected and monitored, such as the three occurring in the Wind watershed.

Allotropa virgata (candystick) is a non-photosynthesizing plant that is dependent upon mycorrhizal affiliation for its survival. It is not rare in the Cascades; the coast ranges may be the area of greatest concern. This species occurs in closed canopy forests ranging from 1,500-5,000 ft. elevation. It has been observed in stands as young as 60 years, though this is uncommon. Interim management actions will be to regionally select populations for assessment of fire history, coarse woody debris, canopy closure, plant associations, and abiotic factors such as soil moisture and snowpack. It is recommended that candystick surveys commence as soon as possible and all populations mapped and cited.

Important Ethnobotanical Species

The following is a list of plant species with historical cultural significance. Undoubtedly, many other of such species exist in the watershed. Species management recommendations need to be developed for these species by the botanist, in consult with the archaeologist and other specialists.

Huckleberries (especially *Vaccinium membranaceum*) - staple fruit, as many as 10 different *Vaccinium* species in Wind watershed. Native Americans once managed the huckleberry crop by burning large fields in the highlands (see Human Uses section).

Tuberous perennials - staple starch, found in numerous habitats, mostly meadows that were maintained by Native Americans with fire.

Desert parsleys (*Lomatium* spp.) - staple food and medicare along Columbia River and in drier, cliff-like areas of the Wind River

Beargrass (*Xerophy tenax*) - leaves are essential for the rite of basketry. This plant is currently being intensively harvested for the floral trade (see Special Forest Products section).

Ligusticum canbyi - highly prized medicinal plant of wet areas.

Other notable plants used for medicine, food, and/or tools probably that occur or used to occur in this watershed include:

- wapato
- tule
- cedar bark roots
- Indian hemp
- Yellow pond lily
- Camas false hellebore
- death Camas
- golden currant-staple fruit
- dogwood
- serviceberry
- choke cherry
- Prunus fruit

Special Sites and Habitats

Oak Habitat:

The Wind watershed has scattered populations of Oregon white oak (*Quercus garryana*), the only oak growing in Washington state and a species that has had dramatic decline in the last 150 years. In most cases, oaks represent an early seral stage. In the Wind, oak occupies droughty and harsher sites where it does not have competition from conifers. Oak is intolerant of shade and is eliminated once overtopped by conifers. Once more abundant because of more frequent and free-roaming fires, oaks were heavily harvested by early euro-american settlers, which is why there are not many large specimens in the drainage.

Oak woodlands are identified as a priority habitat by the Washington Department of Fish and Wildlife. A review of wildlife food demonstrated that *Quercus* was the single-most important genus for wildlife in North America. Some 321 wildlife species depend upon or utilize oak habitat at various times of the year (Audubon 1990). One biologist identified over 100 species of birds using the oak forests of the Columbia Gorge region. Oak also provides habitat for the western gray squirrel, California mountain kingsnakes, mountain quail and for the rare plants Shelton's violet (*Viola sheltonii*), common blue cup (*Githopsis specularioides*) and pine broomrape (*Orobanche pinorum*). All these species are listed by the Regional Forester or WNHP. Mountain quail, a candidate for federal listing, utilizes oak-conifer woodlands, and has been seen in the Little White Salmon basin, which borders the Wind watershed.

Oak woodlands also give rise to unique, early seral, herbaceous, lichen, and mushroom communities. A survey of the lichens associated with oaks, near the analysis area, revealed an abundance of gelatinous lichens, and *Dendroscocaulon intricatum*, *Stictia fuliginosa* and *Normadina pulchella* (Davis, unpublished). These species are uncommon or rare. No surveys for mushrooms in oak habitat has been conducted in or near the analysis area. Cut oak limbs are used to cultivate valuable commercial shitaki.

An inventory of existing oak woodland in the watershed should be conducted. This can be done using aerial photographs followed by on-site verification. Age class, stand density, associated vegetation, and recruitment should be established. Once further information is gathered, management activities to be considered are: removal of overtopping conifers or periodic underburning to stimulate young shoot growth (Audubon 1990).

Carson Depot - Less than a mile outside the analysis area is a prized oak stand that should be given special consideration as a botanical area by the CRGNSA. A unique assemblage of flora and fauna has made Carson Depot Oak Area a sanctuary for naturalists, partly because of its accessibility.

Weigle Hill - In the center of the analysis area, there is a Botanical Special Interest Area, Weigle Hill, that is being considered as a Research Natural Area in 1996, as per the Forest Plan (1990). It's representative qualities of low-elevation old-growth western hemlock plant communities, combined with steep, wet, slopes, accessibility, and grassy, oak woodlands at the top, make it a likely candidate for an RNA. It also houses several populations of the rare pine broomrape (*Orobanche pinorum*).

Wetlands:

Wetlands are integral in maintaining water supply and quality, flood control, habitat for breeding, nesting, and migrating birds and other animals, and habitat for rare and unusual plants and plant communities. Historically, more wetlands existed along the once free-flowing Columbia River, and within once heavily-forested areas. No intentional wetlands have been constructed to replace these in or near the analysis area. The Clean Water Act, and the Emergency Wetland Resources Act of 1986 as well as the Gifford Pinchot Forest Plan (as amended 1995), all promote protection of wetlands.

Wetlands occur throughout the watershed. These can be seasonally wet, wet shrublands, swamps, bogs, and seeps. Rare plants and amphibians have been documented in many wet areas of the Wind watershed. Important wetlands occur around Black Creek Swamp and McClellan Meadows. McClellan Meadows appears to be part of a large wetland complex on the geological bench that extends north and east into the Lewis River and Trout Lake Creek drainages (including Skookum, Lone Butte, and Grand Meadows). It is not clear whether or not these wetlands are connected to the south with Black Creek Swamp, and such connections should be evaluated. The extent of wetland habitat connectivity is curtailed by distances with heavy forest management such as between McClellan Meadows and Black Creek Swamp. Connectivity is important for flows that sustain these unique communities.

McClellan Meadows - At least one sensitive plant population occurs in these meadows, though they have not been thoroughly surveyed. Other plants of interest include mid- to high elevation wet meadow species such as tofieldia, birch, willow, several types of bladderwort, and St. Johns. Beaver and elk heavily utilize the area. In the fall, a rare fungus, *Phaeocollybia* sp., is expected here.

Black Creek Swamp - This is a favored viewing grounds for elk. The rare fringed pinesap grows on the outskirts of the swamp. Tansy ragwort is a noxious weed that has invaded Black Creek Swamp, and may soon further reduce the biodiversity of life in the wetland.

Ash Forest - Oregon ash (*Fraxinus oregana*) is an uncommon tree in the Wind watershed. It indicates warmer, wet forest conditions, and a high water table (standing water in spring). One ash forest occurs in a two acre area between the Wind River Ranger Station and the TTMunger RNA, at the base of Bunker Hill. A plant list has not been compiled, but it is believed to contain unusual mosses and liverworts. Four survey and manage fungus species were identified in and around this unique forest. A complete biological survey and of the area and consideration for special management classification is recommended.

Grassy Knoll:

Grassy Knoll is a Botanical Special Interest Area (BSIA) designated by the Gifford Pinchot Forest Plan (1990). Grassy Knoll contains populations of certain plants at the southern and western limits of their range. The ridge communities may have evolved with a consistent fire regime, or it is also likely that the exposure, soils, and higher elevation keep the conifers in check. These communities and the plants of interest need to be monitored for decline in event that they are fire dependent. Recreation use will also continued to be monitored for inconsistency with the BSIA establishment. It is monitored every five years

the next year being 1997. Uncommon and noteworthy plants occurring in Grassy Knoll are: *Silene antirrhina*, *Cymopterus terebinthinus*, *Synthesis stellata*, *Physaria alpestris*, *Aster glaucescens*, *Balsamorhiza deltoidea*, *Fritillaria pudica*, and *Synthesis stellata*.

Big Huckleberry Mountain:

Big Huckleberry Mountain is one of the favorite botanizing areas in the Columbia Gorge (Jolley, 1989) and harbors disjunct populations of species not seen elsewhere in the Gorge. Two trail systems access the Grassy Knoll/Big Huckleberry area, whose open ridgetops are the largest such openings on the Gifford Pinchot National Forest (report on file). Thin soils on these ridgetops probably inhibit forest growth, though fire may also play a role in maintaining the early seral stage. It is a high meadow/forest mosaic, straddling the divide between the Little White Salmon and Wind drainages. Big Huckleberry Mountain is similar to Grassy Knoll, but is not currently protected. Unusual and noteworthy plants on Big Huckleberry Mountain include *Arenaria capillaris* and *Lonicera utahensis*. This area was probably burned and maintained by Native Americans for huckleberry picking. In the first half of the 20th century, it was actively grazed by sheep. This mountaintop offers a striking diversity of National Forest use. It is recommended that it be elected to join Grassy Knoll to create one large Botanical Special Interest Area, or two complimentary, separate areas.

Old-Growth and Late-Successional Forest:

The amount of old-growth and late successional forests in the watershed has not been noticeably impacted by fire since the advent of euro-american fire suppression. Instead, timber harvesting has reduced large amounts of this habitat and it has become a habitat foremost concern. Unlike fire, timber harvest occurs in smaller patches, leaving more edge habitat, and does not leave legacy structures, as does fire. Historically, large patches of old-growth remained intact and a diverse biota associated with the habitat evolved to depend on such large patches.

As forests mature, a succession of species unique to the oldests of forests assume this habitat (Neitlich 1993, Sillett 1994). For example, 400 year-old growth forests have been shown to house species that 200 year-old growth do not. Examples of guilds that require this habitat are mosses and lichens, whose sensitivity to humidity and substrate requirements grow on the oldest trees.

There are 12 stands comprising 2,885 acres of forests older than 300 years in the watershed. These have been mapped and should be managed appropriately. Other very old trees are not included in this figure that was derived from combining "Stand Origin" dates and multi-layer stands. Ancient, individual trees such as the ones at Paradise Campground and Government Mineral Springs are examples of important old-growth resources that were not mapped from "Stand Origin" data. Map 10 and Table III-7-25 show how little of this habitat remains. Preservation and enhancement of these stands should be taken into consideration during future planning efforts.

TABLE III-7-25: Acres by Subwatershed with trees 300+ years-old.

Subwatershed	Acres
Layout Creek	.01
Lower Falls Creek	62.62
Lower Trout Creek	1100.48
Upper Panther Creek	30.44
Upper Trout Creek	266.15
Middle Wind	1425.64

8. HUMAN USES

The human uses core topic is presented in two parts: Part 1 - Heritage Resources. Part 2 - Human Uses, Recent Times; uses that have evolved since the area was included in the National Forest system.

HERITAGE RESOURCES

The Wind River Watershed has been used by people over a several thousand year period, for a variety of uses. In the distant past the hunting of large game animals and the quarrying of stone for tools formed the focus of people's activities, while in the more recent past (the last 2000 years) people's efforts centered around the collection of huckleberries, cedar bark, beargrass, and a variety of other plants. During the historic period, people used select portions of the watershed for residential and agricultural purposes, while timber harvest occurred at an early date over a broad area. Selected areas within the watershed were used to provide forage for sheep and cattle. Other known uses include recreational gold mining, hunting, general recreation, and the collection of miscellaneous products such as beargrass, mushrooms, young conifers and assorted other shrubs.

NOTE: A complete report titled "Past Human Uses of the Wind River Watershed" is attached as Appendix --.

CURRENT CONDITION:

Indian people continue to collect traditional resources from the watershed. These include, but are not limited to, huckleberries, beargrass, cedar bark, cedar roots, and medicinal plants. Huckleberries are considered one of the five sacred foods for Indian people in this area, and a traditional First Foods feast is held every year on the Forest to give thanks for this resource. Indian people consider that the Forest has a trust responsibility to ensure a continuing supply of these traditional resources over time. The commercial harvest of huckleberries and beargrass in particular by non-Indians could potentially have an impact on the availability of these resources over time.

The key natural processes affecting vegetation used by people are succession and fire. Huckleberries grow best in high elevation areas that have been burned over by forest fires (Minore et al. 1979). Ecologically these huckleberry fields are seral, being temporary stages in the natural succession from treeless burn to climax forest. The maximum amount of berries is produced a few years after establishment of the field, with production gradually declining as other shrubs and trees begin to dominate the site.

At least one site within the watershed qualifies for consideration as a Traditional Cultural Property. This site, the Indian Race Track, is of cultural importance to living Indian people. Heritage sites are a non-renewable resource, and may be subject to impact from activities such as road building, timber harvest, mining and the collection of miscellaneous products.

Undoubtedly, other prehistoric and historic sites occur within the watershed. Of the 45 known prehistoric sites, two have been the subject of data recovery excavations and another four have been tested. The remaining sites remain in a protected status.

Peeled cedar trees continue to be found within the watershed. Of the 32 peeled cedar sites located within the watershed, ten have been selected for preservation status, and will be protected with a 200 foot no harvest buffer. The remaining sites may be harvested after appropriate mitigation is completed, which includes photographic documentation and determination of the date of peeling. Timber harvest and road building could potentially impact the availability of cedar for traditional use.

Cultural resource surveys, which are required prior to federal undertakings, will likely result in the discovery of additional prehistoric and historic sites within the watershed. Continued consultation with the Yakama Indian Nation would be required in managing and protecting heritage sites.

REFERENCE CONDITION:

In an analysis of site distribution in an upland area of the Mt. Hood National Forest, Burtchard (1990) has suggested that the effects of the Altithermal, a shift to warmer and drier climatic conditions during the early part of the Holocene, or post-glacial epoch, may have led to initial human use of the Cascades. Burtchard postulates that with this early Holocene warming the ungulate habitat in the Great Basin and Plateau would have decreased, but available forage in the Cascade uplands would have increased. This could have led to a redistribution of ungulate populations into the mountain uplands, with human population distributions most likely shifting along with them.

A total of 45 prehistoric archaeological sites have been documented within the watershed boundary. These sites are primarily low density lithic scatters, situated in a variety of environmental settings. These include ridgelines, saddles, stream confluences, stream terraces, and meadow edges. The locations and assemblages of these sites are consistent with a model of seasonal transhumance by small hunting and gathering groups, who move into the higher elevations out of low elevation winter residences, following resource availability. The variety of resources utilized is probably reflected in the variety of environmental settings in which the sites are found, but undoubtedly included game animals, berries, other plant foods, medicinal plants, and tool stone.

Combined with information from a number of excavated sites on the Forest, these sites suggest a broadly similar pattern of human use within this portion of the Gifford Pinchot National Forest, which is in itself similar to that seen throughout the central Cascades at this time period. This pattern is one of repeated seasonal occupation by small groups, beginning approximately 7000 years ago and continuing into the historic period. A disruption in occupation may have occurred in parts of the southern Washington Cascades, due to the effects of the ca. 3500 B.P. eruption of Mount St. Helens, which deposited a thick layer of tephra over parts of the area.

Historic Use

The people who occupied this area during historic and late prehistoric times included the Sahaptin-speaking Taitnapam, Klickitat, Yakama and related bands; the Salish-speaking Cowlitz; and a number of Upper Chinookan or Kiksht-speaking bands located along the Columbia River. Their settlement pattern involved winter residence in semi-permanent villages located in sheltered locations along either a major river or tributary, and seasonal camping at root digging grounds, fishing stations, and hunting and berrying locales (Ray 1939). The seasonal salmon runs along the Columbia and its major tributaries formed the emphasis of their subsistence economy, but people took advantage of a wide variety of plant and animal resources throughout the year. After about A.D. 1730, this collecting strategy was succeeded in some parts of the Plateau by an increasing dependence on hunting with equestrian mobility (Schalk and Cleveland 1983).

Berry Picking

A variety of warm season resources were available within the watershed, including huckleberries, strawberries, cranberries, raspberries, blackberries, gooseberries, currants, salmonberries, chokecherries, serviceberries, elderberries, salal berries, kinnickinnick, crab apple, hazelnuts, black lichen, trout, salmon, and animals such as deer, elk, mountain goats, bear and grouse. Of all the berries which were harvested, however, huckleberries were the most important. The several varieties of huckleberries were available in quantities suitable for collection as a stored food, and they could be dried to a raisin-like state.

There are several references in the ethnographic and historic literature to huckleberry collection and processing in the Red Mountain-area as well as in the areas around Big Huckleberry Mountain, Observation Peak, Paradise Hills

and Mowich Ridge. The remains of six huckleberry processing camps have been identified within the watershed boundary, all within the southern half of the Indian Heaven Wilderness.

Prior to the twentieth century, the main disturbance event was fire, ignited either by lightning or humans. Plummer (1900) in an early report for the U. S. Geological Survey, discussed the various causes of forest fires on what is now the Gifford Pinchot National Forest. He wrote that "Indians also start fires for the purpose of promoting the growth of huckleberries, blackberries, and also to drive game." Recent interviews with elderly Yakama informants corroborate this, providing descriptions of how one or two men were chosen specifically for the task of staying behind to burn the fields. Accepting that local Indians most likely used fire as a tool for enhancing huckleberry production, it is also likely that the locations of huckleberry fields would simply shift as fires opened up new areas, and older areas reforested.

Peeled Cedar

Within the watershed boundary, a total of 912 peeled cedar trees have been documented, in 32 clusters or sites. The overwhelming majority of peeled trees documented within the watershed (89%) are located along the western and southern base of Red Mountain. Peeling dates have been determined through tree ring counts in six of these sites, and the 131 peeling dates range from A.D. 1804 to A. D. 1970, with a mean date of A.D. 1887. Since cedar bark baskets were primarily made to hold surplus berries, peaks in bark peeling most likely indicate both a good crop of huckleberries as well as intensive harvest of that crop. Analysis of peeling dates within the watershed boundary has yielded information on the time period when particular areas were used for huckleberry picking, as well as changing patterns of use over time.

Other species of peeled trees have been documented within the watershed boundary, including examples of both western and mountain hemlock. Hemlock bark was used for food, as well as for the manufacture of baskets.

Other Site Types

A number of historic travel routes exist within the watershed boundary. The majority of trails that are interpreted to have served as aboriginal travel routes appear to connect winter village locations along the Columbia to upland resource gathering areas, such as those on Big Huckleberry Mountain, the Paradise Hills, and near Red Mountain. These trails primarily follow drainages and/or ridgelines from points on the Columbia north to the mountains. The major exception is the route of McClellan's Trail, which served as a major cross-Cascades travel route, connecting the Fort Vancouver area to the Yakima Valley. These travel routes have persisted through time, in most cases being adapted later as Forest Service trails and roads.

Other types of sites include talus pit features and rock cairns. Two sites containing talus pit features have been recorded within the watershed boundary. These features may have functioned as part of the aboriginal spirit quest, in which young children were sent off to special places to seek their guardian spirit power. One site containing a rock cairns has been identified, and it may represent a human burial.

Historic land uses include grazing, mining, logging and homesteading.

Lumbering formed the basis of the local economy since the time of the earliest settlement in the 1870's, but some early residents of the Wind River Valley made a living from farming or ranching.

HUMAN USES - RECENT TIMES:

This portion of the analysis addresses relatively recent activities. Current condition and some historical information is presented. The general reference condition for these activities is that they did not exist. In more recent times, starting in the early 1920's, recreation, collection of various forest products, and mining activities have evolved as prevalent human uses in the watershed.

The Forest provides the setting and resources that people rely on in order to pursue various activities they value. In some cases, facilities, such as campgrounds, are the focal point of these activities. In other cases, such as Special Forest Products gathering, the natural resource and/or the activity take the forefront, and few, if any, facilities are used. Also, visitors may engage in several activities during one outing, such as hiking and fishing during the day, while camping in a campground at night. Or they may simply engage in one activity on a day trip.

The following narrative discusses the wide range of human uses that have evolved in the watershed, how they relate to other resources, and the issues and concerns related to these activities. Many of the locations where these uses occur are indicated on Map 20.

Based on the increase in use in recent years and projected growth associated with a rapidly expanding nearby urban area, we assume that demand and amount of use will continue to grow for the foreseeable future.

DEVELOPED RECREATION USE:

CAMPGROUNDS

There are three developed campgrounds in the watershed: Beaver, Paradise Creek and Panther Creek. All three campgrounds have a variety of users, ranging from "through-hikers" on the Pacific Crest National Scenic Trail (PCNST), to those who arrive in expensive motorhomes. There are approximately 20,000 visitors per year using the three campgrounds, with the majority (70%) coming from the local and Portland/Vancouver areas, and the remaining 30% coming from other areas to visit the Pacific Northwest. Use varies throughout the season with the majority occurring during the holiday weekends such as Memorial Day, the Fourth of July and Labor Day. The camping season generally runs from the first of April until the end of hunting season in mid-November.

Beaver Campground lies on the Wind River and was developed in the late 1950's. It contains 24 campsites with a paved access road to the sites. There are three toilets in the campground, two of which are vault toilets, pumped by a private enterprise that hauls the waste material off-site. The third toilet is a flush toilet that empties into a septic system. Beaver Campground's water is supplied by pipeline and water faucets spaced out through the area. Beaver Campground also has a group camp site. Most of the campsites, with the exception of the group site, are situated over 200 feet from the Wind River. Toilet and water facilities for the group site are more than 200 feet from the Wind River. This campground was maintained by the Forest Service until the early 1990's when maintenance was taken over by a concessionaire under a Special Use Authorization. Beaver is the most heavily used of the three campgrounds in the watershed due to its ability to accommodate large motorhomes.

