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...ARTMENT OF AGRICULTURE

FOREST SERVICE

LITTLE WHITE SALMON RIVER

WATERSHED ANALYSIS

SEPTEMBER 1995

MT. ADAMS RANGER DISTRICT

GIFFORD PINCHOT NATIONAL FOREST

★U.S. GOVERNMENT PRINTING OFFICE: 1988-213-563 - 415/6115

FS-6200-7 (10/73)

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CHAPTER I INTRODUCTION

This report documents the watershed analysis conducted for the Little White Salmon River. This analysis responds to the President's Northwest Forest Plan, which identified the Little White Salmon as a key watershed. For the purpose of this analysis, the entire Little White Salmon Watershed was assessed. This includes the key and non-key portions of the watershed, and both federal and non-federal land (see Map A).

Analysis Area

The 86,460 acre watershed lies within Skamania and Klickitat Counties in Washington State. The Gifford Pinchot National Forest manages 68,660 acres of the watershed. The Gifford Pinchot National Forest Land and Resource Management Plan (Forest Plan) as amended by the President' Northwest Forest Plan (ROD) provide direction for the National Forest lands. The remaining 17,800 acres are either privately owned or Washington State lands, located in the lowest reaches of the watershed. These lowest reaches also lie within the Columbia River Gorge National Scenic Area (see Map B).

Process

The process used for this analysis generally follows the Ecosystem Analysis at the Watershed Scale Version 2.1 (the review draft of the Revised Federal Guide for Watershed Analysis) (USDA-Forest Service et al. 1995). This process was modified to fit the funding and time constraints for this analysis and to provide clarity. This report is organized to mirror the process that was followed, beginning with a characterization of watershed, identification of issues and key questions, the answers to those key questions, followed by recommendations for project implementation, restoration, and monitoring.

CHAPTER II CHARACTERIZATION

The purpose of this section is to place the watershed in context with the broader geographical area. A brief description of the dominant physical, biological, and human dimensions of the watershed are presented.

Physical Dimension

The Little White Salmon Watershed lies east of the Cascade Crest in south central Washington. The watershed encompasses approximately 135 square miles. It includes the Little White Salmon River plus the area that drains into the Big Lava Bed. This includes the southern ridges, sideslopes and valleys of the Monte Cristo Range that are drained by the Little White Salmon River and its tributaries (designated Key watershed). It also includes all the tributaries which flow east of Indian Heaven Wilderness and into the Big Lava Bed (non-Key watershed). The Little White Salmon River flows into Drano Lake adjacent the Bonneville Pool of the Columbia River (see Map C).

Hood-Wind Subbasin

The next larger ecological unit would be the Hood-Wind Subbasin as defined by the Regional Ecosystem Assessment Project, referred to as the REAP (USDA-FS, 1993). The Hood-Wind Subbasin is a collection of watersheds that drain into the Columbia River between The Dalles and Bonneville Dams (see Map D). This includes the Hood, Wind, White Salmon, and Little White Salmon Rivers. The Hood-Wind Subbasin and REAP are significant in that they provide the historical range of natural conditions for many of the resources analyzed (e.g. acres of old-growth or maximum water temperatures).

Subwatersheds

Going down in scale, the Little White Salmon Watershed is divided into 23 subwatersheds (see Map E). These subwatersheds range in size from 720 to 13,470 acres and form the base ecological unit for the analysis. At the subwatershed scale, many of the processes that are otherwise masked at the watershed scale, become more readily apparent.

Geology

Like the rest of the Cascades, the geology of the Little White Salmon Watershed is dominated by past volcanic activity. Based on geomorphology, the watershed can be split in two with one area containing tertiary deposits of tuff and pyroclastic flows (Monte Cristo Range). The other area contains a younger quaternary basalt/andesite flows, coming out of Indian Heaven Wilderness.

The older tertiary deposits form most of the main stem of the Little White Salmon River. These older deposits have a tendency to decompose into silts and clays; which in turn have the possibility to form slide plains in large deep seated land slides and debris flows.

Large, past active, deep seated slides on three sides of Augsburger Mountain, have flowed toward the Little White and Mill A areas. Portions of these slides have smaller active portions within them. Soils in these deposits are also deeper and have a tendency to erode.

Big Lava Beds

The younger quaternary deposits have shallower soils and are more stable. These basalt/adesite flows are typically gently sloped as well. The most recent example is the Big Lava Bed a relatively young (8000 years old), flow covering 16,000 acres of the watershed.

Biologic Dimension

The Little White Salmon Watershed reflects the diversity of ecotypes seen within the entire Hood-Wind Subbasin. Its location at the intersection of the Cascades Crest and Columbia River results in a wide elevation range (50-5300 feet) and wide ranging temperature and moisture regimes. Climate and vegetation reflect both the maritime and continental influences.

Vegetation of Key Watershed

The Key and non-Key portions of the watershed exhibit distinctly different forest vegetation. The Key portion lies primarily within the Grand fir zone or ecoclass, and can be described as a mosaic of middle to late-successional forests interspersed with younger, even-aged plantations up to 55 years old. Plantations comprise about 25% of the forested area. Stand-replacement fires appear to have occurred at 100 year intervals. Between major stand-replacement fires, underburning appears to have been fairly common, typical of an eastside environment.