Paradise Creek Campground lies at the confluence of the Wind River and Paradise Creek. It was developed in the 1960's and has 42 sites which are accessed by a paved road. There are three vault toilets which are pumped by a contractor and waste hauled off-Forest. All three toilets are greater than 200 feet from any streams. The water source for this campground is provided by three wells with handpumps. This campground was maintained by the Forest Service until the earlier 1990's when maintenance responsibilities were assumed by a concessionaire under a Special Use Authorization. Paradise Creek Campground is somewhat more primitive than Beaver Campground, but still attracts fair numbers of large recreational vehicles. Both Beaver and Paradise Creek Campgrounds are located on the Wind River Highway, and some visitors use these campgrounds as a stop-over when traveling through the Forest en route to Mount St. Helens National Volcanic Monument.

Panther Creek Campground is located on Panther Creek, a tributary of the Wind River. It was developed in the late 1970's and contains 33 campsites and three vault toilets, which are serviced by a private contractor who takes waste to an off-Forest site. Water is provided by three wells equipped with hand pumps. Access to sites within the campground is provided by a gravel road. All toilet facilities are situated more than 200 feet from Panther Creek. The Pacific Crest National Scenic Trail runs adjacent to the campground.

HORSE CAMPS

Falls Creek Horse Camp is located in the southeast portion of the analysis area on Forest Road 65, close to Falls Creek, a tributary of the Wind River. This rustic facility has six campsites, a loading ramp, and two outdated "pit" toilets (one of which is located within 200 feet of the creek and should be removed/replaced with a contained unit, such as a vault). This recreation facility has a somewhat shorter use period (July 1-November 1) due to the elevation and likelihood of snow early and late in the season.

Crest Horse Camp is located on the central eastern boundary of the analysis area, where Forest Road 60 crosses the PCNST. This "rustic" facility has three campsites and one "pit" toilet that needs to be replaced with a vault unit. This recreation facility has a somewhat shorter use period (July 1-November 1) due to the elevation and likelihood of snow early and late in the season.

Panther Creek Horse Camp is located at the junction of Road 65 and 075, near Panther Creek Campground. This one-site facility has paved parking and a loading ramp and provides access to the PCNST. It receives as much or more day use than overnight use.

DAY-USE FACILITIES

Hemlock Lake

Hemlock Lake is an extremely popular day-use area. Hemlock Lake is formed by a dam on Trout Creek. Historically, the lake has been stocked by the Washington Department of Fish and Wildlife, and local residents have long recognized it as a fine fishing spot. In 1995, the site was made universally accessible. A barrier-free boardwalk and fishing platform were constructed, and other facilities adapted and upgraded. In addition to fishing, picnicking, swimming and bird watching are common activities at this site.

Iron Mike

"Iron Mike" is a small developed recreation site in the Government Mineral Springs area, adjacent to Trapper Creek. An open-sided shelter houses a hand pump that delivers mineral water to visitors, and an interpretive sign describes the history of the Government Mineral Springs Resort. Visitors frequent this area when touring the old growth forests and/or when camping at the adjacent "dispersed" camping area. In the past, this was a developed campground, maintained as part of the resort complex, and people flocked to the springs to partake in their restorative values.

Whistle Punk Interpretive Trail

Whistle Punk Interpretive Trail is a barrier-free trail designed to interpret logging activities, past and present. There are remnants of a steam donkey and other cultural resources on the site. The trail is often part of educational outings that include visits to the Canopy Crane research facility. It is likely that this facility will continue to draw visitors in increasing numbers.

DISPERSED RECREATION USE:

The term "dispersed recreation" refers primarily to overnight camping outside of designated, developed campgrounds. The term may, however, also apply to day uses, such as picnicking, fishing and hiking, at undesignated or "non-hardened" sites. Furthermore, visitors who overnight at dispersed campsites are frequently involved in various other activities during the daytime that contribute to impacts. The following discussion applies primarily to undeveloped camping areas, however, day users should also be considered as contributing to overall conditions of these areas.

Historically, the Forests have always provided a range of recreation settings and developments to suit the range of tastes of its customers. This is the basis of the Recreation Opportunity Spectrum (ROS), which provides guidelines regarding social, physical and managerial settings, so that users may meet their varying expectations. In essence, at one end of the spectrum (primitive), a visitor could expect a pristine setting with few or no other visitors and little or no evidence of management intervention. At the other end of the spectrum (urban), a visitor may expect a full line of facilities, including flush toilets, paved parking lots, fitness equipment and an espresso stand, opportunities to meet and mingle with others, and strict rules regarding use of the area.

Many Forest visitors prefer a more "primitive" setting than our developed recreation facilities provide. Some are seeking more solitude; some are returning to "traditional" use areas year after year; and some are simply avoiding the fees charged and the rules governing developed recreation areas. By definition, dispersed "campsites" are created by users. Various degrees and types of alteration make these areas identifiable as "campsites." In some cases, over time, dispersed areas evolve into developed campgrounds in an attempts by managers to mitigate resource impacts resulting from use.

Humans are attracted to water for aesthetic and recreational reasons. In many cases, evidence of dispersed recreation use is found within 100 feet of either streambanks or lakeshores. In addition to traditional recreation activities such as fishing and picnicking, there appears to have been a significant increase in Special Forest Products collection activity and the associated occupancy of undeveloped Forest areas (ends of spur roads, etc.) in the last five years.

Impacts from Dispersed Recreation Use

Two concerns regarding dispersed camping are: 1) it frequently occurs in riparian areas throughout the watershed, raising concerns for various resources; and 2) it is likely to continue to increase with general population growth and due to the recent policy of transferring management of most Forest campgrounds to private concessionaires. (There is concern that the fee increases resulting from this policy may displace users to previously unimpacted riparian areas. No mitigation measures for this potential displacement were initiated when the campgrounds were turned over to concessionaires).

Several impacts are associated with dispersed camping and other uses of non-"hardened" or undeveloped facilities. These include: trampled vegetation, compacted soil and soil erosion, denuded areas, exposed human waste and associated heath concerns and potential degradation of water quality, displacement of wildlife and alteration of habitat (especially amphibians), and potential visitor dissatisfaction and displacement to less impacted areas.

The following described "Areas of Concern" are main concentrations of dispersed use along the Wind River and its tributaries. In addition, there are many (250+) additional dispersed camp locations in the watershed. Most of these are roadside sites located well away from streams or water sources. However, some of these sites are heavily used and close to small feeder streams. Dispersed camping is increasing, and at some point, policy regarding overnight camping outside of designated campgrounds will need to be addressed on a scale for the entire watershed. It is likely that impacts to riparian areas will continue to increase under the current policy allowing camping "at will" throughout the Forest.

Areas of Concern

A comprehensive inventory of all dispersed recreation sites has not been documented for this watershed, however, thirteen (13) areas of concern have been identified. These areas are located on Bear Creek, Trout Creek, Panther Creek, Beaver Creek, Upper Trout Creek ("the "Flat"), Trapper Creek, Government Mineral Springs, Wind River, Falls Creek (two areas), Wind River Mine area, the Rock Pit ("Vantage") area, and McClellan Meadows. Use varies throughout the season, with the heaviest use occurring during holiday weekends. A detailed description of these sites is attached as Appendix F. Information on these site is summarized in Table III-8-1 below.

TABLE III-8-1: Summary of Major Dispersed Recreation sites

Name	Sub-watershed	Number Sites	Major Impacts Occurring
1. Bear Creek	Lower Bear	5	Use causes erosion and sediment production Vehicles enter creek
2. Trout Creek	Lower Trout	3	Cut bank eroding into stream during high flows
3. Panther Creek	Lower Panther	17	Access roads contribute sediment Site within flood channel, direct vehicle access to streams Loss of riparian vegetation Soil compaction Stream banks broken down by foot travel Gravel bars and stream bed disturbed
4. Beaver Creek	Mid Wind	3	
5. Trout Creek Flats	Upper Trout	4	Access roads contribute sediment
6. Trapper Creek	Trapper, Mid Wind	3	Access trails contribute sediment
7. GMS	Trapper Creek	11	
8. Wind River	Mid Wind	7	Closed road is continually reopened Road accesses winter range Access trails contribute sediment
9,10 Falls Creek	Dry, Upper Wind	5	
11. Mine	Upper Wind	4	
12. Vantage	Upper Falls	3	Site in flood plain produces sediment Road acts as drainage channel
13. McClellan Mdw	HW Wind	5	One site produces sediment Site expanding Loss of vegetation

WILDERNESS USE:

All of Trapper Creek Wilderness (TCW) (6,050 acres) and the southwest quarter of the 20,690-acre Indian Heaven Wilderness (IHW) are within the Wind River Watershed. Both Wildernesses were added to the National Wilderness Preservation System through the 1984 Washington Wilderness Act. A mandatory non-limiting Wilderness permit system has been in effect since 1992. Information obtained through the permit system for the last four years has provided us with the best use estimates to date.

WILDERNESS	AVERAGE NUMBER OF USERS PER YEAR (1992-1995)
Trapper	Creek 2,100
Indian	Heaven 8,000

Visitor demographics derived from the Wilderness permit system suggest that most users of both TCW and IHW come from the local and Portland/Vancouver metropolitan areas.

Recreation use of TCW consists primarily of day hiking. However, there are 12 inventoried campsites within TCW. Two of those sites are along Trapper Creek (one within 100 ft. of shoreline); six sites are on the shoreline (within 100ft.) of Soda Peaks Lake; and the remainder are in the northeast corner of the Wilderness. The Washington Department of Fish and Wildlife has maintained an active stocking program in Soda Peaks Lake since 1960. The species stocked are brown trout and eastern brook trout.

Forest Plan standards for physical (i.e., campsite) conditions are not being met at some locations within TCW. These standards pertain to campsite size and proximity to lakeshores. A Forest-wide revision of Wilderness Management direction is currently in process. This revision would likely identify some campsites for closure and restoration.

Recreation use of Indian Heaven Wilderness (IHW) is more varied than that for TCW. The ratio of day-use to overnight use is approximately 40%-60%. Activities include hiking and horse riding, backpacking and camping, and a significant, though unquantified, amount of fishing and hunting. The portion of IHW within the analysis area contains several lakes and other attractions. Camping and day use occur at these destinations, primarily on shorelines and in riparian areas. Destinations & corresponding numbers of inventoried/monitored campsites are as follows:

Destination	# of Sites	# Sites w/in 100ft. of Shore
Naha Lake	0	0
Lake Umtux	1	1
Rock Lake/Little Rock	6	5
Basin Lakes	1	1
Indian Racetrack	5	1

Many of the lakes within IHW are stocked by the Washington Department of Fish and Wildlife. The schedule of stocking varies from year to year, as does the amount of coordination with Forest Service Wilderness personnel. In 1992 and 1993, the following lakes were stocked:

LAKE	E. Br. Trout	Rainbow Trout	Brn. Trout	Cutthroat
Naha	X			
Umtux				X
Rock/Little Roc	X			
Basin Lks	X			

Impacts to lakeshores associated primarily with camping include trampled vegetation, denuded areas, soil compaction and erosion, damage to tree roots and trunks, exposed human waste and associated health concerns and potential degradation of water quality, displacement of wildlife and alteration of habitat (especially amphibians), and potential visitor dissatisfaction and displacement to less impacted areas. Impacts associated with day use include numerous "user" (-made) trails and similar trampling of vegetation & soil compaction as in campsites. Additional litter associated with angling includes monofilament line and bait containers.

The majority of inventoried campsites within Indian Heaven exceed Forest Plan standards for at least one indicator, and approximately 90% exceed the recommended 100-foot lakeshore setback. A Forest-wide revision of Wilderness Management direction is currently in process. This revision would likely identify some campsites for closure and restoration.

TRAIL USE:

Trails are considered recreation "facilities," and as such are designed and maintained to certain specifications for various types of use. Some trails within the watershed need drainage and tread improvements to meet these standards and to prevent erosion and run-off problems. These trails are specified in the "Recommendations" section of this document.

HIKING:

Hiking is the most prevalent activity pursued in Wilderness, and it is also popular on the watershed's approximately 54 miles of non-Wilderness trails. The most highly used of these trails are the Upper and Lower Falls Creek Trails (#152 & #152A), which lead to spectacular waterfalls on Falls Creek. These trails both have well developed parking areas and trailheads. Some relocation/restoration work was done on Lower Falls Creek Trail within the last two years.

HORSEBACK RIDING:

Horseback riding is another popular use. Generally, horse riding is a day-use activity, with riders camping either in horse camps, at dispersed sites, or at the Skamania County Saddle Club permitted area on Trapper Creek. Impacts associated with horse use include deterioration of trail tread, trampling and erosion of streambanks and lakeshores, damage to tree trunks and roots, introduction of non-Native plant species, and conflicts with other users.

MOTORIZED VEHICLE USE (ORV/ATV):

Use of off-road or "all-terrain" vehicles is increasing in the watershed. There are no areas specifically designed for this use, and damage to soils, vegetation, streambeds and wet areas has been observed. This is a relatively new form of recreation that is likely to continue to grow.

WINTER RECREATION USE:

Winter Recreation occurs throughout the Wind River watershed, depending on the availability of snow. The majority of the activity occurs in the vicinity of the Upper Wind River Winter Sports Area. This area is located near the headwaters of the Wind River. There are approximately 40 miles of developed cross-country ski trails, with 25 miles of trail located within the analysis area. Three Sno-Parks are located in the Upper Wind River Winter Sports Area. Facilities consist of three vault toilets and paved parking lots. None of the Sno-Parks have water systems. Two other Sno-Parks are located in the watershed--one at the intersection of the Wind River Highway and Forest Road 31, and the other at the entrance to the Government Mineral Springs area. These "facilities" are simply parking areas provided by snow removal in winter.

The majority of winter recreation occurs at the higher elevations with approximately 20,000 RVD's/year, depending on snowfall. The majority of the use is cross-country skiing or snowshoeing. Most snowmobile activity occurs farther north, outside of the analysis area.

WHITEWATER BOATING:

Whitewater boating, particularly kayaking, is a growing recreational use within the watershed. Most activity occurs on the Wind River and Trout Creek. Use on Trout Creek occurs downstream of Hemlock Lake. Some boaters launch in the vicinity of the bridge on Forest Road 43 when the road is clear of snow. Boating on Wind River occurs primarily from the Stabler bridge downstream, with some minor use originating at the Fish Hatchery. Although kayaks are currently the vessel of choice, an appreciable increase in rafting has been noted in the last three years. While few impacts are currently associated with this human use, some site hardening and facility installation may be prudent to protect riparian areas. The increase in boating activity is likely reflective of the influx of outdoor recreationists in the Columbia River Gorge in the last decade. It is likely that demand for these recreation opportunities will continue to increase as the local and Portland/Vancouver metropolitan area populations continue to expand.

FISHING AND HUNTING:

Fishing and hunting are popular, yet unquantified, activities within the watershed. These activities, like many other recreational activities, appear to be on the rise. Issues and concerns related to these activities are those identified under "Dispersed Recreation."

DRIVING FOR PLEASURE:

A driving corridor connecting the Wind River area with Mount St. Helens and Seattle lies within the watershed. Visitors drive and view scenery as a primary or secondary recreation activity.

SPECIAL FOREST PRODUCTS GATHERING:

Gathering forest products is a long-standing traditional use in the watershed. Many Special Forest Products (SFP) are botanical items of value in commerce or for personal use. Examples of such items are beargrass, mushrooms, boughs, salal, transplants, moss, peat, poles and rock. Although this activity has occurred over decades and even centuries in some cases, commercial gathering of Special Forest Products has increased dramatically in the last five years. Demand for wild mushrooms, berries and beargrass in the Portland/Vancouver and Seattle metropolitan areas is great, and such activities yield high pay-offs. The GPNF is the lead forest in the Pacific Northwest Region for revenues collected for SFP.

In recent history, conifer boughs and beargrass permits have amassed 60% of the SFP revenues on the south end of the GPNF, which includes the Wind watershed.

TABLE III-8-2: Special Forest Products, Number of Permits Issued 1994. South Skills Center, GPNF

Species/Product	No. of Permits 1994
Forest Greens	3
Equisetum (Snake Grass)	2
Salal	5
Beargrass	966
Boughs	320 lbs
Moss	1
Christmas trees	1,569
Firewood	1,354 cords
Personal Use Huckleberries	9,627
Commercial Huckleberries	~16,000 lbs
Personal Use Mushrooms	494
Commercial Mushrooms	176 @ \$500 ea
Posts and Rails	13

Many Forest visitors have traditionally collected these products for personal use and enjoyment, often engaging in other recreation activities such as hiking and camping while on the Forest. However, with the marked increase in commercial collecting, several concerns have escalated, including: destruction/depletion of the resources (e.g., improper mushroom harvesting techniques damaging reproductive potential of an area), conflicts with recreationists and between collectors, displacement of recreational visitors from camp areas, increased litter and human waste at developed and dispersed recreation sites, increased litter being deposited on private lands adjacent the Forest, and illegal collection, such as in designated Wilderness, with inadequate enforcement of permit conditions by those issuing the permits.

This use is likely to continue growing, and as long as permits are easy to obtain and difficult to enforce, so will the degree and amount of conflict and concern of other Forest visitors and resource managers. Little is known about the physical impacts of harvesting, but the social impacts are evident, and other resource areas, such as Wilderness, are being degraded by this activity.

No studies of the sustainability of these forest resources have been undertaken. Excessive collection of SFP's could remove products at a rate that exceeds plant growth and reproductive capabilities, causing a shift in plant communities. Likewise, the increase demand for SFP's has brought primary and secondary employment into the area (economic diversification) that may not be sustainable. An analysis of SFP use on resources in the Wind watershed is recommended.

SPECIAL USES:

Recreation Residences--Government Mineral Springs Area

The Government Mineral Springs (GMS) area has been a popular use area since the 1920's. The attractions that drew people to the area were natural springs which were high in minerals and thought to be effective in curing

many ailments. In 1920 a large hotel and a campground were developed. These facilities contained a separate recreation pavilion, community kitchen, bathhouse, and an enclosed shelter for a pump over the mineral springs. In 1919 lots were surveyed for Recreation Residences. The development of Recreation Residences was a marketing method at the time to attract people to the National Forests. As the years progressed, a total of 46 cabins were constructed within the area.

There are still 46 Recreation Residences on the site, which is referred to as the Government Mineral Springs Summer Home Tract. All of the cabins are under Special Use Permit. There is a governing board of cabin owners which is essential for maintaining some consistency regarding maintenance of the area as a whole. The cabin owners have developed their own water pipeline and maintain the access roads serving the cabins.

One of the main concerns at this time is sanitary facilities, which vary from pit toilets to vault toilets and indoor plumbing with septic systems. All new septics have to be approved by the Southwest Washington Health District. Most of the cabin owners would like to upgrade their sanitary facilities to septic systems. Up until now this conversion of systems required minimal analysis where the main issues related to cultural resources and hydrology. Most of the cabins are located less than 200 feet from Trapper Creek and are now within the Late Successional Reserve (LSR) and Riparian Reserve land allocations.

Today the GMS hotel and campground are gone, but a small "dispersed" camping area is maintained by Forest Service volunteers. A shelter is still over the main mineral spring. This mineral spring, "Iron Mike," an interpretive site, attracts thousands each year, some of whom come to get the water and believe in its healing capabilities.

Two Forest Service Guard Stations that served as housing for firefighters and lookouts who worked on Observation Peak were built around the same time as Government Mineral Springs was being developed. Howe Guard Station is gone, but the GMS Guard Station still exists. It is in severe disrepair and would need much work to be habitable.

Skamania County Saddle Club Organization Site

In the late 1940's the Skamania County Saddle Club developed a small campground in the vicinity of Government Mineral Springs across the road from Howe Guard Station, which no longer exists. The Skamania County Saddle Club site contains two vault toilets, a picnic shelter, fences, gate, and several picnic tables. It is located at the confluence of Trapper Creek and the Wind River. The toilets are located several hundred feet from both streams. The Skamania County Saddle Club is authorized to use this site under a Special Use Permit. The Skamania County Saddle Club site lies within Late Successional Reserves (LSR) and Riparian Reserve areas.

OTHER SPECIAL USES:

Other special uses permitted within the Wind River watershed include small rock collection, waterline rights-of-way, apiary placement, recreation special events, outfitter/guide activities and commercial photography.

Mining

The major mining activity in the Wind River watershed is the Wind River Mine. This mine is located in portions of Sections 4 and 9, T.5N, R.7E. in the Upper Wind sub-watershed. Access to the project area is via the Wind River Highway (Forest Road 30), approximately 17 miles north of Carson, Washington. The developed site occupies approximately 35 acres.

Current Conditions

Currently the Wind River Mine is being operated by Delano Wind River Mines under a 1-year approved Plan of Operation that will expire April 1996. Delano Wind River Mines has submitted a proposed ten-year Plan of Operation. The proposed operation involves removing ore from the mine and hauling it off-Forest to be milled. After milling most of the tailings would be trucked back to the mine site to be deposited into un-used adits and existing tailing ponds that were developed by a previous operator. This proposal underwent environmental analysis, and a decision notice was advertised on January 15, 1996.

There are currently five adits on the project area (three of which have been closed), five buildings, a water tower, a waterline from water tower to buildings, powerline, septic system, miscellaneous roads, parking areas, diesel tank w/concrete spill container, pipelines from diesel tank to mine, water pipeline from mine to tailing pond, and three tailing ponds. Most of the 35 acre developed site is not used by the present operator. There are some opportunities to rehabilitate portions of the site that are no longer proposed for use in the plan of operations. The present plan proposes little activity on site above ground level. This activity will be in the vicinity of the audit entrances in the upper portion of the area which is located on a 50% to 60% south slope. The lower portion of the project area (area of old tailing ponds) is mostly flat with slopes ranging from 0% to 7%. The tailing pond area is adjacent to the riparian reserve for the Wind River.

The Wind River is east of the mine area. The south boundary of the main mining activity is bordered by a perennial stream. There are several small drainages within the project area where water flows only during periods of high precipitation or during spring run-off.

All of the project area is outside of the Late Successional Reserve (LSR).

History

The location of this activity was discovered in the early 1950's by the Wind River Mining Company (WRMC) in T.6N., R.7E., Section 9. This is not the same company currently operating the mine. In 1956 the Wind River Mining Company conducted a limited drilling program and began mining by driving an adit approximately 450 feet in length along one of the veins discovered earlier. Ore shipment from this operation took place from 1956 through 1974. In 1981 a new operator exposed several new veins and constructed an exploratory road above and north of the existing adit. In 1983, the project area changed operators again and they conducted a new drilling program. As result of this exploration, a new adit was driven parallel to the adit that was driven in 1956. The length of this new adit totals 1700 feet as a result of several extensions to it between 1956 and 1990.

Between 1956 and 1990 several other modifications took place in the project area. These include excavation for three tailing ponds, construction of five buildings, placement of power and waterlines, erection of an above-ground water tank, and the placement of a septic tank which has been approved by the Southwest Washington Health District. In May, 1992, Delano Wind River Mine signed a lease with the Wind River Mining Company and took over the operations at the mine site. Since 1992 Delano Wind River Mine has conducted a drilling program and currently has an approved Plan of Operation for development for one year. Delano Wind River Mine proposes to develop the mine for a period of ten years.

9. SYNTHESIS

In addition to the discussion of synthesis by core topic, Table III-9-1, summarizes data presented in the Wind River Watershed analysis. This table permits a comprehensive look at individual sub-watersheds or at the watershed as a whole. Items in **Bold print** exceed the concern threshold indicated on the left side of the table. The thresholds listed were derived specifically for this watershed analysis and consider the range of natural conditions and current management direction.





WIND WATERSHED ANALYSIS

CHAPTER IV

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CHAPTER IV

RECOMMENDATIONS

This chapter presents recommendations that are the basis for future projects, and recommendations for monitoring.

PROJECT RECOMMENDATIONS:

Project recommendations contained in this section are designed to address resource concerns surfaced during watershed analysis. In most cases the project recommendations are general and will require more site specific information to develop management prescriptions and specific project proposals. Table IV 1a below is a summary of concerns. Table IV-2 lists the projects and indicates the concerns addressed.

TABLE IV-1: SUMMARY OF WATERSHED CONCERNS

Concern	Description
Peak Flows	* Prevent or reduce increases in peak flows
Surface erosion Sedimentation	* Reduce the potential for surface erosion. Surface erosion is associated with roads and road construction.
Soil Productivity	* Soil productivity is lost as a result of soil compaction. Soil compaction is associated with temporary roads, skid roads and areas that receive high amounts of human use. Wet areas and riparian areas are specially susceptible to compaction.
Water temperature	* High water temperatures are lethal to aquatic some organisms and considered a loss of water quality.
Turbidity	* Turbidity resulting from sedimentation results in a loss of water quality.
Colliform	* Colliform bacteria in water as a result of contamination from animal feces results in a loss of water quality.
% late seral in RR and LSR	* A high percentage of late seral vegetation is the desirable future condition for Riparian Reserves (RR) and Late Seral Reserves (LSR).
Low Species Diversity	* Vegetation with low species diversity may be present in some areas as a result of past management practices.
High Density Young Stands	* Dense, over-stocked stands may result from natural events or management activity. High density young stands grow at lower rates and require longer time to develop late seral characteristics.
Special Habitats	* Some areas provide unique habitats for plants and animals. These areas should be managed to protect and maintain their unique characteristics. Management plans and special designation to insure protection is appropriate for these areas.
Critical Deer & Elk Winter Range	* Portions of the watershed are critical for big game survival during winter months. These areas should be free from human disturbance as well as provide forage and cover.
Connectivity	* Connectivity is provided by corridors of late successional forest across the Wind watershed and to adjacent watersheds. Connectivity can be improved by stand tending activities that develop late successional traits.
Un desirable/Introduced Exotic Species	* Undesirable, introduced exotic plant and animal species exist in the watershed. Some plants are defined as noxious weeds. Other species are undesirable because they compete with the natural flora and fauna.
Sub-Standard Recreation Facilities	* Older Recreation facilities and improvements may not meet current standards for water quality, accessibility, safety, etc.
Manage Special Uses and Sites	* Some sites receive concentrated human use and require special management to address the size and extent of development and future reclamation. * Removal of Special Forest Products may cause impact to species and habitats and other forest users and facilities.
Increasing Demand For Recreation	* Recreation in the watershed is expected to increase placing additional pressure on trails and existing recreational facilities. Problems associated with increased human use are likely to increase.
Harassment of Fish	* Concentrated human use and fishing pressure can result in disturbance to fish in critical habitat areas and during critical phases of their life cycle.
Incidental Catch of Native Fish	* Loss of wild fish
PSQ	* The NW Forest Plan and the GP Forest Plan include provision to provide commodities to be sold to meet the demand for forest products and produce revenue to the US Treasury. This is expressed as Probable Sale Quantify (PSQ).
Migration Barriers	* Migration barriers such as dams and culverts can restrict fish passage. Barriers may also result as a result of environmental conditions.
Sub-iterrainian Flows	* Conditions that result in sub-surface flows.
Low Nutrients	* Fisheries productivity may be limited by low levels of nutrients



TABLE IV-2: Proposed Projects, Concerns Addressed

Project	Concerns																			
	Peak Flows	Surface Erosion Sedimentation	Soil Productivity	Water Temp.	Turbidity	Colliform	Sub-terrain Flows	Fish Passage	Hybridization	Over Fishing	Hab. Impr.	% Late Seral in RR & LSR	Low Species Diversity	High Density Young Stands	Special Hab.	Critical Deer & Elk Winter Range	Connectivity	Intro. Exotic Species	Sub Standard Recreation Facilities	Commodity Production
Road Decommissioning	X	X			X															
Road Stormproofing		X			X															
Rehab Temp Roads	X	X	X		X															
Nursery Field Stabilization		X	X	X																
Defer Regen Harvest	X																X			
Landscape Connectivity																X	X			
Riparian Revegetation				X						X		X								
Incidental Catch, Wild Fish									X											
Instream LWD										X										
Bank Stabilization		X			X					X										
Fish Migration								X	X											
Reduce Course Sediment							X	X		X										
Introduce Nutrients										X										
Hemlock Fish Trap									X	X								X		
Fishing Reg Change										X								X		
Exotic Fish Species																		X		
Native Steelhead Supp.									X									X		
Precommercial Thinning										X	X			X						
Riparian Thinning										X	X			X						
Commercial Thinning														X						X
Defer Regen Harvest																				X
Algal Weed Treatment																		X		
Use of Native Species										X								X		
Black Ck Swamp Mgt Plan														X						
Winter Range Mgt Plan														X						
Cave Management Plan														X						
Weigle Hill RNA														X						
Big Huckleberry Mtn BSIA																				
Huckleberry Fields Mgt Plan																				X
Mgt Plan, Quarry Site			X																	X
GMS Opn-Maint Plan						X													X	
Reclam Plan WR Mine		X	X																X	
Improve Horse Camp Facilities					X	X													X	
Impacted Wildmess Sites		X	X		X	X													X	
Replace Trail Bridge		X																	X	
Veg Mgt. Indian Race Track														X						
Build Winter Shelter																			X	
Access & Sanitation. Kayackers		X				X													X	
Dev Mtn Bike Trails																			X	
Restoration Dispersed Rec Sites		X		X	X	X				X									X	
Wind River - Brush Ck Trail																			X	X
Wind River Trailhead																			X	X
Special Forest																				X



Project Recommendation:

1. Road Decommissioning:

- *Location:* Watershed wide. Priority to sub-watersheds with high number road miles per square mile

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
	X	X				X	X	X	X	X	X	X	X	X	X	X					X	X				X

- *Objectives:*

1. Reduce impacts of roads on hydrology and peak stream flows.
2. Reduce sediment production from road surfaces, cuts and fills, and at road/stream crossings.
3. Reduce the potential for culvert or fill failures.
4. Reduce open road density to the benefit of wildlife.
5. Reduce number of road miles requiring expenditure of funds for re-occurring maintenance.

- *Description:* Segments identified for decommissioning and priorities have been tentatively developed based on:

1. The desired future condition (DFC) developed for each road during the Wind River Access and Travel Management (ATM) Plan, Phase I.
2. Road condition surveys, ATM Phase II for those portions of the watershed surveyed. Condition surveys continue. (See Appendix A - Roads).
3. Sub-watershed conditions determined during analysis and indicated in the Watershed Analysis Synthesis Table.

2. Road Maintenance and Storm Proofing

- *Location:* Watershed-wide, on roads identified as necessary for future management and operations. Problem areas identified during condition surveys.

- *Objective:* Reduce or treat drainage problems before catastrophic fill failure or gulying occurs.

- *Description:* Road maintenance activities to control, prevent or reduce road related run-off and sediment production. Reconstruct stream crossings. Replace defective or undersized culverts.

3. Rehabilitation of Temporary Roads and Skid Roads, (Sub-soiling)

- *Location:* Watershed wide. Priority to sub-watershed with a high risk of peak flows.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	X
	X	X				X	X	X		X	X	X	X		X							X			X

- *Objective:* Reduce soil compaction and alteration of hill-slope hydrologic flow caused by temporary roads and old landings.

- *Description:* Mechanically sub-soil temporary roads. Sub-soiling is analogous to deep plowing with a winged ripper.

4. Nursery Field Stabilization

- *Location:* Wind River Nursery fields.
- *Objective:* Reduce sediment production and movement into Trout Creek from Nursery fields.
- *Description:*
 1. Install erosion control structures in designated, key locations.
 2. Maintain season long cover crops on fallow fields.
 3. Maintain surface drainage patterns including cross field and perimeter drains.
 4. Clean sub-surface catch basins and sediment traps.
 5. Contour farm slopes.
 6. Insure that future land use meet or exceed BMP's and mitigation measures identified in the Nursery Pest Management EIS.

5. Defer Regeneration Harvest

- *Location:* Matrix sub-watersheds that have low amounts of late successional vegetation and peak flow concerns caused by low ARP's.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
							X	X				X													

- *Objective:*
 1. Allow development of late seral forest stands
 2. Allow hydrologic recovery of young stands.
- *Description:* On Matrix land in sub-watersheds with high amounts of early seral vegetation and low amounts of late seral vegetation, defer regeneration harvest for approximately one decade. Consider other prescriptions such as thinning, heavy forest retention, and inter-planting of other species.

6. Maintain Landscape Connectivity

- *Location:*

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	X						X				X	X			X							X			

- *Objective:* Maintain landscape connectivity for late successional related species.
- *Description:* Where riparian reserves are not currently functioning as dispersal habitat for late successional related species, delay harvest of adjacent stands to maintain terrestrial linkage.

7. Riparian Revegetation

- *Location(s):* Based on evaluating vegetation using GIS, areas and sub-watersheds that contain the smallest diameter riparian vegetation are . Main stem of Wind River from Dry Creek to Paradise Creek. Main stem of Panther Creek From the Forest Boundary to Panther Creek bridge on Road 65. Within the flood plain of Trout Creek above Road 43. Upper Trout Creek, Lower Trout Creek. Layout Creek Compass/Crater Creek Little Wind River.
- *Objective:* Accelerate revegetation and shade development on perennial streams to increase channel stability and reduce water temperatures. Re-establish conifer species within the alder dominated riparian zones. Restore lower bank stability to reduce bank erosion
- *Description:* Plant red cedar and grand fir within the flood plain. Fall alder to create openings where necessary. Alder will be left on ground as woody debris to decay and provide seedling protection from big game.
- *Timing:* Plant in spring. Order planting stock during prior year.

8. Reduce Incidental Catch Of Wild Fish

- *Location:* Trout Creek, Trapper Creek , Panther Creek. Paradise Creek, Dry Creek, Wind River - Beaver Reach
- *Objective:* Increase number of wild fish. Improve chance for survival.
- *Description:* Develop management options. consider regulation changes, gear changes, education, law enforcement, stop artificial re-stocking.

9. Instream Large Woody Debris

- *Location:* Basin wide.
 - Priority locations would be streams with "Very Low" concentrations of LWD: Pete's Gulch II 1 & 2, Panther 1,4 & 5, East Fork Trout 4, Mid Wind 1,2 & 3, Pete's Gulch 1 & 2, Trout Creek 4,5, & 6, Dry 3, Crater 1,3,5 & 6, Oldman 1,2 & 3, Proverbial 1, Planting 1, SF Planting 1 & 2, Trapper 1, and Compass 1,2 & 3.
 - The reaches of stream that contain poor pools and that are perceived to be limiting salmonid production within the Wind River watershed are: East Fork Trout Creek 2, Compass 1, Crater 1,2 & 6, Layout 1,2 & 3, Oldman 2 & 3, Planting 3 & 4, Paradise 1, Upper Wind 2, 3 & 4, Youngman 1 & 3, Proverbial 2, Dry 1, Cedar 2 & 3, Eight-mile 2, and Mouse 1
 - The streams that have width to depth ratios >10 are: East Fork Trout 2, Mouse 1, Upper Wind 2,3 & 4, Cedar 3, Layout 1,2 & 3, Eightmile 2, Planting 3 & 4, Youngman 1 & 3, Proverbial 2, Dry 1, Crater 1,2,3,4 & 6, Paradise 1, Oldman 2 & 3 and Compass 1.
- *Objectives:* Meet PIG recommendations for amounts of large woody debris and pools per mile. Increase the quality and quantity of fish habitat. Dissipate peak flows, protect stream banks.
- *Description:* Place large wood in streams to protect banks, scour pools reduce width to depth ratios and collect sediment. Increase the quantify and quality of pools. Provide hiding cover.

10. Bank And Channel Stabilization

- *Locations:* The following watersheds are priority for restoration: #1 Lower Trout, #1 Layout Creek, #1 Upper Trout Creek, #1 Compass/Crater and #2 the Middle Wind River.
- *Specific Locations:* Within these sub-watersheds, the following stream reaches will be priority for restoration: #1 Trout Creek 2,5,6 and 7. #1 Layout 1, #2 Middle Wind 1, #3 Compass 1, and #3 Crater 1. Other reaches of stream that will be targeted for future restoration are: Panther 5, Paradise 1, Dry Creek 1 and Trapper Creek 1. (See MAP-16).
- *Objective:* Restore lateral stability (channel belt width), LWD, width/depth ratios, channel/bank stability, sediment regime and pools within the range of natural variability. Reduce the width to depth ratios within identified reaches to less than 10 (2 years), increase channel stability to the "good" Pfankuck ratings (10 years), restore the conifer component along these reaches to eight trees per acre greater than 24" in diameter (60 years), increase in-stream large woody debris >75 pieces per river mile (1 year) and increase pool quantity and quality.
- *Description:* Construct large woody revetments (engineered log jams) and soil bio-engineering (bank stabilization methods incorporating native plants/grasses, wood, and rock. Plant riparian areas dominated with deciduous species with native conifers.

11. Eliminate Barriers To Fish Migration

- *Locations:* Structures with in the Wind River watershed that are adversely impacting aquatic resources: Hemlock dam, Shipperd Falls ladder, irrigation diversion at Martha Creek, domestic water diversion at Bear Creek, and "the old coffer dam" above Shipperd Falls, Wind River Compass Creek Culvert (reach 5), Oldman Creek (three culverts, one per reach) and Youngman Creek culvert near the mouth. (See MAP-16).
- *Objective:* Provide free fish emigration and immigration. Prevent fish kills during emigration and immigration.
- *Description:* Remove or modify culverts and structures to allow free migration.

12. Reduce Build Up Of Course Sediments (Aggradation)

- *Locations:*

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
					X							X													

- *Specific Locations:* Currently, there are 0.68 river miles of subterranean stream within Layout and Dry Creeks caused by accelerated bank erosion/sedimentation/aggradation.
- *Objective:* Restore natural migration and reduce mortality of fish. Every year there are fish stranded in pools within these reaches that die from predation, increased water temperatures or desiccation.
- *Description:*

13. Experimental Introduction Of Nutrients To Increase Fish Production

- *Location:* To be determined in study plan
- *Objective:* Increase fish production
- *Description:* Study would examine the potential for increasing primary production by introducing fish carcasses and/or nutrients into streams

14. Hemlock Adult Fish Trap

- *Location:* Trout Creek at dam, Hemlock Lake
- *Objectives:* To preserve and protect a genetic population of wild steelhead from hybridization of hatchery stocks.
- *Description:* Hatchery fish trapped at the Hemlock Lake fish ladder will be returned to the Wind River, (Trap located at top of fish ladder. Trap to be monitored daily when in place.). Wild steelhead will be allowed to immigrate up stream beyond the ladder.

15. Fishing Regulation Changes

- *Location:* Basin wide
- *Objectives:* To preserve and protect young steelhead from hooking/handling mortality.
- *Description:* Recommend fishing changes to the State of Washington to defer trout fishing within the anadromous sections of the Wind River and tributaries. Resident trout fishing should be confined to the areas occupied by brook and brown trout. The current fishing regulations require release of fish under 14." Electro-fishing and snorkel survey data indicates that populations of ≥ 14 " resident are not a common occurrence within the Wind River and do not warrant a trout fishery.

16. Decrease Interactions With Exotic Fish Species

- *Locations:* Basin wide
- *Objective:* Reduce risk of introduced disease, competition, and predation from exotic or introduced fish species.
- *Description:*
- *Hatchery Steelhead Release Sites:* Reduce straying and isolate the hatchery steelhead to one or two specific subwatersheds to reduce the risk of hybridization. At this time Skamania hatchery smolts are released in the mainstem Wind River below Stabler Bridge. Releasing hatchery smolts or juveniles into smaller tributaries may reduce the amount of straying of hatchery fish in the watershed and reduce the risk of hybridization.
- *Brook trout/steelhead competition survey:* Evaluate brook trout populations in the Trout Creek watershed to determine if they are decreasing the natural productivity of wild steelhead trout.

17. Native Steelhead Supplementation

- *Locations:* Basin Wide
- *Objective:* Evaluate the risk of restoring the native populations of steelhead within the Wind River to a run of >2,500 returning adults per year
- *Description:*
 1. Use an adaptive management approach to preserve the native genetic gene pool of summer steelhead within the Wind River/prevent extinction.
 2. Determine number of wild steelhead needed for broodstock.
 3. Determine methods of broodstock collection to maintain genetic diversity (i.e., avoid excessive selection).
 4. Determine the number, size or stage of steelhead to be released (eyed eggs, fry, smolt).

18. Pre-Commercial Thinning

- *Location:* All sub-watersheds that contain overstocked seedling/sapling stands. Areas are examined periodically and a needs list is maintained

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X					X	X		

- *Objective:* Reduce over stocking in seedling/sapling stands to accelerate the development of select leave trees. In Riparian Reserves and the LSR, the objective is to accelerate the development of late-successional stand characteristics for improved connectivity and stream bank shade. In the Matrix, the objective is to promote commodity value.
- *Description:* Seedling/saplings stands contain trees with average diameter less than 5 inches dbh. Pre-commercial thinning is considered in stands where stocking exceeds 300 trees per acre and desirable growth rates will not be maintained. Thin stands to prescribed spacing to promote growth of residual trees. Stand treatment prescriptions are based on site specific analysis and resource needs.

19. Tree Thinning in Riparian Reserve and LSR

- *Location:* Within the Riparian Reserves and Late Successional Reserves. Information from the GIS Veg Layer indicates a general need in the above sub-watersheds. Identification of specific stands would depend on the results of stand exams - a data gap.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
X	X	X		X	X	X			X	X		X	X			X			X		X	X	X		

- *Objective:* Reduce time required to move mid-successional stands within riparian and terrestrial corridors towards late successional characteristics. Accelerate tree growth with thinning. Inter-plant additional species to create multi-layered canopies. The target tree size is dominant trees in the to the 30 to 40 inch diameter range. Trees of this size will meet needs for cover, stream shade, bank stability and large woody debris.

- *Description:* Stand with average diameters between 9 inches dbh and 20 inches dbh are described as “small trees.” Consider treatment in sub-watersheds that contain over 400 acres in the small tree category and tree density adversely effects stand vigor. Treatments would selectively thin stands to prescribed levels depending on stand characteristics and site needs. Other cultural treatments could be applied to individual trees to increase growth, i.e. fertilizer. Trees to be removed will be used to fulfill ecosystem needs such as snags, down woody debris, or in-stream structures. Trees excess to habitat needs could be removed as a commercial produce or defray the cost of the project.

20. Commercial Thinning In Matrix

- *Location:* The sub-watershed that have the greatest opportunity for commercial thinning are A, B, C, M, V and W. There are two planning areas where sales are currently being considered in the Wind River Watershed: McToo Planning Area and Limbo Planning Area. Commercial thinning opportunities are evaluated for each planning area.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
X	X	X			X		X	X			X	X			X						X	X			

- *Objective:* To capture suppression mortality and keep young stands growing at acceptable rates.
- *Description:* Commercial thinning is done in young stands where growth is being inhibited by the density of the stand and growth is expected to increase following treatment. An even flow harvest analysis of Matrix lands shows that approximately 154 acres per year should be available for commercial thinning within the Wind River watershed for a potential harvest of 1 million board feet. Commercial thinning must comply with standards and guidelines of the GP Forest Plan, Amendment 11.