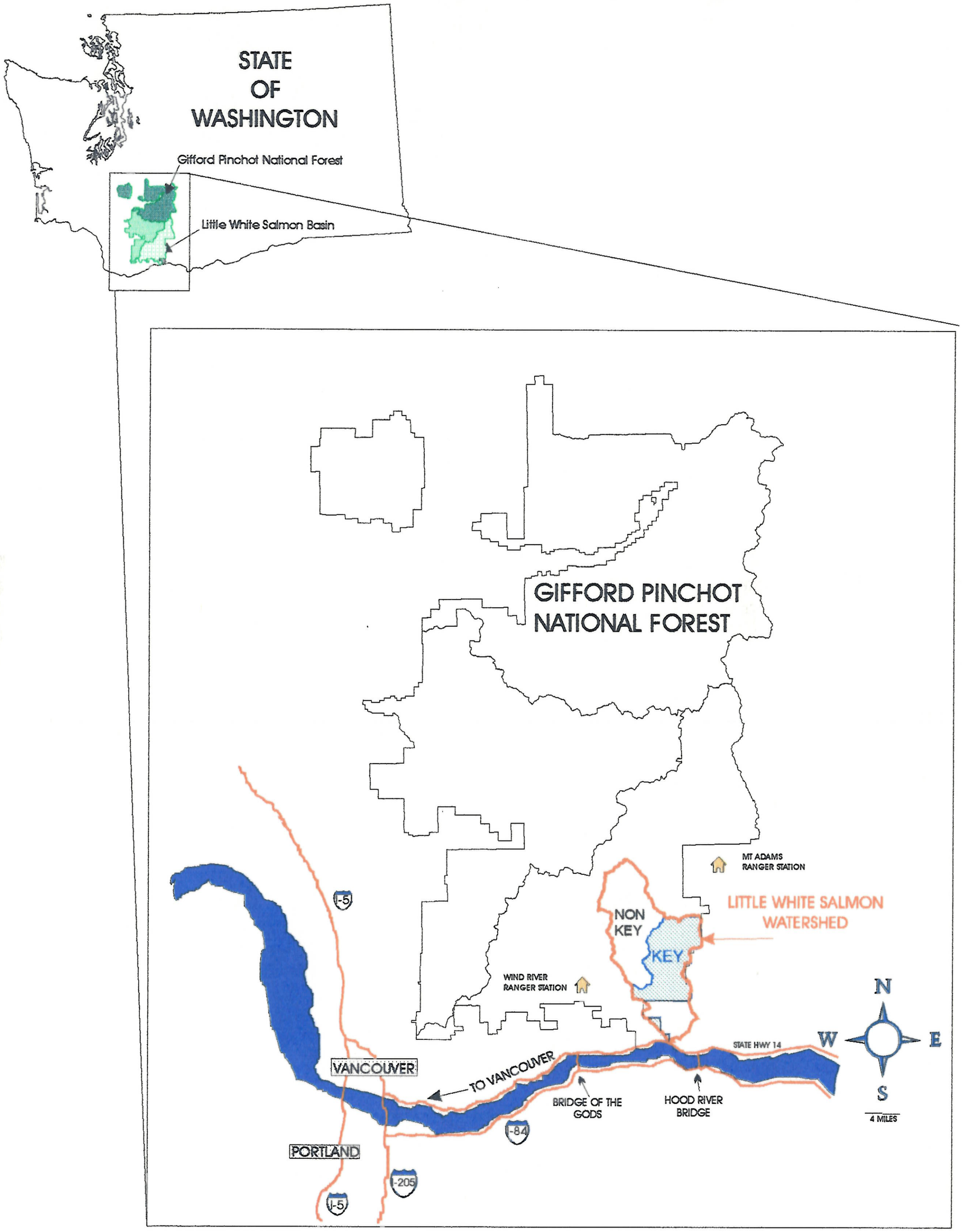
Vegetation of Non-Key Watershed

The non-Key portion of the analysis area is comprised of late-successional to old-growth forests, and is also interspersed with plantations up to 50 years old. Composition is diverse with mixed-conifers typical of the east Cascade Range in the southwest Washington province. This area is situated within the Pacific silver fir zone with upper elevations in the mountain hemlock zone. The Big Lava Beds is an area of cold air accumulation, with little to no soil development. Composition is primarily scattered lodgepole pine, subalpine fir, western white pine, and Douglas-fir. Fires within the non-key portion were typically low intensity fire that only partially replaced the overstory.

Special Habitats

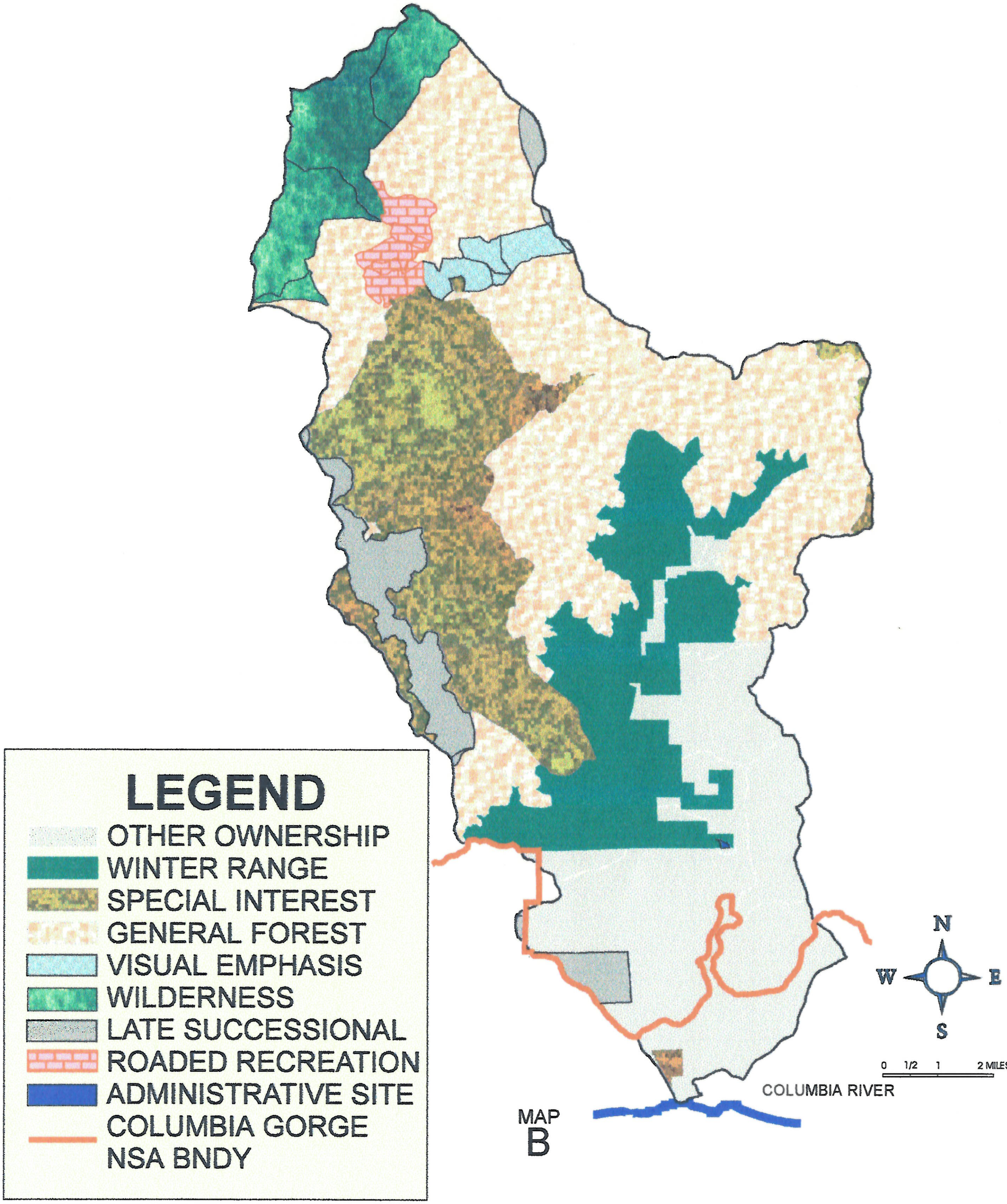
The Little White Salmon has a number of special habitats that contribute to the overall biodiversity of the watershed. These habitats can be analyzed separately, as they provide unique microhabitats, or as part of the landscape mosaic, as is important for widely-ranging species.

LOCATOR MAP FOR THE LITTLE WHITE SALMON WATERSHED

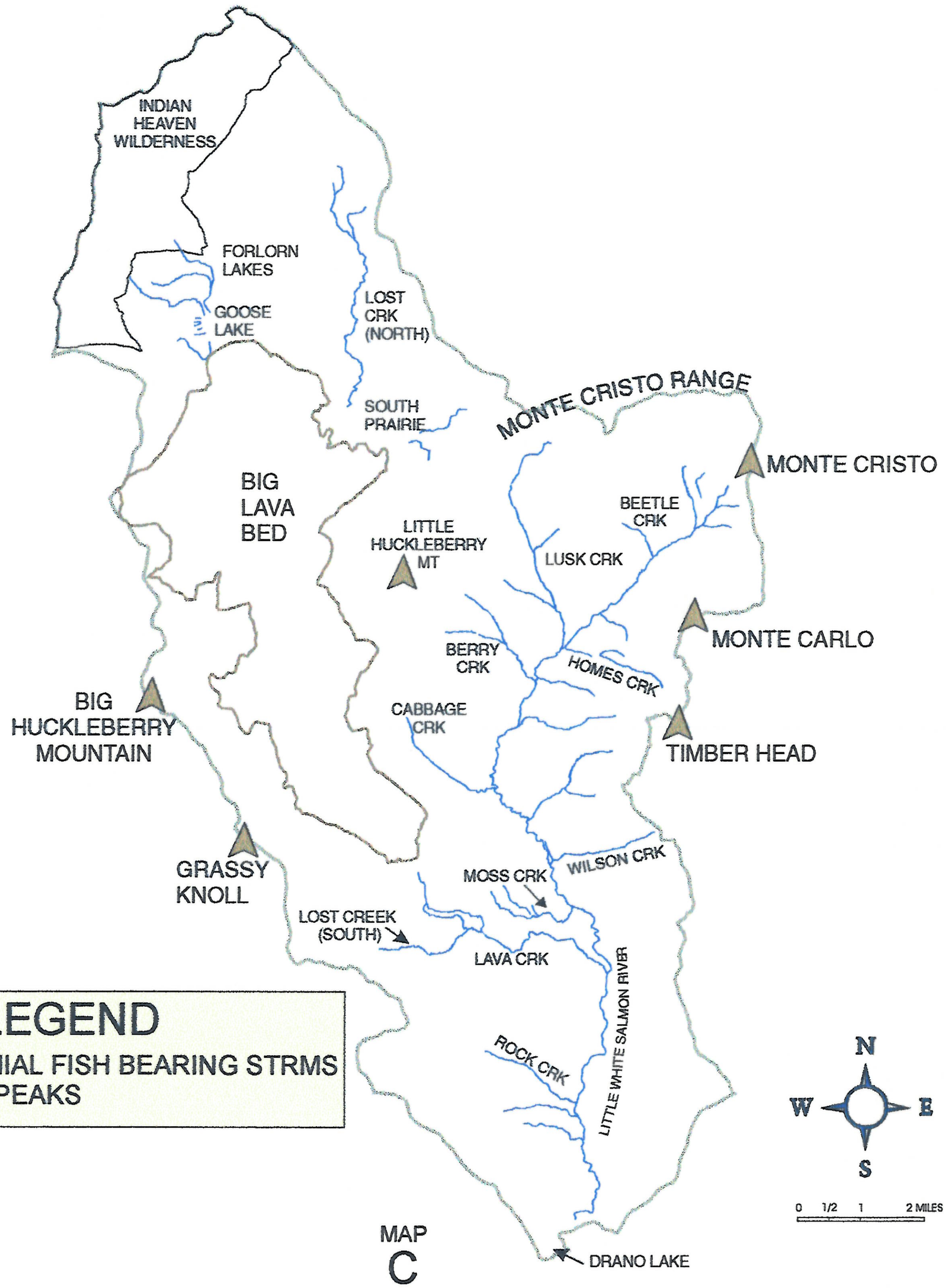


MAP A

FOREST PLAN ALLOCATIONS