21. Regeneration Harvest In Matrix

- *Location:* The sub-watersheds that have the greatest opportunity for regeneration harvest are A, B, C, L, P, V and W. There are two planning areas where sales are currently being considered in the Wind River watershed: McToo Planning Area and Limbo Planning Area.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
X	X	X									X				X						X	X			

- *Objective:* Initiate a new age class of timber in mature or under stocked stands.
- *Description:* Regeneration cut is an even aged management manipulation of a forest stand for the purpose of initiating a new age class. Retention levels of the existing stand will range from 15% to 40% canopy cover. An even-flow harvest analysis of Matrix lands shows that approximately 154 acres per year should be available for regeneration cutting within the Wind River Watershed for a potential volume of approximately 5.4 million board feet. Regeneration harvest must comply with standards and guidelines of the GP Forest Plan, Amendment 11.

22. Noxious Weed Treatment

- Location:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
		X	X	X	X			X	X	X			X							X					

- *Objective:* Control noxious weed infestations in the watershed.
- *Description:* All sub-watersheds in the Wind Basin have noxious weeds. However, certain sub-watersheds are more heavily infested or are more sensitive than others. These sub-watershed should be targeted for noxious weed control projects first.

23. Use Of Native Species

- *Location:* Basin wide
- *Objective:* Use native species in revegetation efforts.
- *Description:* Native species, where practical, should be used in revegetation efforts to maintain a preponderance of organisms that have evolved with other ecosystem elements.

24. Black Creek Swamp Management Plan

- *Location:* Lower Falls Creek Sub-Watershed. Section 24, T.5 N, R.7 E; Sections 24 and 25, T.5 N, R.7 1/2 E; Section 30, T.5 N, R.8 E.
- *Objective:* Develop for Black Creek Swamp a management plan that maintains or enhances the unique habitat for wetland-associated organisms and provides an appropriate amount of public use for wildlife viewing, education and interpretation.
- *Description:* Develop a list of flora and fauna associated with the swamp and describe life-history functions. Black Creek Swamp provides calving and winter range habitat for elk. Map the habitat and develop vegetation management prescriptions that address habitat requirements of all organisms using the area. Determine the effectiveness of road closures and develop a strategy for reducing wildlife disturbance during critical seasons while providing opportunities to view flora and fauna during non-critical times.

25. Winter Range Management Plan, Habitat and Roads

- *Location:*

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	X	X					X	X	X			X													

- *Specific Locations:* Compass-Crater, Headwaters Wind, Layout, Lower Falls. Middle Wind and Upper Trout are the sub-watersheds considered most critical.

- *Objective:* Develop a winter range management plan for priority areas, including "allocated" and core biological winter range to achieve Forest Plan guidelines for cover conditions and road density. Focus on areas where habitat concerns are most critical.
- *Description:* Determine current habitat conditions and distribution. Develop silvicultural and road management prescriptions to bring conditions to levels that meet current standards and guidelines. Develop a list of road locations for closure and/or obliteration. Involve personnel from WA Dept of F & WL (Tim Meyers) and USFS (Flick, Linde, Blythe).

26. Wind River Cave Management Plan

- *Location:*

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	X	X						X			X				X						X				

- *Objective:* Implement the Gifford Pinchot Cave Management Plan and provide site specific management direction for sensitive caves.
- *Description:* Prioritize most sensitive caves. Determine major resource concerns, amount of human use occurring and type of seasonal maintenance and closure required to protect cave resources.

27. Establish Rna At Weigle Hill

- *Location:*

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
																X		X	X						

- *Objective:* To protect representative ecosystem elements at Weigle Hill by establishing the area as an Research Natural Area (RNA).
- *Description:* Weigle Hill has representative oak, bald habitat in addition to a large number of sensitive plant populations and a little represented low elevation old growth stand of Western Hemlock. These elements make Weigle Hill a desirable potential addition to the RNA system.

28. Establish Botanical Special Interest Area At Big Huckleberry Mtn

- *Location:* Big Huckleberry Mountain
- *Objective:* To protect, enhance and appreciate the combined recreational and botanical values at Big Huckleberry Mountain by establishing it as a Botanical Special Interest Area, (BSIA).
- *Description:* The Big Huckleberry Mountain area adjoins Grassy Knoll, a popular BSIA to the south. The two areas could be included in one large BSIA that would include both open ridges or Big Huckleberry Mountain could be established as a separate BSIA.

29. Develop Management Plan For Huckleberry Fields

- *Location:* This project goes beyond the Wind Basin and includes berry fields in other major watersheds.
- *Objective:* Develop a long term (next 50 years) plan for managing the huckleberry fields.
- *Description:* Huckleberry fields such as those on Mowich Butte decreased in size as a result of encroachment/invasion of conifer species. Vegetation management options would be prescribed to maintain and enhance berry production. Producing the management plan would be an opportunity to work cooperatively with groups such as the Yakama Tribe that have a vested interest in maintaining huckleberry production.

30. Management Plan, Vantage Quarry (Falls Creek Quarry)

- *Location:* Vantage Quarry, (Falls Creek Quarry)
- *Objective:* Prevent unacceptable impacts
- *Description:* Make a plan to address development of the quarry site. Establish limits on site expansion. Address rehabilitation of the site.

31. Develop Operations/Maintenance Plan For GMS

- *Location:* Government Mineral Springs
- *Objective:* Reduce potential for point source of water pollution. Replace substandard facilities. Develop simple, efficient, cost effective procedures for dealing with re-occurring requests from cabin owners to make improvements.
- *Description:* Develop operations and maintenance plan to address requests for upgrading sanitation systems and rebuilding structures.

32. Reclamation Plan, Wind River Mine Site

- *Location:* Wind River Mine
- *Objective:* Provide for reclamation of portions of the mine site that are no longer in use or included in the current plan of operations.
- *Description:* Make a plan to reclaim the portions of the site no longer in use that do not meet current standards and guidelines. Eliminate buildings and other "improvements" placed on the site by previous operators that are outside the present plan of operations.

33. IMPROVE FACILITIES AT FALLS CREEK and CREST HORSE CAMPS

- *Location:* Falls Creek and Crest Horse Camps
- *Objective:* Reduce potential for point source of water pollution. Replace substandard facilities.
- *Description:* Replace pit toilets at both locations with self-contained vault units. Add tie-stalls, loading ramps and improve camp sites.

34. Impacted Wilderness Sites

- *Locations:*

Indian Heaven Wilderness: Campsites in the vicinity of Rock Lake, Little Rock Lake, Lake Umtux, Indian Racetrack.

Trapper Creek Wilderness: Campsites in the vicinity of Soda Peaks Lakes, Trapper Creek, Observation Trail.

- *Objective:* Eliminate/prevent unacceptable impacts to soils, vegetation and water quality caused by human use.
- *Description:* Evaluate impacted campsite areas for closure, restoration, and/or relocation. Implement appropriate corrective action.

35. Replace/Repair Trail Bridges

- *Location:* Trail bridges on Trails 133 and 192. Trapper Creek Wilderness.
- *Objective:* Improve water quality by eliminating sediment source. Up grade/replace recreation related structure.
- *Description:* Install "Hiker only" foot bridge on Trail 192. Re-deck bridge on Trail 133.

36. Vegetation Management, Indian Race Track

- *Location:* Indian Heaven Wilderness
- *Objective:* Remove encroaching vegetation. Maintain an acceptable cultural essence of the site.
- *Description:* Develop and implement vegetation management prescription. Trees are encroaching on the racetrack area and will eventually change the character of the site. Explore opportunities to work in partnership with Indian people to plan and implement project.

37. Winter Shelter, Vicinity Road 65/6507

- *Location:* Vicinity Road 65/6507, exact location not determined.
- *Objective:* Provide facility to meet increasing demand for winter sports recreation.
- *Description:* Build small, three-sided shelter for day use during winter. Primary use would be for cross country skiers and snow mobilers. During summer months, the shelter could be used by horse riders.

38. Provide Access And Sanitation Facilities For Kayakers

- *Location:* Hemlock Dam, Stabler, High Bridge
- *Objective:* Meet increasing demand for activity. Mitigate impacts.
- *Description:* Provide sanitation facilities at sites where kayakers frequently access river. Develop partnerships with white water boating organizations. Contain use to selected sites.

39. Develop Mountain Bike Trails

- *Location:* Location would be based on feasibility analysis and incorporate recommendations for "Roads to Trails" proposals developed during Access and Travel Management , Phase 1.
- *Objective:* Meet rapidly growing demand for mountain biking as a recreational activity. Eliminate user conflicts that occurs when mtn bikers use "horse-hiker" trails or ride in restricted areas.
- *Description:* Plan and develop a proposal with exact locations and routes. Convert roads to mountain bike trails in coordination with road decommissioning.

40. Restoration Of Dispersed Rec Sites

- *Location:* The Wind as a Wild and Scenic River and Panther Creek are areas of special concern.
- *Objective:* Reduce impacts to riparian areas, aquatic plants and animals. Eliminate sources of water pollution and sediment production.
- *Description:* Attempt to confine camping to developed sites. Rehabilitate disturbed sites. Restore natural vegetation. Mitigate impacts on sites that will receive continuing use. Develop and enforce closures. Discourage dispersed camping in areas near developed camp grounds that occurs as a result of over flow or avoidance of payment of fees.

41. Wind River - Brush Creek Loop Trail (CGNSA)

- *Location:* Columbia Gorge Nation Scenic Area
- *Objective:* Development to meet increasing demand for recreation.
- *Description:* A conceptual trail was identified in the Recreational Development Plan (proposal T8) of the NSA Management Plan. The trail could connect to the Grassy Knoll trail and Augsperger trail and incorporate portions of the Pacific Crest Trail. Portions of Road 018 and the Hot Springs - Brush Creek Road could be converted into the trail.

42. Wind River Trailhead (CGNSA)

- *Location:* Columbia Gorge Nation Scenic Area
- *Objective:* Development to meet increasing demand for recreation.
- *Description:* A conceptual trailhead was identified in the Recreational Development Plan (proposal 10) of the NSA Management Plan. Trailhead would serve the above described trail and hot springs users. The conceptual location is presently in private ownership.

43. Develop/Revise Plan For Special Forest Products

- *Location:* Basin wide where special forest products are collected.
- *Objective:*
- *Description:* Address impacts to plant populations and effects caused by people gathering special forest products. (effects from camping, poor sanitation). Establish policy that specifies camping areas, conditions of occupancy and collects fees for camping.

Monitoring Item Recommendations:

1. Hydrologic Change Model Validation

- Purpose/Objective: Validate input parameters (climatic variables) for the model
- Parameters to Monitor: Air temperature and wind speeds during rain-on-snow
- Location/Timing: Climatic data is available from local weather stations. Validation should be done prior to use of the model again on this watershed.

2. Hydrologic Change Model and Risk Rating Comparison

- Purpose/Objective: Validate that both tools used for assessing risk lead to common results, or understand why they differ.
- Parameters to Monitor: Results of the Hydrologic Change Model and Risk Rating
- Location/Timing: Can be done at the District prior to the next watershed analysis

3. Peak Flow Assessment Validation

- Purpose/Objective: Validate peak flow assessment tools against instream conditions
- Parameters to Monitor: Stream channel morphology, substrate and depth of scour at selected locations
- Location/Timing: At response reaches in sub-watersheds identified as high risk, with "control" sites in less disturbed sub-watersheds.

4. Water Temperature

- Objective: Determine current water quality conditions across the watershed. Identify which streams meet and do not meet state water quality standards for maximum water temperature.
- Parameters to Monitor: Maximum hourly water temperature.
- Location/Timing: Major tributaries to the Wind River where data is not currently available. Also, continued monitoring of baseline stations for analysis of change over time. Inventory stations where monitoring is needed include: Ninemile, Big Hollow, Dry, Pete's Gulch, Upper and Lower Falls, Eightmile, Upper and Lower Panther, Brush, and the Little Wind. Inventory stations should have temperature data for at a minimum one summer season. Baseline stations should be monitored annually through the summer months.

5. Turbidity

- Objective: Identify source areas of fine sediment production, and determine response characteristics across the watershed to precipitation and increased stream-flow.
- Parameters to Monitor: Turbidity and stream-flow.
- Location/Timing: All major tributaries to the Wind River should be monitored at a range of flow conditions across all seasons.

6. Suspended Sediment

- Objective: Identify current levels of suspended sediment in upper Trout Creek to establish a baseline from which to measure future changes due to restoration or other activities.
- Parameters to Monitor: Suspended sediment and stream flow
- Location/Timing: On Trout Creek at the USGS gauging station established on the 43 bridge. Monitoring should be done on a continuous basis year-round.

7. Fecal Colliform

- Objective: Determine compliance with state water quality standards, identify trends, and locate areas that may need particular management emphasis.
- Parameters to Monitor: Fecal Colliform
- Location/Timing: Monitoring should be done near all high use areas for one year on a quarterly basis to assess conditions through different parts of the year. Frequency of sampling may then concentrate on high use periods only.

8. pH

- Objective: Characterize current conditions, monitor compliance with state water quality standards.
- Parameters to Monitor: pH
- Location/Timing: Continue with baseline stations and add major tributaries and seasonal sampling.

9. Rates of Sediment Production from Channel and Bank Erosion.

- Purpose/Objective: Investigate erosion and sediment production from channel and bank erosion.
- Parameters to Monitor: Changes in bank and channel stability over time and peak flow events i.e., cubic feet of eroded bank. Establish permanent cross sections; monitor yearly.
- Location: Streams with Poor channel stability ratings usually exhibit excessive bank erosion. The majority of sediment generated within these areas comes directly from bank erosion. The stream reaches which show poor bank/channel stability are: Dry Creek 1, Twelve-mile 1, Upper Wind 1 & 5, Youngman 1 & 2, Middle Wind 3, Trout 2, 5, 6, 7, Crater 2 & 4, and Layout 1. Impacts of increased sedimentation from landslides show up in the channel stability rating within reach 2 of Proverbial Creek stream channels.

10. Recovery Rates of Channels After Restoration.

- Purpose/Objective: Evaluate the recovery rates of treated and untreated reaches of stream.
- Parameters to Monitor: Riparian vegetation, bank erosion rates, width to depth ratios, substrate size, large woody debris, water temperature, and fish populations. Establish permanent cross sections; monitor yearly.
- Location/Timing: Reach 1 Layout Creek, Reach 4, 5 & 6 of Trout Creek, Reach 1 Middle Wind River and Reach 1 Dry Creek

11. Stream Shade

- Purpose/Objective: To track the recovery of riparian canopy in relation to maximum water temperatures.
- Parameters to Monitor: Install permanent plots to monitor percent stream shade and canopy cover; correlate with water temperature.
- Location/Timing: Layout Creek, Compass/Crater Creek, Upper Trout Creek, Lower Trout Creek and the Little Wind River. Specific reaches identified during stream surveys include: Crater 1, 2, 3 & 4, Eight mile 1, Upper Wind 3 & 5, Trout 3, 4, 5, 6, 7, Proverbial 1, Paradise 1, Pete's Gulch II 1, Pete's Gulch 2, Oldman 1 & 2, Middle Wind 3, Panther 2, and Compass 1. Monitor yearly.

12. Water Chemistry

- Purpose/Objective: Monitor changes in water chemistry over time as watersheds recover.
- Parameters to Monitor: Establish stations to monitor base line levels of dissolved oxygen, conductivity, and pH.
- Location/Timing: Lower Trout, Layout Creek, Upper Trout Creek, Compass/Crater, Trapper Creek, Panther Creek and the Middle Wind River.

13. Aquatic Inventory

- Purpose/Objective: Identify insect and fish species, distribution, and composition. Locate possible populations of cutthroat trout. Increase information base on non-sports fish species.
- Parameters to Monitor: fish and aquatic insects.
- Location/Timing: Comprehensive survey throughout the basin within one year. Periodic sampling every 5 years.

14. Creel Census

- Purpose/Objective: To evaluate angler harvest (species composition and catch per hour).
- Parameters to Monitor: Anglers within the Wind River watershed. Species, timing and composition of harvest.
- Location/Timing: Basin wide, annually during fishing seasons.

15. Sediment and Peak flows Effects on Spawning Gravel.

- Purpose/Objective: To evaluate spawner success of wild and hatchery steelhead relative to peak flows and sediment.
- Location/Timing:
- Parameters to Monitor: Productivity and habitat condition. Relate differences in productivity to "good" and "bad" to habitat conditions.

16. Smolt Emigration

- Purpose/Objective: Investigate the emigration timing, age structure, and population status of steelhead smolts within the Wind River.
- Parameters to Monitor: Screw traps will be installed throughout the basin to collect and sample scales for aging, weights and length frequencies, and recapture data.
- Location/Timing: Panther Creek, Trout Creek and the Wind River. Smolt emigration generally occurs from mid March through June.

17. Productivity Monitoring

- Purpose/Objective: Assess the current populations and carrying capacity for steelhead to ensure that projects undertaken will enhance the natural production of wild steelhead. Provide rigorous pre and post evaluation of all activities associated with increasing natural productivity.
- Parameters to Monitor: Organic nutrients: Carbon, Nitrogen, Phosphorous and Calcium carbonate, habitat establish permanent aquatic organism baseline stations throughout the basin.
- Location/Timing: Throughout the basin. Seasonally.

18. Forest Stand Conditions

- Purpose/Objective: Maintain and update vegetation information data base.
- Parameters to Monitor: Density, average diameter, height, species composition, growth rate, dominance, health, vigor, etc.
- Location/Timing: Stand information should be updated approximately every ten years. Extent and intensity of examinations can vary depending on need.

19. Stand Damaging Agents

- Purpose/Objective: Determine the extent of insect, disease and wind throw problems and the potential for increased damage.
- Parameters to Monitor: Infestation areas, insect activity areas, blow down areas.
- Location/Timing: Basin wide on an annual basis through aerial and on the ground surveys.



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APPENDICES

APPENDIX A: Roads With Documented Concerns in the Wind River Watershed

APPENDIX B: Silviculture, Tables and Figures

APPENDIX C: Fire Ecology and History

APPENDIX D: Wildlife Tables

APPENDIX E: Fisheries Tables

APPENDIX F: Dispersed Recreation Sites

APPENDIX G: History of Human Uses (Published separately).



APPENDIX A

Roads With Documented Concerns in the Wind River
Watershed



APPENDIX A: Roads With Documented Concerns In The Wind River Watershed

Road Number	3000601	3000602	3000607	3056105	3062055	3062057	3080000	3080097	3080099	3100106
Road Miles	0.3	1.1	0.7	0.9	1.3	0.4	4.3	0.5	1.0	3.8
Remarks					96 project					96 project
ATM DFC Code	G1	F1	G1	F1	G1	F1	G1	F1	G1	D
Survey Complete?					Yes		Yes	Yes	Yes	
In subwtrshd with > 8 stream xings/sq.mi.?	Yes	Yes	Yes		Yes		Yes	Yes	Yes	Yes
Stream xings (#)		1			7	1	21		3	13
Culverts with > 1 ft jump on live stream (#)							3			
Culverts plugged 40% or more (#)					1		5	3	2	4
Mass wasting potential?				Yes	Yes		Yes		Yes	Yes
Mass wasting indicators (#)					3					2
Sites of erosion/ruts > 6 in. deep (#)					2				1	
Miles in riparian		0.9	0.6	0.5	0.9	0.1	2.5		0.3	1.8
% road in riparian	0	82	86	56	69	25	58	0	30	47
In subwtrshd with road density >3.0 mi./sq.mi.?	Yes	Yes		Yes	Yes		Yes	Yes	Yes	Yes
In BWR where open road density > 1.7mi./sq.mi.?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

APPENDIX A: Roads With Documented Concerns In The Wind River Watershed

Road Number	3300000	3300409	3300602	3301000	3301416	3700423	4100000	4101000	4101401	4101403
Road Miles	7.1	0.9	0.3	2.5	2.1	1.9	8.5	3.0	0.4	0.1
Remarks	96 project	96 project	96 project	96 project	96 project	96 project				
ATM DFC Code	B	G1	F1	D/G1	G1	G1	H	F1	F1	F1
Survey Complete?		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
In subwtrshd with > 8 stream xings/sq.mi.?	Yes	Yes	Yes	Yes	Yes	Yes				
Stream xings (#)	20	2	15	12	1	8	4	2	1	1
Culverts with > 1 ft jump on live stream (#)			6	2			1			
Culverts plugged 40% or more (#)			8	10	13	5	4			
Mass wasting potential?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Mass wasting indicators (#)		3		7	12	1		3		
Sites of erosion/ruts > 6 in. deep (#)				1	3	16		1		
Miles in riparian	4.5	0.7	0.1	2.0	1.5	0.2	0.5	1.0	0.2	0.1
% road in riparian	63	78	33	80	71	11	6	33	50	100
In subwtrshd with road density >3.0 mi./sq.mi.?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
In BWR where open road density > 1.7mi./sq.mi.?	Yes		Yes	Yes			Yes	Yes	Yes	Yes

APPENDIX A: Roads With Documented Concerns In The Wind River Watershed

Road Number	4200000	4200418	4200422	4300434	4309415	4309428	5400304	5400305	5400306	5400325
Road Miles	7.8	2.9	0.5	0.8	2.0	0.2	2.0	1.5	1.9	0.6
Remarks		96 project					96 project			96 project
ATM DFC Code		G1	G1	F1	F1	F1	F1/G1	F1	G1	F1
Survey Complete?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
In subwtrshd with > 8 stream xings/sq.mi.?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stream xings (#)	14	11		2	5		4	8	4	
Culverts with > 1 ft jump on live stream (#)	1	2						1		
Culverts plugged 40% or more (#)	9	6		7	4		5			1
Mass wasting potential?		Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mass wasting indicators (#)		3		2	2		1	2	2	
Sites of erosion/ruts > 6 in. deep (#)		1	2		11	2	1	1		
Miles in riparian	3.0	1.3		0.2	1.0		0.5	1.0	0.5	
% road in riparian	38	45	0	25	50	0	25	67	26	0
In subwtrshd with road density >3.0 mi./sq.mi.?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
In BWR where open road density > 1.7mi./sq.mi.?	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes