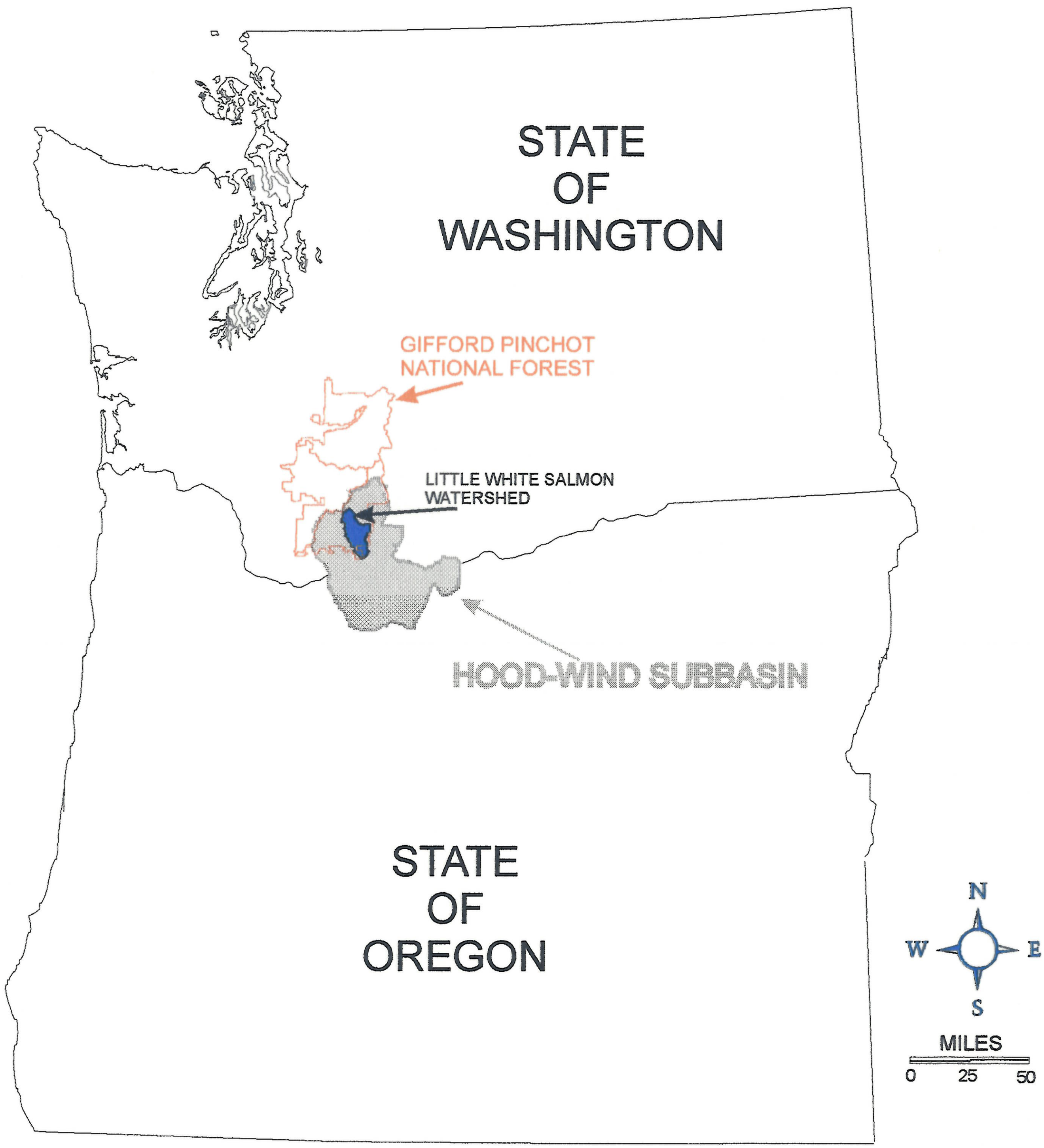
MAJOR NAMED FEATURES



LEGEND

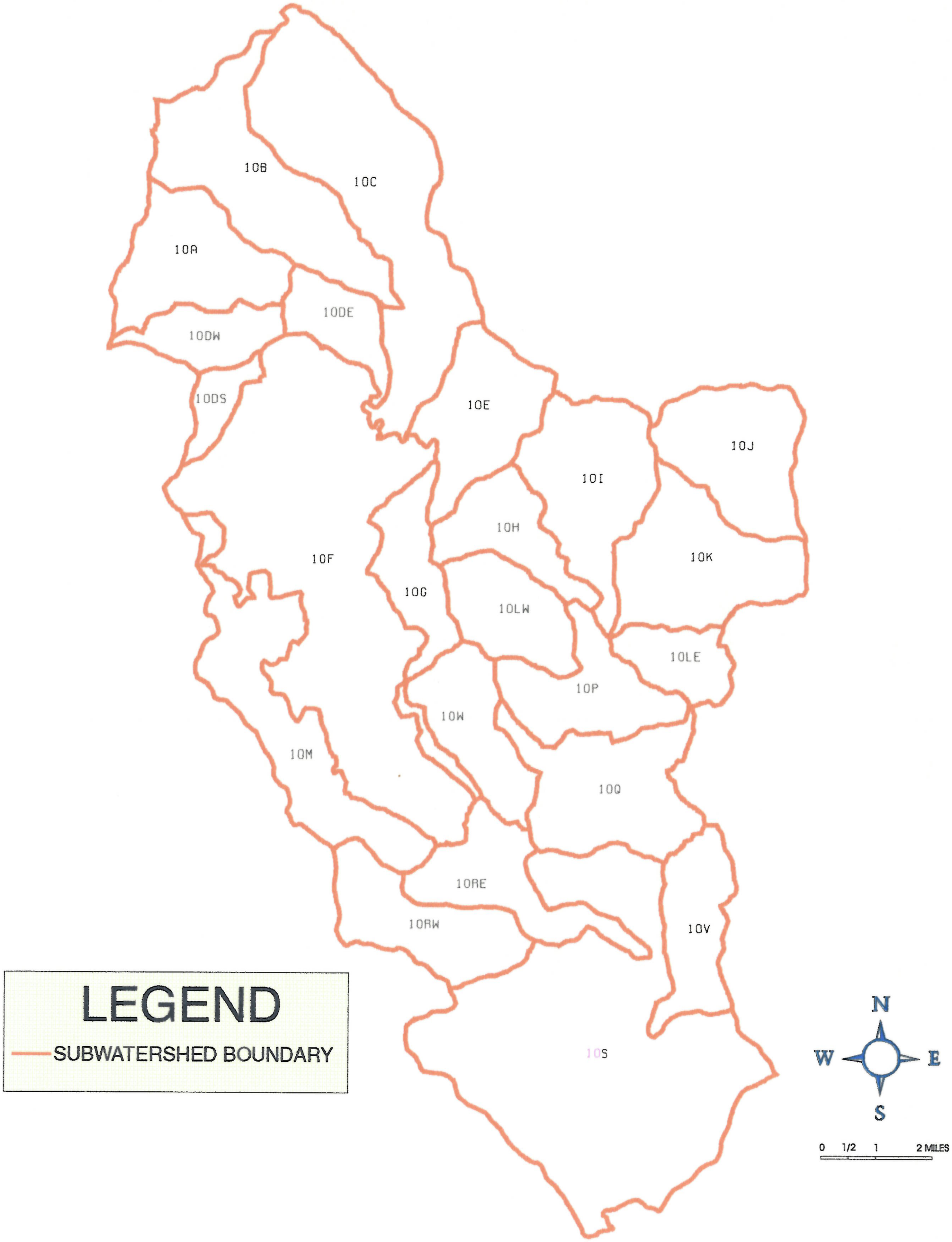
- PERENNIAL FISH BEARING STRMS
- MAJOR PEAKS

HOOD-WIND SUBBASIN



MAP
D

SUBWATERSHED BOUNDARIES



MAP
E

Eight sensitive plant species, constituting 71 populations, occur in the Little White Salmon Watershed. Golden chinquapin, branching montia, and pine broomrape are at the northern periphery of their natural range. The Little White Salmon drainage contains the vast majority (roughly 80%) of the former two species for the state of Washington, and over half the individuals of pale blue-eyed grass in the world (WA Natural Heritage Program, Biological Conservation Data Base 1995). The watershed, is therefore, not only rich in sensitive plant populations relative to surrounding watersheds, it is also houses genetically and evolutionary significant occurrences of these species.

Sensitive Plants

Many species in the watershed are associated with limited and unique habitats; such as cliffs, talus, oak and chinquapin woodlands, wet meadows, upland dry meadows, and late-successional or old-growth forests. The Big Lava Bed is encircled by roads; however, its interior serves as a large tract of unroaded and undeveloped land where important elk and deer movement occurs between the Little White Salmon River and Indian Heaven Wilderness, as well as Panther Creek and Bear Creek Subwatersheds of the adjoining Wind River Watershed. It is also unique habitat for several threaten, endangered, and sensitive (TES) species of amphibians, bats, a reptile, and a butterfly associated with the open-grown golden chinquapin. Two federal endangered, three federal threatened, and thirty Forest Service Region 6 sensitive animal species including birds, mammals, amphibians, reptiles, butterflies, and mollusks exist within the watershed.

Wildlife

The northern spotted owl is one of the federal threatened species occurring in the watershed. Suitable habitat in the watershed abuts the Columbia River which has been viewed as a major north/south migration barrier affecting the spotted owl's natural range. Prior designation of the watershed as critical habitat (CHU WA-41) by the U.S. Fish and Wildlife Service (USFWS) reflects the sensitivity of maintaining dispersal habitat so as to not accentuate this barrier. While further west in the Wind River Watershed, this region is protected in the Late-Successional Reserve, here it is allocated Matrix per the President's Forest Plan.

Northern Spotted Owl

Elk and deer biological winter range occur in the watershed. Low elevation lands nears the Columbia River provide a relatively warmer climate, and open forage conditions related to the frequent, low-intensity fire history. With human settlement in the lower watershed, including Highway 14 and railroad, the orchards along the Cook-Underwood Road, Mill A, Willard, and scattered homesteads up to the Homes Creek tributary, the National Forest winter range for elk and deer becomes increasingly important.

Winter Range

The hydrologic regime reflects the wet winters and warm dry summers with 75% of the precipitation falling within the months of October to March. Much of the watershed lies in the elevation band that has a high probability of experiencing rain-on-snow events.

Hydrology

Streams throughout the watershed were historically populated with native trout including rainbow and possibly cutthroat. Under a vigorous stocking program, rainbow, cutthroat, brook and brown trout are currently planted in the streams and lakes in the watershed by the Washington Department of Fish and Wildlife. The presence of native trout has not been confirmed.

Trout Fisheries

Historically fall chinook, spring chinook, coho, and chum were present up to river mile 1.9. At this location, anadromous fish migration was completely blocked by a series of waterfalls approximately 37 feet high. An impassable dam is now present at the Little White Salmon Fish Hatchery which blocks upstream fish migration at the confluence of the Little White Salmon River and Drano Lake. What wild anadromous fish stocks were historically present in the watershed are now extinct. In addition to the Little White Salmon Fish Hatchery, the Willard Fish Hatchery is also located in the watershed. Both hatcheries are operated by the USFWS. These hatcheries produce fall and spring chinook salmon (*Onorhynchus*

Salmon Fisheries

tshawytscha) and coho salmon (*Oncorhynchus kisutch*) which are released directly into the Little White Salmon River for their short trip to the Columbia River. Drawn by the cooler waters of the Little White Salmon, summer steelhead and salmon pull into Drano Lake to rest during their migration up the Columbia River. Drano Lake provides little if any spawning habitat. Bull trout have been recorded in Drano Lake, but not in the Little White Salmon River itself or it's tributaries.

Water Quality

The Tier 2 classification of the Little White Salmon Key Watershed reflects the lack of anadromous or other threatened fish stocks above Drano lake, yet recognizes the importance of high water quality to the Columbia River and federal hatcheries near the mouth of the Little White Salmon River. As measured at the hatcheries, water quality is generally good. The exception is sediment and turbidity during peak flows, which is extremely problematic for the hatcheries. Further upstream within the National Forest, high water temperatures (18° C) have been noted.

Human Dimension

Native Americans

The Little White Salmon River Watershed encompasses an area that has seen thousands of years of human use. Both past and present use emanates from the Columbia River. During recent years a number of sites on the Gifford Pinchot National Forest have been the subject of archaeological investigation. Several sites are located within five miles of the watershed boundary. Information from these sites helps to provide a context for understanding sites located within the watershed boundary. The locations and assemblages of these sites are consistent with a model of seasonal transhumance by small hunting and gathering groups, who move into higher elevations out of low elevation winter residences, following resource availability. Earliest use within the watershed dates back approximately 7000 years and centered primarily around the hunting of large game animals. More recent use (last 2000 years) was directed at the gathering of huckleberries and other plant foods. A total of fifteen prehistoric archaeological sites have been recorded within the watershed boundary, primarily along the river itself, on lakeshores, meadows and peaks. Locations within the watershed were used as annual social gatherings by the Indians. The sites were used for races and as a social gathering place for Indian people from many places. Many of the roads used for travel in the area today are located along routes used by Indians as well as by trappers, early sheep and cattle men, and Columbia National Forest rangers.