APPENDIX A: Roads With Documented Concerns In The Wind River Watershed

Road Number	5400325A	5400326	5400328	5400328A	5400431	5400433	5400633	6000058	6000088	6060042
Road Miles	0.3	0.9	1.0	0.4	0.5	0.8	0.7	0.5	0.9	0.8
Remarks	96 project	96 project	96 project	96 project		96 project	96 project	96 project		
ATM DFC Code		G1	F1		G1	H	G1	G1	G1	F1
Survey Complete?	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
In subwtrshd with > 8 stream xings/sq.mi.?	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes
Stream xings (#)			4	2		5		1	3	
Culverts with > 1 ft jump on live stream (#)										
Culverts plugged 40% or more (#)		1	1		2	3				
Mass wasting potential?	Yes	Yes							Yes	
Mass wasting indicators (#)	2	3							1	
Sites of erosion/ruts > 6 in. deep (#)		1	1	1		9	2		1	1
Miles in riparian		0.4	0.8	0.4		0.6	0.4	0.1	0.6	0.2
% road in riparian	0	44	80	100	0	75	57	20	67	25
In subwtrshd with road density >3.0 mi./sq.mi.?	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
In BWR where open road density > 1.7mi./sq.mi.?	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	

APPENDIX A: Roads With Documented Concerns In The Wind River Watershed

Road Number	6060059	6060060	6063039	6063040	6063041	6063083	6063090	6063091	6063092	6063092A
Road Miles	2.1	0.9	3.3	1.1	0.6	0.8	0.8	0.4	0.3	0.1
Remarks			96 project			96 project	96 project			
ATM DFC Code	G1	G1	G1	G1	F1	G1	G1	G1	G1	
Survey Complete?	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
In subwtrshd with > 8 stream xings/sq.mi.?	Yes		Yes	Yes	Yes	Yes			Yes	Yes
Stream xings (#)	2		11	5	4	1	3		2	
Culverts with > 1 ft jump on live stream (#)			3							
Culverts plugged 40% or more (#)	3		5			1			1	
Mass wasting potential?			Yes	Yes			Yes			
Mass wasting indicators (#)			1	1			3			
Sites of erosion/ruts > 6 in. deep (#)	2	1	2	1	1					1
Miles in riparian	0.4	0.1	1.5	0.7	0.4	0.2	0.4		0.3	0.1
% road in riparian	19	11	45	64	67	25	50	0	100	100
In subwtrshd with road density >3.0 mi./sq.mi.?	Yes	Yes		Yes		Yes			Yes	Yes
In BWR where open road density > 1.7mi./sq.mi.?			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

APPENDIX A: Roads With Documented Concerns In The Wind River Watershed

Road Number	6063093	6400201	6400203	6500070	6500602	6511000	6511029	6513085	6513086	6513087
Road Miles	1.0	2.6	3.6	0.8	0.2	1.5	1.2	0.6	0.6	0.6
Remarks								96 project	96 project	96 project
ATM DFC Code	F1	H	D/G1	G1	G2	G1	G1	G1	G1	G1
Survey Complete?	Yes	Yes		Yes		Yes	Yes	Yes	Yes	Yes
In subwtrshd with > 8 stream xings/sq.mi.?	Yes					Yes	Yes	Yes		Yes
Stream xings (#)	4	7	13	1	1	10	4	1	6	
Culverts with > 1 ft jump on live stream (#)										
Culverts plugged 40% or more (#)		4		3		1	5	1	2	1
Mass wasting potential?						Yes				Yes
Mass wasting indicators (#)						1				2
Sites of erosion/ruts > 6 in. deep (#)	1					4		1		
Miles in riparian	0.5	2.0	2.0	0.2	0.2	1.0	0.4	0.5	0.5	
% road in riparian	50	77	56	25	100	67	33	83	83	0
In subwtrshd with road density >3.0 mi./sq.mi.?						Yes	Yes			Yes
In BWR where open road density > 1.7mi./sq.mi.?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

APPENDIX A: Roads With Documented Concerns In The Wind River Watershed

Road Number	6701000	6800019
Road Miles	4.4	1.6
Remarks		
ATM DFC Code	B	G1
Survey Complete?		Yes
In subwtrshd with > 8 stream xings/sq.mi.?		
Stream xings (#)	5	7
Culverts with > 1 ft jump on live stream (#)		
Culverts plugged 40% or more (#)		3
Mass wasting potential?		
Mass wasting indicators (#)		3
Sites of erosion/ruts > 6 in. deep (#)		1
Miles in riparian	1.0	0.9
% road in riparian	23	56
In subwtrshd with road density >3.0 mi./sq.mi.?		
In BWR where open road density > 1.7mi./sq.mi.?		Yes

APPENDIX B

Silviculture, Tables and Figures

Appendix B

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Appendix B - Table 1

Wind River Watershed
Matrix - Evenflow Harvest Acreage Calculation
Estimated Probable Sale Quantity (PSQ)
Outside of ROD Riparian

<u>Sub-Watershed</u>	(a)	(b)	(c)	(d)		(e)	(f)
	<u>Forest Acres</u>	<u>Dedicated Reserve Acres</u>	<u>Regen cut per decade Acres</u>	<u>Available Regen Areas</u>			<u>Young Stands</u>
				<u>Lg Tree</u>	<u>Sm Tree</u>		<u>Sm Tree</u>
Compass/Crater	1,280	128	104	421	-		127
Headwaters Wind	4,809	480	393	954	978		978
Layout	1,567	156	128	314	-		650
Lower Falls Cr.	2,672	267	218	688	384		384
Paradise	2,865	286	234	791	650		650
Pete Gulch	1,618	161	132	327	404		405
Upper Falls	1,169	116	96	627	64		64
Upper Panther	1,202	120	98	1,140	-		41
Upper Trout	199	19	16	70	-		13
Upper Wind	1,416	141	116	169	531		531
Total acres	<u>18,807</u>	<u>1,874</u>	<u>1,535</u>	<u>5,501</u>	<u>3,138</u>		<u>3,843</u>

Harvest Calculation

1. Regeneration Harvest: Available regeneration acres per decade were calculated by dividing all Matrix forest acres (a - b) by the average rotation length of 110 years and multiplying by 10 years. Total regeneration harvest per acre was calculated as follows:

$$1,535 \text{ ac} / 10 = 154 \text{ ac/yr} \times 35 \text{ MBF/ac} = 5,390 \text{ MBF per year}$$

2. Intermediate Harvest: The assumption is that all young stands would be thinned at least one time during a rotation. Acres available for intermediate cut in the next decade would be the same as for regeneration cut or 1,535 acres. An estimate of intermediate harvest volume per year is:

$$1,535 \text{ ac} / 10 = 154 \text{ ac/yr} \times 7 \text{ MBF/ac} = 1,078 \text{ MBF per year}$$

3. Total estimated harvest on Matrix lands:

$$\text{Total annual harvest} = 6,468 \text{ MBF / year (rounded to 6.4 MMBF)}$$

Appendix B - Table 2

Wind River Watershed
 Seral stages for Martix outside ROD Riparian

<u>Sub-Watershed</u>	<u>S/Sap</u>	<u>Poles</u>	<u>L.For</u>	<u>Sm Tree</u>	<u>Lg Tree S-Story</u>	<u>Lg Tree M-Story</u>	<u>HW</u>	<u>Admin</u>	<u>Dry Meadow</u>	<u>Wet Meadow</u>	<u>Rock</u>	<u>Water</u>
Compass/Crater	250	471	-	127	221	200	11	-	-	1	8	-
Dry	-	1	-	7	-	3	-	-	-	-	-	-
Headwaters Wind	1,017	881	1	1,956	231	723	-	-	-	-	69	-
Layout	147	431	-	650	112	202	25	-	-	23	21	-
Lower Falls Cr.	601	505	110	768	577	111	-	-	60	-	20	-
Paradise	396	369	9	1,300	192	599	-	2	-	-	61	-
Pete Gulch	326	125	31	809	81	246	-	-	-	-	15	-
Upper Falls	177	170	67	128	214	413	-	-	-	5	8	-
Upper Panther	-	21	-	41	1,073	67	-	-	-	-	7	-
Upper Trout	38	78	-	13	14	56	-	-	-	-	2	-
Upper Wind	<u>75</u>	<u>92</u>	<u>-</u>	<u>1,062</u>	<u>7</u>	<u>162</u>	<u>18</u>	<u>7</u>	<u>-</u>	<u>-</u>	<u>272</u>	<u>1</u>
Total acres	3,027	3,144	218	6,861	2,722	2,782	54	9	60	31	489	1

Commercial forest 18,807 acres
 Non-forest 590 acres
 total 19,397 acres

Appendix B - Table 3

Wind River Watershed
 Seral stages for Martix within ROD Riparian

<u>Sub-Watershed</u>	<u>S/Sap</u>	<u>Poles</u>	<u>L.For</u>	<u>Sm Tree</u>	<u>Lg Tree S-Story</u>	<u>Lg Tree M-Story</u>	<u>HW</u>	<u>Admin</u>	<u>Dry Meadow</u>	<u>Wet Meadow</u>	<u>Rock</u>	<u>Water</u>
Compass/Crater	125	286	-	85	124	133	23	-	-	105	-	8
Dry	-	-	-	-	-	-	-	-	-	-	-	-
Headwaters Wind	416	339	-	1,551	177	303	1	-	-	39	31	3
Layout	184	556	-	406	117	197	41	-	-	123	15	19
Lower Falls Cr.	146	178	43	240	146	58	1	-	-	14	2	-
Paradise	153	234	-	1,192	350	460	-	-	-	43	39	1
Pete Gulch	113	43	17	547	16	94	-	-	-	97	19	1
Upper Falls	102	79	66	55	72	214	-	-	-	158	-	-
Upper Panther	-	-	-	-	228	8	-	-	-	-	1	-
Upper Trout	50	63	-	3	7	16	-	-	-	9	-	11
Upper Wind	<u>24</u>	<u>42</u>	<u>-</u>	<u>638</u>	<u>4</u>	<u>131</u>	<u>89</u>	<u>4</u>	<u>-</u>	<u>2</u>	<u>124</u>	<u>46</u>
Total acres	1,313	1,820	126	4,717	1,241	1,614	155	4	-	590	231	89

Commercial forest 10,986 acres
 Non-forest 914 acres
 total 11,900 acres

Appendix B - Table 4

Wind River Watershed
Current LSR Seral Stages

Sub-Watershed	S/Sap	Poles	L.For	Sm Tree	Lg Tree S-Story	Lg Tree M-Story	HW	Admin	Dry Meadow	Wet Meadow	Rock	Water
Big Hollow	145	575	113	1,383	138	1,476	12	-	-	76	30	-
Brush	-	148	-	609	40	460	-	6	-	11	-	-
Cedar	281	266	10	922	119	2,076	40	2	-	3	82	-
Compass/Crater	135	656	-	88	9	532	-	-	-	20	131	-
Dry	273	639	26	3,158	-	1,325	127	-	145	26	150	11
East Fork Bear	176	339	-	1,011	1,258	673	31	-	-	8	99	-
Eightmile	633	773	-	1,590	122	594	5	-	-	2	21	1
Little Wind	-	378	-	114	274	955	-	117	-	-	102	7
Lower Bear	183	165	22	517	481	181	75	-	-	-	18	4
Lower Falls Cr.	705	830	88	1,079	290	758	10	-	-	213	-	11
Lower Panther	373	198	29	2,706	685	1,439	161	5	8	8	148	100
Lower Trout	437	671	-	3,816	133	1,497	183	330	-	11	45	117
Lower Wind	-	-	-	562	5	162	38	-	-	-	49	22
Middle Wind	887	1,168	29	5,895	1,474	1,385	177	27	-	52	237	95
Mouse	104	61	7	767	139	1,358	8	-	20	8	105	-
Ninemile	527	790	-	1,066	463	527	3	-	-	-	11	-
N.F. Bear	23	183	19	1,427	789	953	19	-	29	36	235	6
Paradise	-	-	-	-	-	12	-	-	-	-	-	-
Trapper	80	32	-	285	99	711	-	83	-	10	37	1
Upper Panther	-	47	30	155	653	2,560	-	-	4	29	270	-
Upper Trout	1,266	727	-	624	302	1,983	-	-	-	109	723	37
Upper Wind	39	10	-	539	107	107	-	-	-	-	33	-
Total acres	6,269	8,656	373	28,313	7,473	21,724	875	570	206	622	2,526	412
Average Age	13 y	38 y		110 y	166 y	200 y	30 y					

Appendix B - Table 5

Wind River Watershed Eco-Classes

<u>Eco-class</u>	<u>Acres</u>
A Administrative	2,909
CA Subalpine fir	270
CC Cedar	381
CD Douglas-fir	4,392
CF Silver fir	37,937
CH Western hemlock	88,118
CL Lodgepole pine	41
CM Mountain hemlock	719
F Forblands	19
HA Red alder	850
HB Big leaf maple	602
HC Cottonwood/ash	50
HO Oak	210
MD Dry meadows	206
MM Moist meadows	290
MW Wet meadows	466
NA Avalanche paths	5
NC Cinders, lava flows, mud flows	1,034
NF Flood plain periodically denuded	574
NL Land failures - slumps	14
NR Rocky land	2,801
NT Talus land	315
NX Non-vegetated	31
S Shrublands	930
W Water: springs, ponds, lakes, streams	293
	<u>143,527</u>

Wind River Watershed
6th Field Watersheds

<u>Sub-Watershed</u>	<u>Acres</u>
Big Hollow	4,120
Brush	1,876
Cedar	3,974
Compass/Crater	3,789
Dry	5,753
East Fork Bear	3,740
Eightmile	2,356
Headwaters Wind	8,363
Layout	3,552
Little Wind	5,929
Lower Bear	2,045
Lower Falls Cr.	8,106
Lower Panther	7,184
Lower Trout	8,244
Lower Wind	9,464
Middle Wind	13,051
Mouse	2,579
Ninemile	3,501
N.F. Bear	3,709
Paradise	5,416
Pete Gulch	3,496
Trapper	7,413
Upper Falls	5,776
Upper Panther	10,349
Upper Trout	6,143
Upper Wind	<u>3,508</u>
Total acres	143,438

APPENDIX B

FIGURE 1

EARLY SUCCESSIONAL VEGETATION IN THE CLASS 1, 2, & 3 STREAMS OF THE TRUE RIPARIAN ZONE

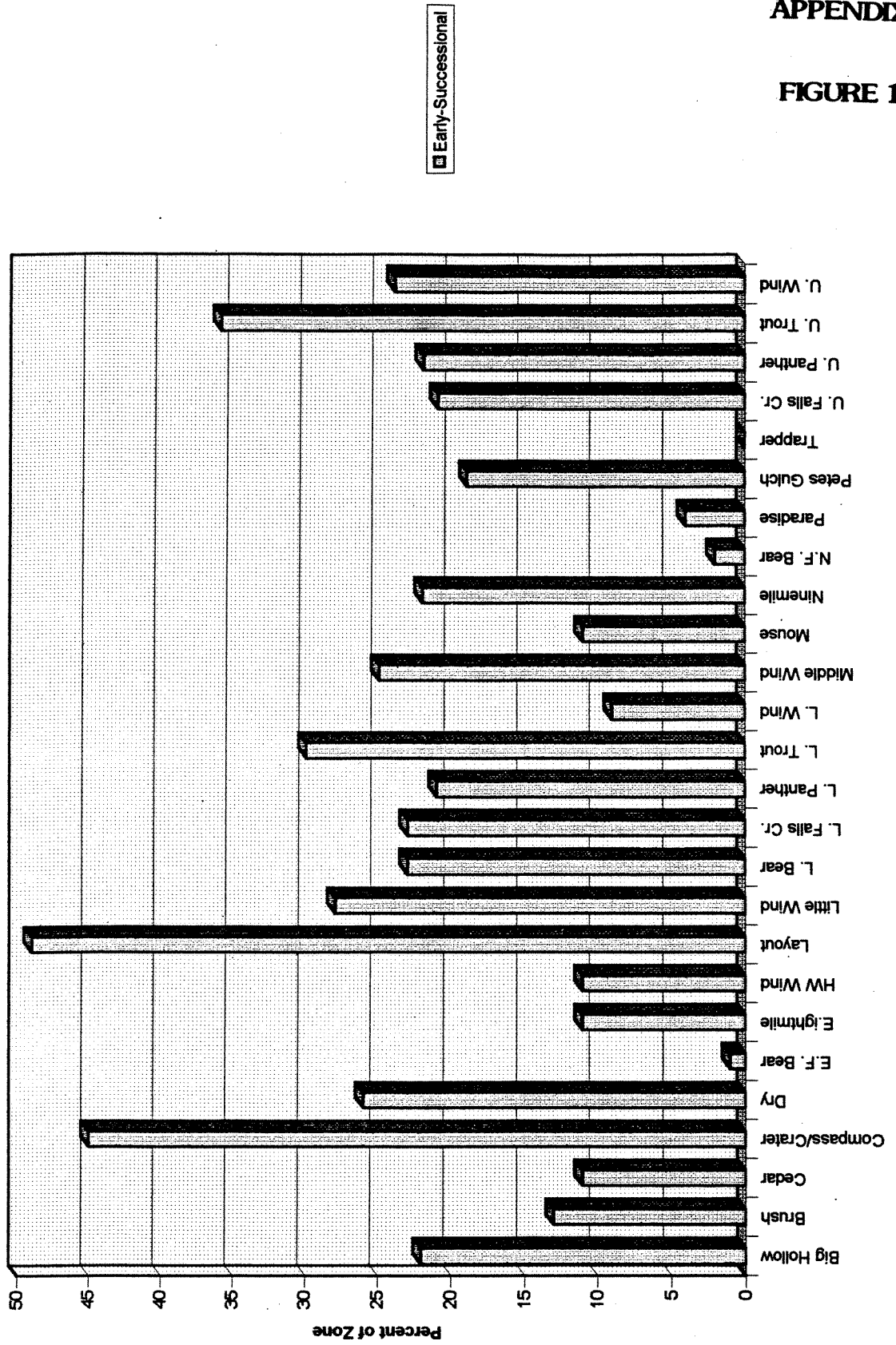
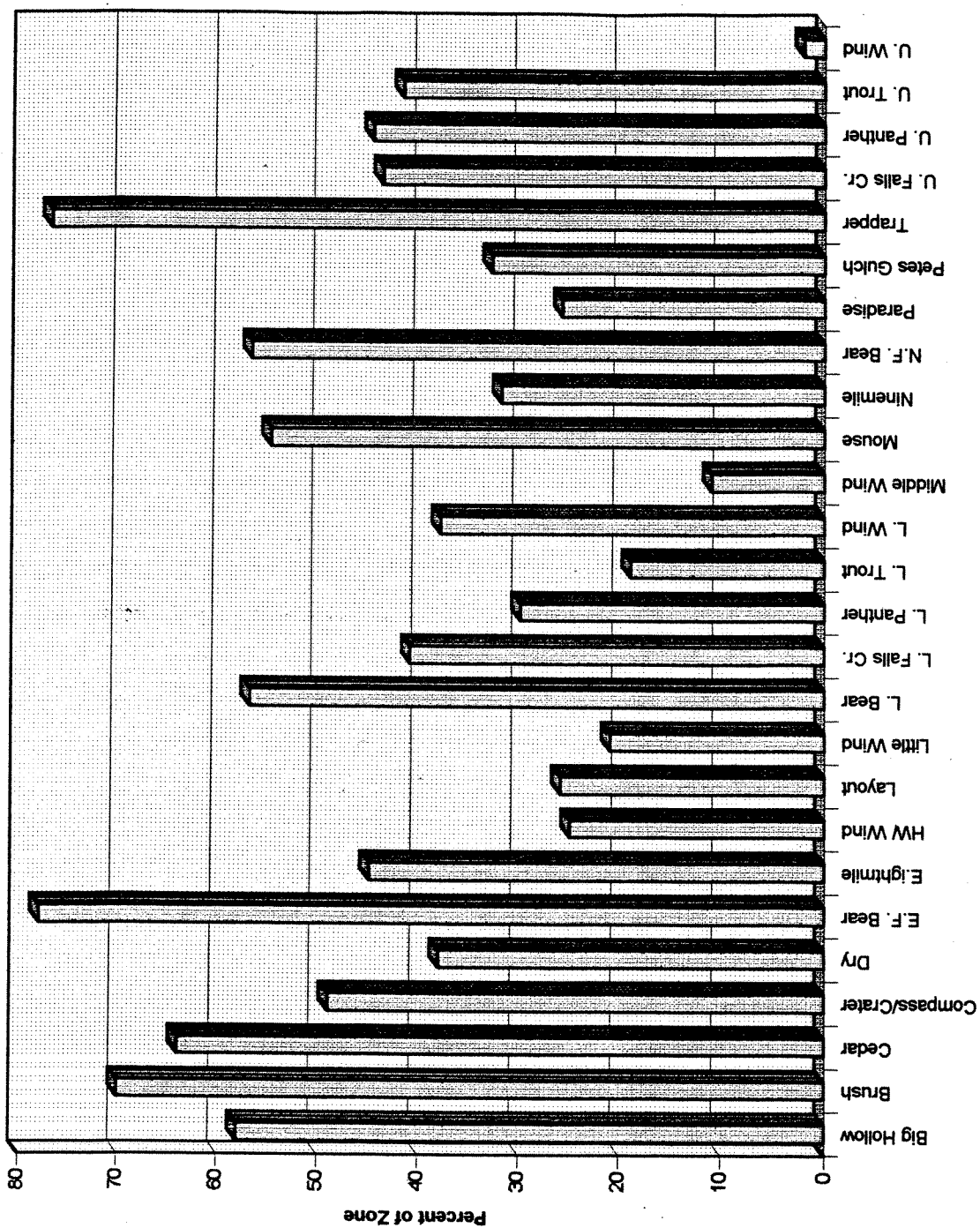


FIGURE 2

LARGE TREES WITHIN THE RIPARIAN ZONE OF CLASS 1, 2, & 3 STREAMS



APPENDIX C

Fire Ecology and History



WIND RIVER WATERSHED ANALYSIS

FIRE ECOLOGY AND HISTORY

Rob Crump
South Skill Center Fire Specialist
January 1996

FIRE ECOLOGY AND DISTURBANCE PERSPECTIVE

The following is based, in part, on information taken from the report "A First Approximation of Ecosystem Health" hereafter known as the REAP report. This report was developed from information compiled at the local and regional level. The information cited here is from the sub-region; Columbia River. The Columbia River sub-region includes eight river basins. The Wind River watershed is located within the Hood-Wind river basin as described in the REAP report. The REAP report utilized current and historical data to characterize the fire disturbance within the sub-basin. Another source of fire disturbance information utilized is the report titled "Fire Ecology of the Mid-Columbia" Evers et al, 1994. This report looks at the fire ecology of the area. It utilizes plant associations and fire history to establish fire regimes.

Fire disturbance regimes for the Gifford Pinchot National Forest are intermediate along a gradient between those found in cool, wet and warm, and dry climatic conditions. A wide variety of fire sizes, intensities and frequencies characterizes the fire regime.

The area near the crest of the cascades probably experienced the most severe fires, with large stand-replacement fires occurring a few to several centuries apart. These areas experienced a high incidence of lightning. On the west flank of the cascades, a combination of dissected topography and high climatic variability resulted in a complex pattern of both stand-replacement and underburn fires. Stand-replacement fires appear to have occurred at intervals of two to eight centuries apart, with lower slope positions and northerly aspects burning less frequently and intensely. Between major stand-replacement fires, underburning appears to have been fairly common.

Large fire events as recently as 1902-1925 contributed to reductions in the amount of late successional vegetation currently present, whereas current suppression of such fire events has reduced the amount of early successional vegetation created by fires. Historical fire events periodically created large openings which may have been great distances from seed sources. Combined with occasional reburns, stands often may have remained in an early successional condition many decades longer than at present.

During a recent field trip to the Wind River watershed, October 1995, Fred Hall, Regional Ecologist, suggested that the lack of large down woody material in a stand could be an indicator that the area had at least two fires. The first fire would have likely been a crown fire that did not wipe out the entire stand. During the period between the first fire and the second fire, the dead standing trees killed during the first fire began to fall. In addition to the increase of large woody debris, the understory would have been stimulated due to the increase in available light and nutrients. As the understory developed, it then created a ladder fuel component. When the second fire came through, the intensity would have been greater than the first and would have consumed the large downed woody material.

HISTORICAL CONDITION

Left in its natural state without influence from humans, this watershed would not have had quite so many incidences of fire. However, there appears to have been over 20 moderate to large fires in a period from about 1880 to 1925. These fires were predominately human caused. As settlement of the area increased, so did fire occurrence and fire severity. In fact there are several areas along the Wind River between Bear

Creek and Paradise Creek that have had overlapping fires within a period of fifteen years, 1910 and 1925. Harvest activities and landclearing changed the makeup of the landscape and the fuel profiles. Those activities were the primary causes of the fires after the turn of the century.

Historical maps, photographs, and documents indicate that between 1820 and the mid 1920's, there were several moderate to large size fires within this watershed. Moderate sized fires would be classified as being in the 200-500 acre range, and large fires being between 1000-3000 acres in size. Specific cause of the fires prior to about 1850 is unknown. Settlers used fire as a tool for land clearing and there was a significant amount of logging that started fires. Lightning may have been the cause in the higher elevation ranges with the exception of areas that might have been maintained by native Americans for huckleberry harvesting.

KEY PROCESSES AND INTERACTIONS

Fire regimes of the Pacific Northwest have been described by Agee (1983) and by Evers et al. (1994). They are a function of growing environment (temperature and moisture patterns), ignition pattern (lightning, human), and plant species characteristics (fuel accumulation, adaptations to fire).

Two topographic functions can affect fire regimes, they are slope and aspect. The predominate slope (39% of the Wind River basin) is less than 20%, with the next highest percentage being (34%) in the 21-40% range. Slopes greater than 40% total just 25% of the basin. Aspects within the basin break soen to the following percentages: South aspects = 28.7% of the basin, West = 27.6%, East = 23.5% and North = 20%.

Effects of fires can be more precisely described if effects can be grouped by fire regimes. Based on information contained in the draft report "Fire Ecology of the Mid-Columbia" (Evers et al. 1994), the Wind River watershed fall into the following fire groups.

- Fire Group 6 - Cool, Moist Lower Subalpine
- Fire Group 8 - Warm Moist Western Hemlock and Pacific Silver Fir
- Fire Group 10 - Upper Subalpine and Timberline Forests

Fire Group 6

Fire Group six incorporates the wetter portion of the transition zone between eastside and westside as well as cooler sites on the westside. In this watershed, this fire group is located primarily along the Cascade Crest in the Indian Heaven Wilderness. The typical environment for Fire Group Six plant associations includes heavy snowpacks, short growing seasons, frequent frost, and cold moist soils. The slopes predominately range from flat to 40% however some areas are as steep as 80+%. Aspects are generally west.

Most of the downed woody fuel loading is in the greater than 3" diameter class. However, this group has a potential for high woody fuel loadings due to the denser stands that are typical of these moister sites. Associations in this group are warm enough that most smaller dead woody fuel decays almost as rapidly as it accumulates until later in the successional pathway. The abundant shrubs also provide a very large heat sink under normal conditions, greatly reducing the rate of fire spread. During prolonged drought, these shrubs and forbs can provide a significant fuel load. Much of the large diameter woody fuel tends to be rotten. The higher moisture holding capacity of these rotten logs also reduces fire risk through much of the fire season. However, once this fuel dries out, severe soil damage from prolonged heating may result if the area burns. In areas of open canopy, regeneration has developed creating more ladder fuels. This understory combined with a high level of moss hanging from the boles allows crown fires to develop and spread.

The portion of fire group six that lies within the Wind River watershed, has experienced at least two moderate sized fires. One around 1840 and another one prior to that date. This is based on the observations from Fred Hall that there is little to no large downed woody debris in these stands. Prior to that, fire history is unknown but ecology plot data suggests a fire return interval of 170-430 years. In other words, fire does not visit this fire group very often. When it does, it would prepare a mineral soil seedbed, increase scenic and wildlife habitat diversity through the creation of mosaics, and rejuvenate the shrubs.

Fire behavior in the past would have tended to be of a low intensity nature. Fires would have crept around on the forest floor until dry east winds fanned the flames into a higher intensity fire. These higher intensity fires, would spread by torching and spotting. Crown fires could have occurred but once the winds were to die down, the fires would drop out of the crowns.

Current fire behavior would exhibit similar fire behavior as that of the past. Recent fires in similar stands outside of this watershed, tended to be small until the fire got into the crowns. These fires then flashed through the mosses in the crowns until the winds died down and the humidities came up.

Fire Group 8

Fire Group eight includes most of the western hemlock and Pacific silver fir plant associations found in the mid-Columbia. It includes a wide range of topographic positions, moisture regimes, and temperature regimes. It excludes the drier sites where western hemlock is considered climax. In general, the plant associations reflect a warm, moist climate to the west generally shifting to a cooler and drier climate to the east. Since this fire group spans the majority of the Wind River watershed, the slopes and aspects also span wide ranges.

This fire group generally lacks fine fuels through most of the stand history. Sites containing skunk cabbage and devil's club, may have very heavy fuel buildups, but the presence of water keeps these fuels too moist to burn readily and facilitates relatively rapid decay. "Classic" old growth stand conditions (closed canopy overstory of large diameter trees over a lush understory) are common in undisturbed areas, indicating infrequent disturbance. Fuels loadings can build once the overstory begins to die and the canopy breaks up. Conditions become drier in these canopy gaps and can easily provide a suitable fuelbed for fire starts. Deep duff and large logs are typical of this group. The resulting wildfire hazard is usually low to moderate, depending on weather conditions in a given year and on whether extensive canopy gaps have begun to develop. In most years, the associations in this group are well watered and slow to dry. However, once the duff dries, it will carry fire. Prolonged smoldering in deep duff and punky logs can cause severe soil damage.

Fire frequency in the western hemlock associations average 50-200+ years and in the Pacific silver fir associations they average 170-300 years. There are stands of western hemlock/Douglas-fir that are over 450 years old.

Fire in this group serves to prepare mineral soil seedbeds, produces a mosaic of stand structures and age classes across the landscape. It also affects within stand species diversity. Fire history maps indicate that most fires are either very small (less than 10 acres) or very large. Mid-sized fires (less than 1000 acres) occurred in the watershed and appear to depend on a combination of dry conditions and moderate winds. Large fires depended upon dry conditions and strong winds, most likely these were dry east winds in the upper elevation ranges of the watershed. All but three of the moderate to large historical fires within this watershed occurred in fire group eight.

Past and current fire behavior probably has not changed much. Fires would tend to smolder with some small crown fires occurring. Past fires would burn for several weeks to a couple of months. During these periods the fires would create more mid-sized fires and more of a mosaic of stand conditions across the landscape. If a fire lasted until mid-September to October, then strong east wind conditions could have

created a large, fast moving, high intensity fire. Underburning was probably more common, with lower intensity fires.

Fire Group Ten

Fire Group Ten in this watershed occurs in the Indian Heaven Wilderness around Red Mountain. Relatively sparse fine fuels and moderate to heavy loadings of large diameter woody fuels characterize this group. Most of the logs are rotten and much of the dead downed woody fuel loadings result from wind and snow breakage. Because of the climatic conditions of high moisture and cold temperatures, fire hazard is low even with the heavier fuel loadings. This fire group contains slopes up to 40% with aspects predominately west.

Climate and soil exert a far greater influence over stand conditions and forest development than fire does in this group. The site is cold, moist, rocky, snowbound unproductive and generally just does not support the start of spread of fires. If a fire was to start, it would spread primarily by torching and spotting between clumps of trees of individuals. Fire intervals would be 200-300+ years. Fires would tend to start at lower elevations and burn into this fire group. Sometime around 1840, a fire did occur in this fire group and as stated already, it most likely started below this group and burned into it.

CURRENT CONDITIONS

Current ignition sources for fire include lightning, debris burning, smoking, and campfires. The most common ignition source since 1970 has been lightning (40 fires). Recent fire history (prior to 1970) is missing, however since the preponderance of ignitions since 1970 were lightning caused, it is highly probable that lightning has always been the primary ignition source. Even though there has been several fires in recent history, they have all been kept small. Debris burning is second to lightning as a cause of fires within the watershed. These fires were started from hazard reduction burns in conjunction to timber harvest. Table 1 shows the statistical causes, total per cause, and acres of fires since 1970.

TABLE 1.

Cause	Total Number	Acres	Remarks
Lightning	40	60.7	Two fires equaled 58 acres, the rest were less than 1 acre
Equipment Use	2	.3	
Smoking	16	2.4	
Campfire	19	.3	
Debris Burning	24	252.1	Escaped slash burns
Arson	8	.2	
Children	2	0	
Misc.	11	1.4	

Timber harvesting and slash burning have actively modified fuels in the last 40-50 years. Clearcutting has been widely utilized in this watershed since logging began. Broadcast burning has been the primary hazard reduction treatment until the mid-1980's. The burning prescription usually called for complete consumption of down woody material. This would eliminate the risk of fire and would provide for easier reforestation. This type of treatment also produced a high amount of particulate emissions.

Since the mid-1980's, broadcast burning has decreased significantly. Now this type of treatment is used sparingly and the burning prescription requires that a certain amount of downed woody material (including duff), be left on site after treatment. This has reduced the amount of particulate emissions produced. Other fuel treatment measures utilized include piling (hand and machine), underburning, no

treatment, and removal through utilization. Machine piling utilized today is usually accomplished by using a low ground pressure loader. Unless site disturbance is desired, very little tractor piling is done today.

EXPECTED FIRE BEHAVIOR UNDER CURRENT CONDITIONS

Recent fires, within Fire Group 6 but outside of the Wind River watershed, have tended to burn through the crowns with relatively limited surface fire. Aerial fuels, such as moss and lichens, have been the main carriers of the fire. In many cases, these fires would not have spread without strong, gusty winds which cause the fires to "flash" through the crowns. Once the winds died down, burning became limited to snags and larger surface fuels. It is suspected that the same type of fire behavior would occur in the area of the Wind River watershed that includes Fire Group 6.

In Fire Group 8, as with the other fire groupings, the weather conditions will be a major factor in the type of fire behavior that might occur. Low rates of spread and low fireline intensities dominate unless wind or droughty conditions prevailed. In the event of prolonged smoldering, fire severity could be high. The watershed contains a fair amount of young stands including saplings. If these areas still have some residual fuels left on site from either harvest activities or thinning, the rates of spread and fire intensities may be high. A stand replacing fire could dominate during a large fire, however, a more likely scenario would be a fire that would be more mosaic in design. There would be some areas that would have little fire evidence (creeping and smoldering) and there would be areas that would have stands completely destroyed. Again, weather and prolonged drought will have the biggest effect on what the behavior would be. These conditions present themselves most often from mid-September through October.

In Fire Group 10, fire behavior is really limited to torching and spotting between clumps of trees. The burned area within a given fire perimeter usually involves less than 1/3 of the ground.

MANAGEMENT CONSIDERATIONS / IMPLICATIONS

In his book, "Fire Ecology of Pacific Northwest Forests", Jim Agee writes "To suggest that fire is an appropriate process in the preservation of old-growth forests seems paradoxical. Yet it is apparent that almost all of the natural forests of the hemlock zone are first- or multigeneration stands born of fire. Fire is responsible for their destruction, yet it is also responsible for their creation and maintenance. Without fire, the proportion of Douglas-fir in natural stands will decline, particularly on more mesic sites, and western hemlock will assume a more important role".

We are not able to allow fire to play the role it once did. No natural areas within the watershed are large enough to allow totally free-ranging fire and none of the natural areas have management objectives that will allow prescribed natural fire. The large LSR within the watershed, Trapper Creek Wilderness, nor any of the research naturals, have fire plans at this time. It is highly unlikely that any fire plan for these areas would allow a large stand replacement fire. A fire that is ground based and does little damage to the overstory (with the exception of some minor amounts of torching) is a more likely scenario.

We will have to be content to utilize harvest activities to mock the stand replacing fires of the past, at least to the degree that they can. Utilizing fire on a large landscape basis may have to be limited to underburning and some broadcast burning. Fires that start from natural ignitions should be assessed for their risks of damage or threat to life and property, and then initiate appropriate suppression actions. We need to utilize fire as a tool where we can. Fire intensities can be regulated to achieve various ecosystem reactions. Elimination of fire, eliminates some ecological effects that can not be replicated through any other means. Continued use of fire effects research and implementation should be encouraged.



APPENDIX D

Wildlife Tables



Table III-7-7-1

Wind River Reserve Land Allocations under the 1994 NW Forest Plan and 1995 Gifford Pinchot Forest Plan Amendment 11:

Reserve land allocations are managed for organisms associated with late-successional forest. These blocks of land will also serve as movement corridors within matrix land which is managed for timber outputs.

Wind River Watershed			
Reserve Land Allocations under the 1994 President's Plan & 1995 Forest Plan Amend 11			
* = w/in LSR			
Reserve Land Allocation (acres - % watershed)	Description	Amend Reference	Types of Habitat Reserved
Late-Success'l Reserve (82319 - 57)	Land that protects & enhances old-growth & late-success'l ecosystems: no harvest >80 yr stands; thinning may occur in stands ≤80 yrs to create, enhance, or maintain late-success'l forest conditions	5-1/13	Late-success'l forests: multi-species & layers of trees; mod-high canopy closure; imperfections like cavities, broken tops, & deformed limbs; mod-high accumulations of fungi, lichen, & bryophytes
Congress'lly Reserved Areas (10,238 - 7)	Land w/ congress'l designations that preclude timber harvest	3-1/14	Wildernesses: Trapper Creek & Indian Heaven
Riparian Reserves	Land along streams & unstable areas; to provide habitat & connectivity across the watershed to riparian-dependent & associated organisms	2-4,5,7,8	All standing & flowing water: lakes, ponds, wetlands, streams, stream processes
Matrix: (31,309 - 22)	Manage for timber outputs		Reserve lands in matrix include those listed below & riparian reserves
• Unmapped Late-Success'l Reserves	Preserve intensively used portion of the breeding season home range & to meet obj for other late-success'l assoc. species	5-3/4 & 6-7	100-acre cores of best available habitat for spotted owl centers found ≤Jan 1, 1994
Administratively w/drawn Areas, no-harvest areas only listed : (3271 - 2)	Include areas not mged for timber outputs	4-1 & 2	See bullets below
• Special Interest	Maintain special features: botanical; geologic; scenic; historic; cultural	4-17/21	Falls Creek Lava Tubes; Hackamore LavaBed*; Grassy Knoll*; Weigle Hill*
• Wildlife Special	Sustain or enhance significant wildlife habitat	4-33/35	McClellan Meadows; Black Creek Swamp*
• Roaded Recreation w/o Timber Harvest	Dispersed recreation opportunity by auto	4-14/16	Mowich Berryfields (Road 41)
• Unroaded Recreation w/o Timber Harvest	Outstanding recreation attributes near roads but in a substantially undisturbed condition	4-22/24	Trails access special areas
• Scenic River	Maintain natural landscape with some recreation site construction	4-28/32	Wind River Segment
• Research Natural Area	Manage plant communities & provide for research, study, observation, monitoring & educat'l activities	4-10/13	TT Munger*; Sister Rocks

Note: Allocated winter range for elk & deer is not included above because harvest is allowed when the % optimal cover threshold is met.



Table III-7-7-2

List of Potential Wildlife Species by Life-History Guild
Wind River Watershed
January 1996

Reference: Mellen, Kim; Mark Huff; and Rich Hagestedt. 1995. Interpreting landscape patterns: a vertebrate habitat relationships approach. Habitat-species relational database for the Wind River Watershed, Gifford Pinchot National Forest.

Species are grouped into life-history guilds based on how [the authors] expect species will respond to different amounts and distributions of habitats across the landscape. Home range size, patch configuration use, and general habitat use (stand scale) were used to group species. Definitions are located at the end of this document.