Euro-American history

The Euro-American history of the watershed is dominated by logging and homesteading. Human use has undoubtedly altered the landscape, particularly in those areas where the earliest logging activities took place. On private land it dates back to the 1880's. Harvest activities within the National Forest began in the 1920's for fire salvage. Selective harvest was introduced in the 1940's, with clearcut logging practices beginning in the early 1950's continuing into the 1990's. Homesteading in the Little White Salmon Valley was extensive, due to its low elevations and fertile soils. Much of this early homesteaded land has been sold off as parcels for summer homes, and the majority to Broughten Lumber Company. Most homes are centered around Mill A and Willard.

The watershed is rich with special forest products, and is used by many people for gathering berries, mushrooms, beargrass, conifer transplants, and other assorted shrubs. Gold mining, firewood collection, and grazing also occurs. The typical recreational endeavors associated with National Forests occur, such as hunting, fishing, hiking. Developed and dispersed camp sites are located primarily around lakes, rivers, and streams. Indian Heaven Wilderness is popular to hikers and horseman, being easily accessed from all sides.

Current uses of the watershed include the following:

Current Uses

- Developed Recreation (Big Cedars County, Moss Creek, Oklahoma, Goose Lake Campgrounds).
- Dispersed Recreation (camping, hiking, hunting, fishing, driving).
- Domestic water (single home diversions and Buck Creek (City of White Salmon)).
- Fish Hatcheries (Little White Salmon and Willard).
- Grazing (private and federal (Cave Creek Cattle Allotment).
- Mining (minerals and lava rock).
- Miscellaneous Forest Products (berries, beargrass, firewood, mushrooms, transplants).
- Native American Traditional Uses.
- Private Homes and Communities (Mill A and Willard).
- Timber Harvest (private, state, federal).
- Wilderness (Indian Heaven).

In addition to the above current uses, the following specific projects have been proposed on the National Forest land:

Proposed Projects on National Forest land

- Construction of Oklahoma Loop Trail.
- Limited Permit System for Indian Heaven Wilderness.
- Forlorn Lakes Recreation Projects.
- Demonstration of Ecosystem Management Options (DEMO) (research and accompanying LW Timber Sale).
- Jammin Timber Sale.
- Timber Stand Improvement (pre-commercial thinning).
- Designation of Monte Cristo Research Natural Area.
- Re-activating Twin Buttes Sheep and Goat Allotment.

CHAPTER III ISSUES AND ANSWERS TO KEY QUESTIONS

Key Questions

For each issue the following key questions were asked:

- What are the key processes that affect or have affected the issue?
- What were historic or reference conditions?
- What are the current conditions?
- What projects are likely to affect the future condition?
- What are the likely future conditions under the ROD?
- Where are there data gaps, and what are there implications?

Issue: Soil Productivity

Conservation of soil productivity is required by essentially every law or regulation that governs Forest Service activities. We are directed to manage our lands without significantly impairing the productivity of the soil. Soil damage can also lead to degraded watershed condition through impairment of hydrologic function and through erosion and sedimentation.

In Forest Service Region 6 there have been 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. The Gifford Pinchot Forest Plan directs that no more than a total of 20% of an activity area may be compacted, puddled, displaced, or subjected to a severe burn as a result of the activity (Forest Plan p. IV-61). In addition, the President's Forest Plan further directs modification of site treatment practices and harvest methods to minimize soil disturbance, so that soil fungi, arthropods and other soil organisms are not adversely affected (ROD S&G p. C-44).

For about the last ten years, soil scientists on the Gifford Pinchot National Forest have monitored timber sale units to assess compliance with the regional standards. While some of these units have met or exceeded the standards, the majority 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 Processes

Soil productivity is a result of soil structure and nutrient availability. The processes of compaction, erosion, mass wasting, and volatilization of organic matter have the potential to affect significant change in a short time period to soil structure and nutrient availability and hence soil productivity. The processes of soil weathering, nutrient deposition, leaching, and biologic interactions also affect these soil attributes, but these processes occur much more slowly and are less affected by management actions.

Historic Condition

Forest soils in this watershed rate as site class III-V for Douglas-fir productivity (50-160 cubic feet per acre per year of timber). Fire was the main factor in affecting significant changes in soil productivity. Fire volatilized both above and below ground soil organic material (nutrients). Exposed mineral soils would also be subject to erosion and mass wasting under the altered hydrologic regime.

Current Condition

Today, natural fire has been modified through active fire suppression. Timber harvest and subsequent slash treatment are now the main factors affecting soil productivity. Both logging and slash treatments remove organic material from above ground and from the soil's duff layer. Timber harvest, in particular tractor log skidding, has the potential to displace and compact soils. Denuded, displaced, and compacted soils are further subject to surface erosion and can increase the potential for mass wasting. As much as 20% of the capable forest land in the watershed has been traveled over by logging machinery, particularly Subwatersheds C, DE, DS, E, K, LE, and V where much of the ground based logging has occurred. Assuming soil disturbance directives have been met, significant compaction has occurred on log landings and skid roads and total 4% of the capable forest land in the watershed. Road construction would also cause direct losses in soil productivity and indirectly increase the potential for adjacent mass failures through the alteration of surface and subsurface hydrology.

Cattle and sheep grazing have also altered soil productivity through vegetative changes and compaction, but the overall impact to soil productivity is minor in comparison. Noxious weed have been surveyed on most roads in the watershed. Noxious weed introduction and spread is influenced by timber harvest, road construction, and grazing. Noxious weeds in and of themselves cause compaction (Brotherson and Field 1987; Lacey et al. 1989).

Projects Likely To Affect Future Condition

Timber harvest will remove vegetation, increase compaction and possibly increase surface erosion. Road construction will do much the same, but it will increase surface erosion. Other projects such as grazing and dispersed/developed recreation sites will have a minor effect on the watershed; although, it may be a large effect on a localized area. Prescribed burns will remove the vegetation and also volatile some of the nutrients needed for regeneration.

Future Condition

Timber harvest in the matrix will continue, but with better implementation of mitigation for soil productivity. Subsoiling as soon as possible after harvest will help mitigate soil compaction from various harvest techniques. Soil impacts from slash burning should decrease as the trend away from broadcast burning will continue. This will be offset slightly by increased utilization of logging residue and increased underburning elsewhere in the watershed. Implementation of the President's Forest Plan should mean a drop in road density in the Key watershed, and the non-Key watershed should drop or stay the same. The damage already done due to past logging and road construction will remain; although, some will be corrected through restoration and some naturally through root action, gophers, and frost heave.

There is a level of uncertainty of whether the direction of limiting soil disturbance to less than 20% of harvested areas will be met in actual practice in the future. Past monitoring on the Gifford Pinchot National Forest has shown that we do not consistently meet this standard. Research has shown that it is possible to meet this standard. With improved harvest and post harvest activities it is possible to meet this standard in actual practice. As the President's Northwest Forest Plan further emphasizes the protection of soils, it is time to commit to achieving this standard.

Data Gaps

While an estimate of the area compacted has been made, the actual amount of productivity lost has not been quantified. Instead, emphasis should be placed on minimizing soil impact in future projects and verifying (monitoring) that impacts are as expected.

Issue: Mass Wasting

The Little White Salmon Watershed has some large past active landslides and debris flows within its boundaries. Most of the occurrences are in the Key portion of the watershed and not the upper portions of the watershed by Indian Heaven and the Big Lava Bed. Some activity has been noted in the Lusk Creek area, as well as near Guler Mountain. Compared to other watersheds on the Gifford Pinchot National Forest, the Little White Salmon Watershed is one of the most stable. Still, mass wasting is of concern for its potential to cause large problems.

For the most part, unstable areas in this watershed have been avoided for timber harvest. In those areas that have been logged, mass failures are rare. However, the road network has not been able to avoid mass failures. Poor past road construction and lack of road maintenance have created numerous problems recently from fill slope failures that directly or indirectly move sediment into streams.

Key Processes

The key processes involved with mass wasting are slope of the ground, precipitation and major storm events, groundwater, and vegetation cover which also relates to root strength. Other factors that affect mass wasting in the Little White Watershed are the overall geology of the area and possibly seismic activity.

Historical Condition

Based on geomorphology, the watershed can be split into four sub-regions; 1) the Big Lava Bed which is a young series of flows that erupted out of a crater in the north central portion of the flow. These flows are thought to have taken place between 8500 and 13,000 years ago. The flows cover about 12,800 acres of the watershed which is about 15% of the landscape. 2) The area north and north east of the Big Lava Bed is composed of flows that came out of Indian Heaven from about 150,000 years ago to 10,000 years ago. These flows are dominantly basalt with some thin interbeds of pyroclastic material. These flows have not had much weathering. Soil production in this area has evolved from tephra deposits from various volcanic centers during this time period. Glaciation has also had an effect on this landscape by smoothing the landform and moving material down from the Indian Heaven area. Due to the glaciation, soils in the area are thin and not very erosive. 3) The eastern and southern portions of the watershed which are composed of older material that has had a greater time for weathering to occur and for geologic processes of folding and faulting to take place. The bedrock material in this area is on the order of millions of years old. 4) The very southern end of the watershed which comprises most of the private land, is part of the Columbia River Basalts. These basalts are between 16 and 12 million years old.

Mass wasting

Of the four sub-regions in the watershed the eastern area (sub-region 3 above) is the most susceptible to mass wasting. The geology of this area is thicker pyroclastic flows which have a tendency to weather into plastic silts and clays. Past active landslides and debris flows have been identified as shown on Map F.