GUILD: TSGG small home range (<60 ac), generalist (uses variety of seral stages)

Species	Species	Species
Northwestern salamander	long-toed salamander	Western toad
mountain beaver	cedar waxwing	ruffed grouse
hermit thrush	house finch	pine siskin
purple finch	Swainson's thrush	rubber boa
Vaux's swift	band-tailed pigeon	Western wood pewee
evening grosbeak	Steller's jay	yellow-rumped warbler
black-thr gray warbler	blue grouse	Northern alligator lizard
Southern alligator lizard	Hammond's flycatcher	ensatina
Western skink	Northern pygmy owl	varied thrush
dark-eyed junco	snowshoe hare	red crossbill
song sparrow	creeping vole	brown-headed cowbird
ermine	Townsend's solitaire	Clark's nutcracker
Western screech owl	mountain chickadee	chestnut-backed chickadee
deer mouse	Forest deer mouse	black-headed grosbeak
pine grosbeak	rufous-sided towhee	Western tanager
downy woodpecker	hairy woodpecker	W. red-backed salamander
raccoon	Pacific treefrog	red-legged frog
Cascades frog	ruby-crowned kinglet	golden-crowned kinglet
Western gray squirrel	Western fence lizard	coast mole
rufous hummingbird	red-breasted nuthatch	white-breasted nuthatch
pygmy nuthatch	masked shrew	dusky shrew
vagrant shrew	red-napped sapsucker	chipping sparrow
red-breasted sapsucker	Casc g-mtld grd squirrel	yellow-pine chipmunk
tree swallow	Douglas' squirrel	rough-skinned newt
violet-green swallow	Townsend's chipmunk	American robin
Nashville warbler	warbling vireo	Hutton's vireo
solitary vireo	Wilson's warbler	mourning dove
winter wren		

GUILD: TMGG medium home range (60-100 ac) , generalist (uses variety of seral stages)

Species	Species	Species
Cooper's Hawk	sharp-shinned hawk	Northern saw-whet owl
common nighthawk	Northern flicker	Western rattlesnake
Virginia opossum	porcupine	hoary bat
wild turkey	long-tailed weasel	mink
long-eared myotis	Western small-footed bat	long-legged myotis
Yuma myotis	black-tailed deer	gray jay

GUILD: TLGG large home range (>1000 ac), generalist (uses variety of seral stages)

Species	Species	Species
Swainson's hawk	gray wolf	coyote
American crow	common raven	mountain lion
Northern lynx	bobcat	black bear

GUILD: TSPLT small home range (<60 ac), patch (uses 1 homogeneous patch), large tree structure (>21 in dbh)

Species	Species	Species
Northern flying squirrel	white-winged crossbill	shrew-mole
Trowbridge's shrew	Pacific-sloped flycatcher	

GUILD: TSGOS small home range (<60 ac), generalist (uses variety of seral stages) for open and small tree (<21 in dbh)

Species	Species	Species
yellow warbler	willow flycatcher	black-capped chickadee
fox sparrow	house wren	Bewick's wren
CA mountain kingsnake		

GUILD: TSGSL small home range (<60 ac), generalist (uses variety of seral stages) for small and large trees (all dbh sizes)

Species	Species	Species
brown creeper	Southern red-backed vole	hermit warbler
Townsend's warbler		

GUILD: TMMLT medium home range (60-1000 ac), mosaic (aggregate patches), large tree structure (>21 in dbh)

Species	Species
black-backed woodpecker	three-toed woodpecker
Eastern gray squirrel	

GUILD: TLMLT large home range (>1000 ac), mosaic (aggregate patches), large tree structure (>21 in dbh)

Species	Species	Species
Northern goshawk	pileated woodpecker	wolverine
American marten	Pacific fisher	Northern spotted owl
barred owl		

GUILD: TSC small home range (<60 ac), contrast species (uses 2 different seral stages in close proximity)

Species	Species	Species
Cassin's finch	olive-sided flycatcher	Lewis' woodpecker
flammulated owl		

GUILD: TMC medium home range (60-1000 ac), contrast species (uses 2 different seral stages in close proximity)

Species	Species	Species
American kestrel	big brown bat	silver-haired bat
little brown myotis	California myotis	fringed myotis
European starling	barn owl	

GUILD: TLC large home range (>1000 ac), contrast species (uses 2 different seral stages in close proximity)

Species	Species	Species
golden eagle	red-tailed hawk	great horned owl
turkey vulture	elk	great gray owl

GUILD: TSPO small home range (<60 ac), patch (uses 1 homogeneous patch), open structure (<21 in dbh)

Species	Species	Species
dusky flycatcher	yellow-bellied marmot	long-tailed vole
Townsend's vole	MacGillivray's warbler	Savannah sparrow
lazuli bunting	ring-necked pheasant	heather vole
vesper sparrow	gopher snake	Say's phoebe
Townsend's mole	mountain bluebird	Western bluebird
California grd	Western meadowlark	least chipmunk
W.terres. garter snake squirrel	Western pocket gopher	NW garter snake
common garter snake	Northern pocket gopher	orange-crowned warbler
Pacific jumping mouse	golden-crowned sparrow	white-crowned sparrow
racer	Lincoln's sparrow	Eastern cottontail
California ground squirrel		

GUILD: TSPST small home range (<60 ac), patch (uses 1 homogeneous patch), small tree

Species
red-eyed vireo

GUILD: TMPO medium home range (60-1000ac), patch (uses 1 homogeneous patch), open structure (<21 in dbh)

Species	Species
rosy finch	black-billed magpie

GUILD: TSMO small home range (<60 ac), mosaic (aggregate patches), open structure (<21 in dbh)

Species	Species	Species
California quail	Brewer's blackbird	Northern shrike
loggerhead shrike	mountain quail	bushtit
calliope hummingbird	Western kingbird	scrub jay

GUILD: TMMO medium home range (60-1000 ac), mosaic (aggregate patches), open structure (<21 in dbh)

Species	Species
merlin	striped skunk
badger	Western spotted skunk

GUILD: TLMO large home range (>1000 ac), mosaic (aggregate patches), open structure (<21 in dbh)

Species	Species
rough-legged hawk	red fox

GUILD: LAKEA aquatic habitats of LAKES

Species
American widgeon

GUILD: LAKERO riparian open habitats of LAKES

Species	Species
American bittern	Virginia rail

GUILD: LAKEARO aquatic and terrestrial open habitats of LAKES

Species	Species
greater yellowlegs	spotted frog

GUILD: LKRVA aquatic habitats of LAKES and RIVERS

Species	Species	Species
Northern shoveler	green-winged teal	gadwall
Cope's giant salamander	common loon	bullfrog
bufflehead		

GUILD: LKRvro terrestrial open habitats of LAKES and RIVERS

Species	Species	Species
spotted sandpiper	red-winged blackbird	killdeer
common snipe	common yellowthroat	solitary sandpiper

GUILD: LKRVARO aquatic and terrestrial open habitats of LAKES and RIVERS

Species	Species	Species
Northern pintail	cinnamon teal	blue-winged teal
mallard	Canada goose	common goldeneye
painted turtle	Western pond turtle	American coot
water vole	muskrat	

GUILD: LKRVARF aquatic and terrestrial forested habitats of LAKES and RIVERS

Species	Species	Species
wood duck	Barrow's goldeneye	belted kingfisher
Pacific giant salamander	hooded merganser	common merganser
Pacific water shrew	water shrew	Van Dyke's salamander

GUILD: LKRVARG aquatic and terrestrial, all stages of LAKES and RIVERS

Species	Species	Species
great blue heron	beaver	bald eagle
river otter	osprey	pied-billed grebe

GUILD: RIVARF aquatic and terrestrial, forested habitats of RIVERS

Species	Species
American dipper	harlequin duck

GUILD: RIVA aquatic habitats of RIVERS

Species
tailed frog

GUILD: RIVRO terrestrial open habitats of RIVERS

Species
yellow-breasted chat

GUILD: SPCL requires specific special habitats

Species	Special Habitat (obligates)
Northern harrier	meadows and wetlands
peregrine falcon	cliff - mountain hemlock zone
cliff swallow	bridges and buildings
barn swallow	bridges and buildings
house mouse	buildings
bushy-tailed woodrat	talus and cliff
pika	talus
mountain goat	talus and cliff
bank swallow	embankments- riverine or road near water
house sparrow	buildings
Western pipistrelle	talus and cliff
Larch Mtn salamander	talus and lava - Western hemlock zone
Townsend's big-eared bat	caves
Norway rat	buildings

DEFINITIONS from Reference:

1. terrestrial habitats---

- a. home range: small (<60 acres)
medium (60-1000 acres)
large (>1000 acres)
- b. structural habitat: open, small tree (<21 inches dbh)
large tree (>21 inches dbh)
- c. patch configuration: patch (use 1 homogeneous patch)
mosaic (aggregate patches)
contrast (use 2 different seral stages in close proximity)
generalist (use variety of seral stages)

2. riparian habitat obligates---

- a. water bodies: lakes
riverine
lake and riverine
- b. aquatic and/or riparian vegetation
- c. open or forested structure

3. special & unique habitat obligates---

APPENDIX E

Fisheries Tables

Appendix E
Fisheries Table

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Table 1
Yakima Indian Nation Wind River Harvest of spring chinook and steelhead from 1991 to 1994.

Species	1991	1992	1993	1994
Spring Chinook	900	1209	2986	256
Steelhead	0	3	0	5

Table 2. Steelhead punchcard summer runs
 Summary of 1981 to 1994 State of Washington Department of Fish and Wildlife steelhead punch card recorded catches for the Wind River.

Year	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Summer Run Total
1981-82	59	152	519	346	125	107	66	28	17	24	21	7	1471
1982-83	44	310	316	158	136	186	111	13	3	0	0	0	1277
1983-84	13	26	45	39	15	15	37	2	4	9	6	2	213
1984-85	0	13	20	24	7	4	9	2	9	4	2	0	94
1985-86	0	2	13	47	20	2	11	0	7	2	0	0	104
1986-87 M	2	72	146	235	119	47	55	11	11	0	5	0	703
U	0	0	0	0	2	0	2	2	0	2	3	0	11
Total	2	72	146	235	121	47	57	13	11	2	8	0	714
1987-88 M	16	96	147	87	96	42	58	7	31	16	7	0	603
U	0	4	0	4	0	5	0	15	22	13	4	0	67
Total	16	100	147	91	96	47	58	22	53	29	11	0	670
1988-89 M	0	207	235	85	44	33	68	15	8	2	0	0	697
U	0	0	0	0	0	0	0	7	7	0	2	0	16
Total	0	207	235	85	44	33	68	22	15	2	2	0	713
1989-90 M	0	90	129	86	31	27	56	4	2	0	4	0	429
U	0	0	0	0	0	0	0	8	13	2	8	0	31
Total	0	90	129	86	31	27	56	12	15	2	12	0	460
1990-91 M	0	100	126	74	30	26	37	6	2	2	0	0	403
U	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	100	126	74	30	26	37	6	2	2	0	0	403
1991-92 M	2	164	170	91	60	33	42	0	2	0	0	0	564
U	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2	164	170	91	60	33	42	0	2	0	0	0	564
1992-93 M	0	90	77	123	135	32	58	2	5	2	0	0	524
U	0	21	19	30	16	14	21	0	0	0	0	0	121
Total	0	111	96	153	151	46	79	2	5	2	0	0	645
1993-94 M	0	59	147	105	137	40	3	0	5	0	0	0	496
U	3	3	0	11	3	8	0	0	0	0	0	0	28
Total	3	62	147	116	140	48	3	0	5	0	0	0	524

M=Marked (with adipose fin clip) U=Unmarked. Starting in 1986-1987 fish were designed hatchery or wild. In 1991-1992 the terminology change to marked and unmarked.

The harvest reported here is corrected for a bias included in historical punchcard estimates. Studies conducted by the Game Department indicate that historical estimates are high due to the fact that successful anglers are more likely to return punchcards than unsuccessful anglers. This resulted in the use of too high a projection factor in catch summaries issued for seasons prior to the summer of 1974. Current projections of punchcards are made by comparing returned punchcards with "creel census" estimates of sports catches on several river systems. The derived projection factor was multiplied times the punches reported for each river.

Table 3
Creek and Lake Stocking Records

Creek or Lake	Year Stocked	Species	Number	Size or Weight	Year Caught	Number Caught	
CREEKS							
Black	1940	EB	20000				
	1948	RB	6225	3 inches			
	1951	EB	15040	160 pounds			
	1952	CT	14105	1085 pounds			
Dry	1951	RB	3675	10.5 pounds			
Falls	1938	EB	10000	2.5 inches			
	1939	CT	5000	5 inches			
	1947	RB	4798	4.5 inches			
	1947	RB	4798	4.5 inches			
	1948	CT	4750	5 inches			
	1948	RB	5400	8.5 inches			
	1949	RB	5000	6.5 inches			
	1949	CT	4394	5 inches			
	1950	RB	5146	6-6.5 inches			
	1950	RB	4795	6-6.5 inches			
	1951	RB	4000	10 pounds			
	1952	RB	3340	9 pounds			
Little Wind	1940	EB	30000	---			
Martha	1940	RB	5000	---			
Panther	1947	RB	12730	2 inches			
	1947	RB	17500	3 inches			
	1949	RB	3937	6.5 inches			
	1952	RB	440	11 pounds			
Paradise	1935	SH	35000	1-1.5 inches			
	1939	RB	5000	3 inches			
	1940	RB	10000	---			
	1949	RB	3497	6.5			
Trapper	1935	EB	40000	6 inches			
	1939	RB	10000	3 inches			
	1940	RB	10000	---			
	1947	RB	4794	4.5 inches			
Trout	1939	RB	30000	3 inches			
also Reservoir	1940	RB	25000	---			
	1947	RB	7440	5-5.5 inches			
	1948	RB	6930	5.5 inches			
	1948	RB	50226	2 inches			
	1949	RB	3850	6.5 inches			
	1949	RB	5586	5.5 inches			
	1950	EB	4900	6 inches			
	1950	RB	19000	2 inches			
	1951	RB	3488	10 pounds			
	1952	RB	3000	10 pounds			
	1952	RB	368	8 pounds			
	Tyee	1935	CS	3000000	eyed eggs		
		1936	CS	1050000	1-1.5 inches		
Wind	1931	ST	2081625	fry			
	1932	CS	4222200	fry			
	1932	ST	994695	fry			
	1938	CT	10000	1.5 inches			
	1938	EB	18000	1 inch			
	1938	SH	14300	1 inch			
	1939	CT	5000	5 inches			
	1951	SH	7250	8 inches			
1951	RB	3645	10.5 inches				
1952	RB	7200	8 inches				

	1953	RB	4770	6 inches		
		RB	3200	8 inches		
	1956	RB	8460	6 inches		
		SH W	24718	14 inches		
	1957	RB	4000	8 inches		
	1959	SH W	10060	7 inches		
		SH S	20060	8-10 inches		
	1960	R	3000	3 inches		
	1960	SH	0		1962	707
	1961	SH	62000	>10 to pound	1963	604
	1962	SH	40000	>10 to pound	1964	504
	1963	SH	59000	>10 to pound	1965	905
	1964	SH	102000	>10 to pound	1966	1743
	1965	SH	89000	>10 to pound	1967	934
	1966	SH	67000	>10 to pound	1968	1152
	1967	SH	76000	>10 to pound	1969	1136
	1968	SH	98000	>10 to pound	1970	882
	1969	SH	70000	>10 to pound	1971	1183
	1970	SH	97000	>10 to pound	1972	1722
	1971	SH	102000	>10 to pound	1973	825
	1972	SH	70000	>10 to pound	1974	673
	1974	SH	69000	>10 to pound	1975	965
	1975	SH	75000	>10 to pound	1976	906
	1976	SH	76000	>10 to pound	1977	1924
	1977	SH	76000	>10 to pound	1978	1471
	1978	SH	77000	>10 to pound	1979	1054
	1979	SH	83000	>10 to pound	1980	1038
	1980	SH	99000	>10 to pound	1981	1471
	1981	SH	75000	>10 to pound	1982	1277
	1982	SH	64000	>10 to pound	1983	313
	1983	SH			1984	94
	1984	SH			1985	104
	1985	SH	40000	>10 to pound	1986	714
	1986	SH	30000	>10 to pound	1987	670
	1987	SH	28000	>10 to pound	1988	713
	1988	SH	20000	>10 to pound	1989	460
	1989	SH	20000	>10 to pound	1990	403
	1990	SH	40000	>10 to pound	1991	564
	1991	SH	20000	>10 to pound	1992	645
	1992	SH	42000	>10 to pound	1993	524
	1993	SH	41000	>10 to pound	1994	
LAKES						
McClelland Pond	1952	CT	1,120	448/#		

CT=Cutthroat RB=RainBow SH=Steelhead (S=Spring and W=Winter) BN=Brown or Lock Leven
 EB=Eastern Brook
 CS=Chinook

Early stocking numbers from Columbia National Forest Range and Wildlife records, 1960 to 1993 from Washington Department of Wildlife records. Most Wind River stocking by the Department of Wildlife takes place at the Stabler Bridge.

Table 4
Wind River Juvenile Salmonid biomass grams per cubic meters

Stream	SH 0+	SH 1+	SH 2+	SH 3+	SH Total	Chinook	Brook	Total
Big Hollow	.09	.68	7.37	2.41	10.56	---	---	10.56
Compass	2.36	3.50	.68	---	6.54	0.39	1.00	7.93
Crater	2.43	3.93	2.56	0.55	9.47	0.56	4.64	14.67
Dry	1.23	3.19	3.99	3.06	11.46	---	---	12.57
Martha	8.81	16.72	29.65	3.41	58.60	---	---	58.60
Mouse	2.28	8.93	5.98	2.19	19.38	---	---	19.38
Paradise	1.15	4.92	1.75	---	7.82	---	---	7.82
Planting	10.99	12.35	16.49	---	39.82	0.19	---	40.01
Trapper L	2.75	3.57	.37	---	6.69	---	---	6.80
Trapper U	2.55	7.69	1.65	0.67	12.57	---0.11	---	12.57
Trout	.87	2.26	1.04	---	4.17	7.66	1.64	13.47
Wind	4.54	3.18	.22	---	7.93	0.29	---	8.22
Average	3.34	5.91	5.98	2.05	16.25	1.53	2.43	17.72
SD	3.30	4.69	8.75	1.20	16.36	3.01	1.94	15.68

SH=steelhead, Total=total salmonids

Total juvenile steelhead biomass ranged from a low in Trout Creek (4.17) to a high in Martha Creek (58.60). At the time of this study Trout Creek ranked lowest of the 11 streams in total steelhead biomass but highest in chinook (Crawford 7).

Table 5
 Salmon Egg-take at the Wind River Hatchery 1899-1938

Year	Fall Chinook Eggs Taken
1899	2730000
1900	2810000
1901	1505000
1902	3480000
1903	2490000
1904	300000
1905	1320000
1906	1373000
1907	2317600
1908	2250000
1909	3120000
1910	3026600
1911	4031900
1912	9000000
1913	12836500
1914	11947950
1915	*15906200
1915	10736350
1916	---
1917	20357050
1918	4302000
1919	4203550
1920	632400
1921	1723355
1922	---
1923	---
1924	---
1925	---
1926	2298000
1927	750000
1928	2032650
1929	1208500
1930	3663000
1931	1206000
1932	4493000
1933	2553000
1934	629000
1935	4080000
1936	25482000
1937	587000
1938	1907262

*Four month period

The records for 1899-1902 were recorded as "fry and spawn on hand and fry turned out."
 Chinook females average 5000 eggs per female. Eggs taken range from a high of 25,482,000 in 1936 to none in some years

Table 6
Eggs handled at the Carson Hatchery between 1938-1950

Year	Chinook	Kokanee	Coho	Steelhead/ Rainbow	Brook	Cutthroat
1938 ¹	3000000.			450000	384000	
1939 ¹	2878000.			420000	132600	600200
1940 ¹	1146000.			696000	425000	
1941	3000000.			396750		400000
1942	557172.			499900	700000	175000
1943	320514 ²	862218		10000		
1944	318131 ³	730843	51474			
1945	823217 ⁴	434112		188481		
1946	6984160 ⁵					
1947	8286260 ⁶					
1948	10290000.	509867				
1949	4691180 ⁷				129625	
1950	16697000 ⁸				220462	

¹ Fiscal year basis

² Includes 71,034 summer chinook eggs from Bonneville Dam.

³ Includes 68,131 summer chinook eggs from Bonneville Dam.

⁴ Includes 35,382 spring chinook eggs from Idaho, remainder fall chinook from Wind River.

⁵ Includes 956,160 fall chinook eggs from Wind River.

⁶ Includes 3,394,365 fall chinook eggs from Wind River.

⁷ Includes 2,513,080 fall chinook from Wind River.

⁸ Includes 4,931,000 fall chinook from Wind River.

Table 7
Carson Hatchery Spring Chinook Returns 1975-1995

Year	Number
1975	4896
1976	5210
1977	2966
1978	2955
1979	2537
1980	3336
1981	2545
1982	1636
1983	2490
1984	2108
1985	4672
1986	5589
1987	4374
1988	2054
1989	2134
1990	10622
1991	4330
1992	4188
1993	4439
1994	922
1995	565

(WDFW 1991:146 and USFW Carson Hatchery)

Table 8
PHYSICAL DESCRIPTION OF STREAMS, WIND RIVER DISTRICT 1936

Stream Name	Black Creek	Falls Creek	Little Wind River	Panther Creek	Paradise Creek	Trapper Creek	Trout Creek	Tree Springs	Wind River
Location	T5N, R7E	T5N, R7E, Sec 4	T3N, R9E	T4N, R7.5E	T6N, R7E	Upper Wind River	T4N, R7E	T5N, R7E	T3N, R8E
Elevation	2000	1300-3000	150-1500	100-1800	1400-3000	1500	1100	900	100-2000
Fishable Length	2 miles	9 miles	5 miles	10 miles	2 miles upper part	3 miles	7 miles	none	25
Average Width	4 feet	12 feet	15 feet	60 feet	10 feet	25 feet	42 feet	35 feet	150 feet
Average Depth	4 inches	12 inches	8 inches	18 inches	8 inches	15 inches	12 inches	8 inches	2 feet
Dams or Obstructions	---	falls 2 miles from outlet	---	---	---	many high falls	T4N, R7E, S27 dam	should be cleared out	T4N, R7E, S10 dam
Shore Cover	aboreal	upper virgin timber logged off	big 2nd growth	large 2nd growth	aboreal	aboreal, oldgrowth fir, and undergrowth	aboreal	arboreal	logged and reproduction
Water Vegetation	moss	green algae	green algae	none	green algae	---	moss	coontail, nettles	brown algae
Food Conditions	good	good	good	good	excellent	fair	excellent	excellent	poor
Color of Water	brown	clear	clear	good	clear	clear	clear	clear	clear
Kind of Bottom	swampy	boulders, swampy	boulders	boulders, gravel	boulders, gravel	boulders, gravel	boulders, gravel	mucky	boulders, gravel
Water Temperature	---	---	---	38° winter	---	36° winter	33° winter	---	38° winter
Natural or Stocked	unknown	natural	natural	natural	stocked	natural	stocked	natural	natural
Number Planted	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown
When Planted	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown
Size Caught	medium	medium	medium	small	medium	varied	stream closed	none	small
Species of Fish	CT, RB, BR	CT, RB, BR	CT	RB, CT	CT, RB	CT, RB, SH	CT, RB	stocking site	SH, CT, RB
Degree Fished	med	heavy	heavy	medium	light	heavy	none	none	heavy
Type Spawn Grounds	poor	gravel bars	boulders	gravel bars	sand, gravel	gravel bars	gravel bars	none	gravel bars
Planting Sites	1 mi W of Carson-Guler	above falls	Mouth Little Wind River Trail	Panther Creek Road	3 miles up	1st or 2nd bridge, road end .5 mile below falls above Gov. Springs.	above water system	all along stream	anywhere
Recommended Closures	none	none	7/1 to 10/1	none	closed area	none	none	entire creek closed	none
Route to Reach	Carson-Guler Road	Wind River Hwy, Siouxon Road	Evergreen Highway	Wind River Highway	Wind River Hwy, Siouxon Road	Wind River Highway	Wind River Highway	Wind River Road	North Bank Highway

CT=Cutthroat RB=RainBow SH=Steelhead BN=Brown or Lock Leven EB=Eastern Brook

Table 8

PHYSICAL DESCRIPTION OF STREAMS, WIND RIVER DISTRICT 1936

Stream Name	Black Creek	Falls Creek	Little Wind River	Panther Creek	Paradise Creek	Trapper Creek	Trout Creek	Tyee Springs	Wind River
Location	T5N, R7E	T5N, R7E, Sec 4	T3N, R9E	T4N, R7.5E	T6N, R7E	Upper Wind River	T4N, R7E	T5N, R7E	T3N, R8E
Elevation	2000	1300-3000	150-1500	100-1800	1400-3000	1500	1100	900	100-2000
Fishable Length	2 miles	9 miles	5 miles	10 miles	2 miles upper part	3 miles	7 miles	none	25
Average Width	4 feet	12 feet	15 feet	60 feet	10 feet	25 feet	42 feet	35 feet	150 feet
Average Depth	4 inches	12 inches	8 inches	18 inches	8 inches	15 inches	12 inches	8 inches	2 feet
Dams or Obstructions	---	falls 2 miles from outlet	---	---	---	many high falls	T4N, R7E, S27 dam	should be cleared out	T4N, R7E, S10 dam
Shore Cover	aboreal	upper virgin timber logged off	big 2nd growth	large 2nd growth	aboreal	aboreal, oldgrowth fir, and undergrowth	aboreal	arboreal	logged and reproduction
Water Vegetation	moss	green algae	green algae	none	green algae	---	moss	coontail, nettles.	brown algae
Food Conditions	good	good	good	good	excellent	fair	excellent	excellent	poor
Color of Water	brown	clear	clear	good	clear	clear	clear	clear	clear
Kind of Bottom	swampy	boulders, swampy	boulders	boulders, gravel	boulders, gravel	boulders, gravel	boulders, gravel	mucky	boulders, gravel
Water Temperature	---	---	---	38° winter	---	36° winter	33° winter	---	38° winter
Natural or Stocked	unknown	natural	natural	natural	stocked	natural	stocked	natural	natural
Number Planted	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown
When Planted	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown
Size Caught	medium	medium	medium	small	medium	varied	stream closed	none	small
Species of Fish	CT, RB, BR	CT, RB, BR	CT	RB, CT	CT, RB	CT, RB, SH	CT, RB	stocking site	SH, CT, RB
Degree Fished	med	heavy	heavy	medium	light	heavy	none	none	heavy
Type Spawn Grounds	poor	gravel bars	boulders	gravel bars	sand, gravel	gravel bars	gravel bars	none	gravel bars
Planting Sites	1 mi W of Carson-Guler	above falls	Mouth Little Wind River Trail	Panther Creek Road	3 miles up	1st or 2nd bridge, road end .5 mile below falls above Gov. Springs.	above water system	all along stream	anywhere
Recommended Closures	none	none	7/1 to 10/1	none	closed area	none	none	entire creek closed	none
Route to Reach	Carson-Guler Road	Wind River Hwy, Siouxon Road	Evergreen Highway	Wind River Highway	Wind River Hwy, Siouxon Road	Wind River Highway	Wind River Highway	Wind River Road	North Bank Highway

CT=Cutthroat RB=RainBow SH=Steelhead BN=Brown or Lock Leven EB=Eastern Brook

Table 10
 Redd Surveys in Wind River Streams

Date	Stream	Species*	Redds	Times	
1978	Compass		2	1	
	Layout		0	1	
	Paradise		0	1	
	Trout		13	9	
	Wind		10	3	
1981	Dry		0	0	
	Layout		?1	1	
	Trout		1	1	
	Wind		?2	3	
1985	Big Hollow		0	2	
	Bourbon		0	1	
	Cedar		2	2	
	Compass		6	3	
	Crater		6	3	
	Dry		3	5	
	Eight Mile		1	2	
	Falls		4	2	
	Hollis		0	2	
	Jimmy		0	0	
	Layout		23	5	
	Layout NF		0	1	
	Martha		16	7	
	Nine Mile		1	2	
	Panther		7	8	
	Paradise		0	2	
	Planting		8	2	
	Trout		33	7	
	Trapper		3	1	
	Wind		122	7	
	1986	Cedar		0	0
		Compass		17	3
		Crater		9	3
Dry			5	5	
Eight Mile			0	0	
Falls			2	3	
Hollis			0	1	
Jimmy			0	0	
Layout			24	10	
Layout NF			5	2	
Martha			2	7	
Nine Mile			2	3	
Panther			10	6	
Paradise			2	4	
Planting			4	6	
Trout			70	16	
Trapper			3	4	
Wind		98	15		
1987	Cedar		1	3	

	Compass		28	3
	Crater		4	3
	Dry		11	3
	Eight Mile		3	3
	Falls		1	3
	Layout		52	7
	Layout, NF		0	1
	Martha		41	5
	Nine Mile		4	4
	Paradise		0	2
	Planting		16	4
	Trapper		4	4
	Trout		52	8
	Wind		84	4
	Falls	Brook	4	2
	Black	Brook	0	1
1991	Dry		2	2
	Falls		3	3
	Martha		8	5
	Nine Mile		3	3
	Paradise		2	3
	Planting		5	4
	Trapper		1	3
1992	Dry		2	4
	Falls		0	4
	Nine Mile		0	4
	Panther		12	3
	Paradise		1	4
	Trapper		0	4
	Wind		15	4
1994	Dry		0	3
	Falls		2	4
	Nine Mile		1	4
	Panther		1	3
	Paradise		2	4
	Trapper		10	6
	Wind		1	4

*Steelhead unless otherwise noted.

No hatchery steelhead smolts were planted in the Wind in 1983 so returning adults in 1985 were wild fish (Lucas 1985:1).

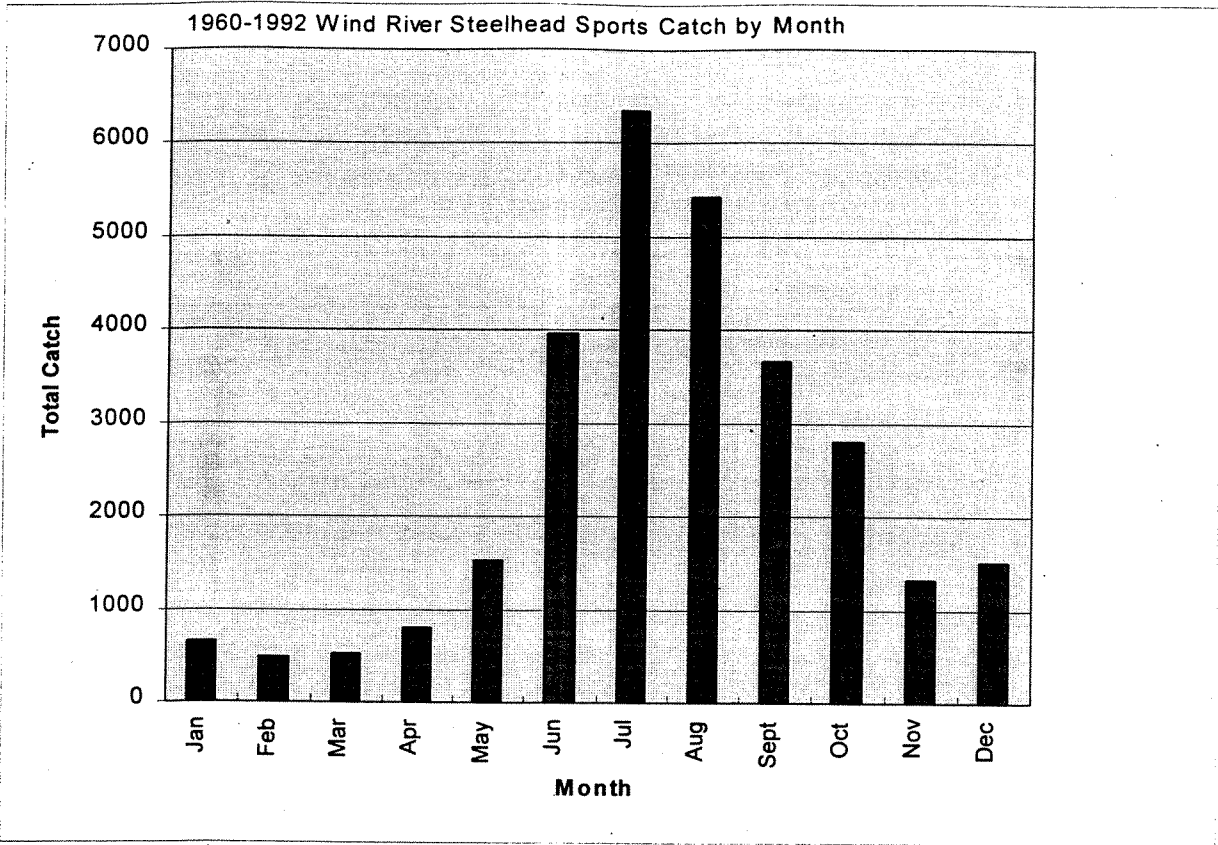
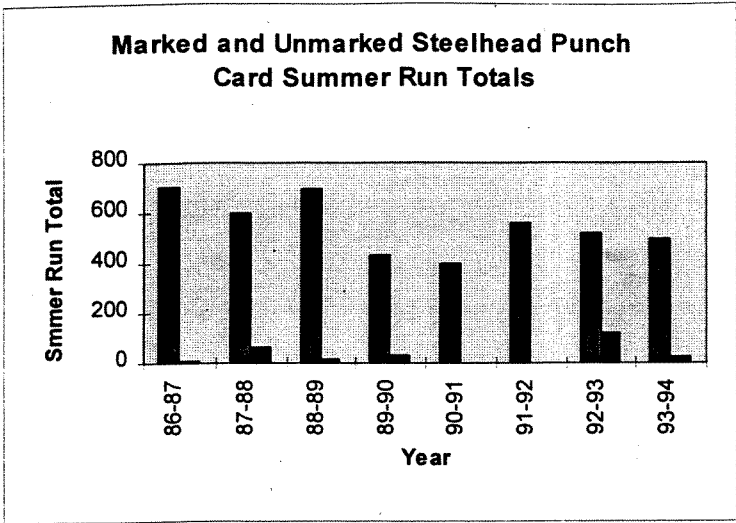


Figure 1. Wind River sports catch



First column=marked fish, second column=unmarked fish.

Figure 2. Marked (hatchery) and unmarked (wild) punch card totals for Wind River summer steelhead.



APPENDIX F

Dispersed Recreation Sites



Appendix F

Dispersed Recreation Sites

Areas of greatest concern

A comprehensive inventory of all dispersed recreation sites has not been documented for this watershed; However, thirteen (13) areas have been identified where resource damage results from concentrated use. These areas are located on Bear Creek, Trout Creek, Panther Creek, Beaver Creek, Upper Trout Creek ("the "Flat"), Trapper Creek, Government Mineral Springs, Wind River, Falls Creek (two areas), Wind River Mine area, the Rock Pit ("Vantage") area, and McClellan Meadows. General descriptions of the areas are included below. Preliminary recommendations need to be reviewed by an inter-disciplinary team to insure that all resource concerns are met.

Area 1: Bear Creek

- *Description:* This area has five dispersed campsites located in riparian area. Use of these sites is heavy to moderate; sites are occupied 70% of the weekends from June 1 to Oct. 30th. Three sites have direct access to the creek and are used heavily for water play and fishing. Two sites are located away from the stream bank and do not have access to the stream. One of the three stream side sites is located along a six-foot cutbank which is eroding into the creek. There is also a trail down the cutbank that is eroding and run-off from the site and access road drain directly into the creek. Access to these sites is provided by native surface road which has been "extended" by the public trying to drive to the creek.
- *Preliminary Recommendation:* Limit access by blocking road to prevent vehicle access to creek. Stabilize bank.

Area 2: Trout Creek

- *Description:* This area has three dispersed campsites located in riparian area. Use of these sites is moderate. They are occupied 50% of the weekends from May 15th to September 15th. Two sites are located away from the stream and have no direct access; one site has direct access. The stream side site is used for fishing and water play activities. The site located at an old road crossing next to the stream. A cutbank erodes into the stream during high flows. The road bed is used to access to the stream on foot. The access road to these areas is covered with native surface material. There is no direct surface flow into the stream.
- *Preliminary Recommendation:* Improve the access road. Repair the cutbank. Provide an access trail.

Area 3: Panther Creek

- *Description:* This area has 17 dispersed sites located in riparian area. Use of these sites is heavy to moderate. Sites are occupied 85% of the weekends from May 15th to Dec. 15th. Use is also moderate on weekdays. Four of the sites are located away from the creek, but have access via foot trails developed by users. Seven sites have direct access to the creek. Six sites are located within the flood channel and are flooded during high flows. Six access roads to these sites were built for logging activities with native surface materials, while three others are "user-made" wheel tracks. Seven of these nine access roads contribute direct run-off flow into the creek. The four sites located away from the creek are used mostly as hunting camps and summer overnight camps. These sites are growing in size and impact to vegetation is clearly visible around the site. The user-created trails leading to the creek from these sites are well-defined but do not contribute run-off into the creek. The seven sites with direct access to the creek are used as summer camps, and to some extent, as hunting camps. These sites are growing in size and impact to stream bank vegetation is apparent. Silt flows directly

into the creek from these camps during some conditions, and the stream banks are being broken down from foot travel. The six sites in the floodplain are used exclusively for summer camping. These sites have likely been created by users as "overflow" sites when Panther Creek Campground is full. These sites are growing in size and use, and impacts to vegetation on stream banks and in-stream gravel bars is evident. These sites flood during high flows, with the resulting silt going into the stream. Access roads to these sites are also in the flood plain and vehicles have direct access to the stream. ORV's have been observed in the streambed during the summer.

- *Preliminary Recommendation:* Close some of the access roads and provide parking at the main road. Consider making the sites walk-in campsites. Repair banks eroding from foot travel and develop foot paths for access. Move some sites back from the shoreline and install barriers to prevent direct run-off from entering the stream. (Move two of the six sites in the floodplain back out of the floodplain to their original location. Close and restore four sites in the floodplain to a more natural condition. Close and revegetate two access road.

Area 4: Beaver Creek

- *Description:* This area has three dispersed camps located in riparian area. All three sites have direct access to the creek but are buffered from the creek by a vegetative screen or large stable rock bank. The access to these sites is native material surface roads. These sites receive heavy to moderate use for about 90% of the weekends from May 15th to October 30th. There is also a foot trail developed from these sites along the creek in the floodplain. The primary use of these sites is summer camping and fishing access, with some hunter camping. All the sites and the access roads are stable and do not appear to contribute run-off directly into the creek.
- *Preliminary Recommendation:* Leave the main site as is and consider closing one site to alleviate crowding of the area. Close one site on the west side of the river to prevent vegetation damage and erosion that will occur if this site is permitted to stay in use. Close the existing access trail along the river and develop a trail outside the floodplain to permit angler access.

Area 5: Upper Trout Creek ("the Flat")

- *Description:* This area has four dispersed campsites, all within the riparian area. All of these campsites are located on rock stockpile sites, and two have direct access to the creek. One site is located away from the stream and has no trail or other user-made access to the creek. These sites are used primarily by hunters (area includes a user created "shooting range"), berry pickers, and anglers. Use is primarily in the fall of the year for about 40% of the weekends from August 15th to November 15th. These sites are accessed by gravel roads. Run-off and erosion from the roads directly enters the creek. One road has evolved into an overflow stream course from the beaver ponds along the creek.
- *Preliminary Recommendation:* Close one access road and revegetate to prevent future road failure and erosion created from beaver activity. This closure would remove one site used for access to fishing & the shooting area. Develop parking at the main road for fishing access and a shooting range could be developed at an alternate location.

Area 6: Trapper Creek

- *Description:* This area has three dispersed campsites, two of which are in riparian area. One site is located on an old road bed and has no direct access to the creek, while the other two sites directly access the creek by trail, and run-off enters the creek from these locations. The primary uses are summer camps, fishing access and some hunter camping. The use season is May 15th to Sept 30 with sites occupied about 75% of the weekends. Access to these sites is by a gravel road and a native-material surfaced road. One site is located next to the creek on the edge of the floodplain and has an access trail to the creek. One site is located above the creek on a old road bed that has been extended by users into the streambed. Vehicles have been seen using the stream bed as a travel way during summer and fall.

- *Preliminary Recommendation:* Develop the site out of the riparian area to make it more attractive to users. Close the two sites within the riparian area, the parking area and the access road. Revegetate/restore to a more natural condition. Improve the access trail.

Area 7: Government Mineral Springs

- *Description:* The eleven sites in this area are located in an old campground which has a vault toilet facility. Two of these sites are in the Trapper Creek riparian area.
- *Preliminary Recommendation:* Close the two stream side sites. Restore and improve the remaining sites away from the creek to encourage camping in these locations.

Area 8: Wind River

- *Description:* This area has seven dispersed campsites that have been developed in the riparian area by users. The primary uses are summer camps, fishing access and water play. The use season is June 1 to Sept 15, with about 60% of the weekends used during this period. All sites have access trails leading to the river. This area has also been used repeatedly as large group campsite for events. This area lies within critical deer/elk winter range. The sites are accessed by a primitive, native-surface material road which has been designated closed but has been re-opened by users. The road is located so no run-off flows directly into the river. Two sites have access trails to the river on steep, unstable slopes that permit erosion to reach the river. These sites are growing in size, and impacts to stream side vegetation are apparent. The remaining sites are located above the river on flat ground and have no paths or run-off areas that permit direct erosion into the river.
- *Preliminary Recommendation:* Improve the five acceptable sites. Move two sites back from the stream; block existing access. Close the road and develop parking at the main road. Continue to allow use of dispersed sites, but as walk-in only. Install four temporary toilets. Restrict use to summer camping. Permit large group event camping.

Areas 9 & 10: Falls Creek

- *Description:* This area has five dispersed campsites located on old road beds outside the riparian area. The primary use is camping in summer and during the hunting season. Fishing and water play are important activities for users. The use season is from May 15th to October 30th, with about 40% of the weekends used. An existing road, developed for logging, crosses Falls Creek. Access to all camp sites is by gravel-surfaced roads. The roads do not appear to contribute run-off directly into the creek. Two sites are located above the river, with direct access to the river provided by a path down a rock face. Vegetation is limited in both areas and does not appear to be impacted. One site is located at an existing trailhead and has direct access to the creek by way of an old road bed. Vegetation is limited from past road construction activity and not impacted from current recreation use.
- *Preliminary Recommendation:* Maintain four sites as is, with no additional development permitted. Close and revegetate the site that is off the road at an old logging landing. Effectively close the road crossing Falls Creek and prevent further access.

Area 11: Wind River Mine area

- *Description:* There are four dispersed sites within the riparian area. Two of the sites are located in an active rock stockpile area. Two sites are located on a old railroad grade. All sites have access to the river via a user-made foot path. Run-off is not a problem. This area is used about 40% of the weekends from May 15th to Nov. 15th, primarily for summer and hunting season camping. Some minor fishing, water play, rock-hounding and gold panning occur in this area. Access is via native material surface roads. No run-off has been noted going into the river from these roads.
- *Preliminary Recommendation:* Maintain all dispersed sites as they are, but do not permit addition sites to develop.

Area 12: Rock Pit ("Vantage")

- *Description:* There are three dispersed sites in this area: one in the riparian area, one outside the riparian area, and one in the floodplain. The area is used primarily for camping in summer and during the hunting season, with berry picking also an important activity. The use season runs from June 1st to November 15th and is used about 75% of the weekends during this time. One site is located in an active rock stockpile pit and has direct access to the creek. The site is level and no run-off has been noted. The second site is located on an old logging spur, with no direct access to the stream. The third site is located in the floodplain of the creek with direct access to the stream. This site was developed and used as a water-filling site for the rock pit and fire control. The area drains the roadway and feeds run-off directly into the stream. The road has deteriorated badly and a drainage channel has developed across the road, permitting run-off from the rock pit to enter the creek through this site. The stream also backs up across this site and onto the roadway. All the sites are accessed by a gravel-surfaced road.
- *Preliminary Recommendation:* Leave two of the sites as they are, with no additional improvements. Close one site and construct a barrier to prevent water from backing up onto the access road. Correct drainage problems and maintain access road.

Area 13: McClellan Meadows

- *Description:* This area has five dispersed sites. Two are located in the riparian area; three are not. These camps are primarily used by permittees completing contracts on the Forest. They are used less frequently by summer visitors and during the hunting season, generally from April 15th to November 30th, with use occurring on about 30% of those weekends. There is also significant occupancy during the week. Access to all the sites is by a gravel-surfaced road which has had run-off surface damage in the past. Road flooding has also occurred in the past due to beaver activity. Four sites are stable and have no run-off or direct access to the stream. One site has direct contact with the creek and is accessed by a native material logging skid trail. Run-off from the site goes directly into the stream. Vegetation has been impacted along the stream bank. The site is expanding and evolving into two sites.
- *Preliminary Recommendation:* Discourage use of four sites by commercial users, and direct camping to locations established in permits. Make sites smaller. Close one site and block access road.

APPENDIX G

History of Human Uses

(Published separately, available as a separate report.)