Current Condition

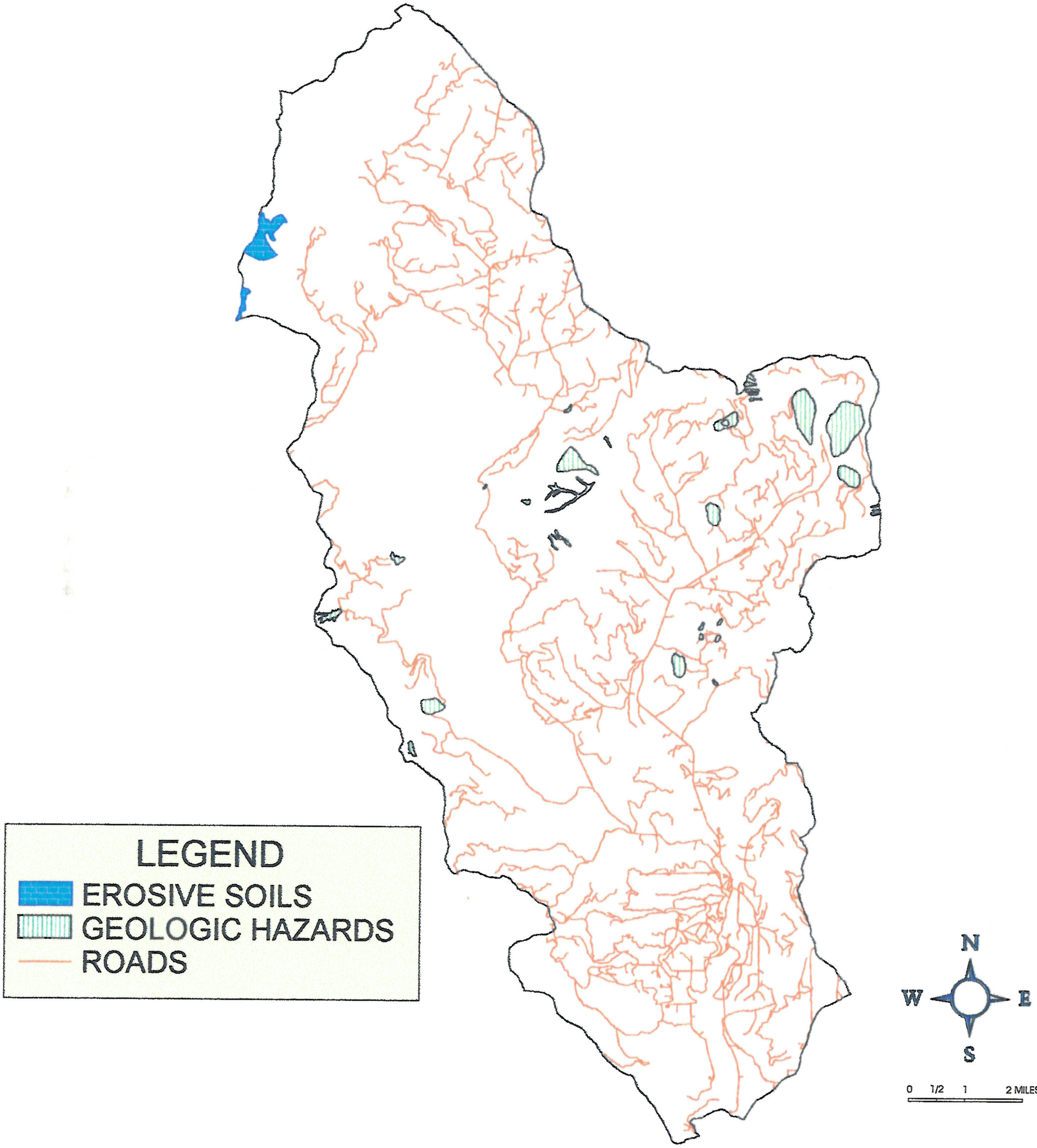
Mass wasting

The mass wasting of today is much like it was in the past. Past active landslides still present a potential for movement if conditions become favorable. The conditions such as raised groundwater, and vegetation cover have direct influence from managed activities in the area. Harvesting of timber has proven to raise groundwater levels due to decreases in evapotranspiration, increasing snow fall accumulation on the ground and increases in infiltration of rain into the ground. Soil types have been mapped based on their characteristics, slope, and aspect to determine areas of potentially unstable ground. These areas were included in the Riparian Reserves and are shown on Map L.

Debris flows

Debris flows in the watershed have been limited also to the eastern part of the basin. Debris flows are usually shallow rapid failures caused by oversteepened slopes and increased groundwater. These failures normally occur in channels thus providing direct input of sediment to the stream system. Debris flows can be activated naturally or by management activities such as road building and timber harvest. Road construction in the past has called for sidecasting material in order to reduce earthwork. This material was generally not compacted. As runoff from the road during storm events saturated these fills, they failed and usually took much of the natural ground with them as they moved down slope. This material was usually fine with some coarse material within it. Naturally occurring debris flows happen much the same way only the ground is composed of loose material that becomes saturated and the steepness of the ground makes the area unstable. A form of debris flow that does not move much soil through the system are avalanches which are caused by build up of snow in the steep headscarp areas of drainage's. These oversteepened snow areas give way and move

ROADS, EROSIVE SOILS AND GEOLOGIC HAZARDS



MAP
F

down slope removing vegetation but don't take much of the underlying soils. Areas of the watershed where this type of ground is located are around Grassy Knoll, the headwaters of the Little White Salmon River, Lusk Creek, and off of Little Huckleberry Mountain.

Projects Likely To Affect Future Condition

Harvest areas in the headwaters of the Little White, Lusk Creek, Grassy Knoll, and Little Huckleberry areas will have a higher susceptibility of debris flows and landslides occurring. Road construction may create unstable situations especially in the potentially unstable soils mapped area. This should be minimized due to better construction practices. Lack of maintenance on some roads has increased the potential for sidecast failures to occur.

Future Condition

Naturally unstable areas will remain unstable. Better management practices and better design will help minimize risk of future failures within the watershed. Decommissioning un-needed roads can lessen the effects to unstable areas and reduce the need for continual maintenance.

Data Gaps

Initial soil inventories on the Gifford Pinchot National Forest began in 1967 and were completed in 1971. Mapping of soils has been periodically updated Forest-wide between 1975 and 1990. Site specific changes in the inventory are made when on the ground surveys, usually in association with development projects, permit refinement. One group of soils that in the past has received much interest and ground truthing are the potentially unstable soils. As potentially unstable soils are included within Riparian Reserves until proven otherwise, they will continue to be scrutinized on the ground.

Issue: Surface Erosion

Surface erosion from roads has been a major contributor of sedimentation to streams in the past. The first two to three years following construction is when most of the sediment is transported. After this time growth on the fills and cut slopes help alleviate this problem but in areas near stream crossings the problem can continue to influence stream habitat for many years.

Surface erosion from hillslopes becomes a concern when slopes are left bare (to natural soil) after management activities such as timber harvest and hot burns that removes the natural duff layer. It becomes more of a concern on steep slopes (greater than 50%) as the material has more of a tendency to move downslope toward streams.

Key Processes

The key processes of surface erosion are slope of the ground, rainfall, and fire as natural processes. Management activity also has a key effect on erosion of slopes and roads. Processes such as poor construction techniques, road maintenance, undersized culverts, surfacing material, sidecasting for construction or waste, and uncontrolled access during wet weather all have an influence on sediment production.

Historical Condition

Historically fires have been the main contributor of surface erosion in the watershed. The intensity of the burns would determine whether the duff layer was destroyed or not. If it was, then the mineral soil would have a tendency to erode during storm events.

Current Condition

As fire prevention has been the direction over the last 60 years, surface erosion from hillslopes has declined to a level that it is not a major concern in providing sediment to the streams. Areas that still need to be monitored are on steep slopes that have had cable yarding which in turn has disturbed the duff layer down to mineral soil.

Road Construction

The big change from past to present is in the construction of roads. Road construction has had a major effect on sediment production over the past 50 years. Sediment off of roads is greatest within the first two to three years after construction or until vegetation takes hold on the slopes. Other concerns from roads develop by the construction techniques used. Early roads were constructed by placing slash material in the fills which worked fine for a time. After about 20 years, though, this material has started to decay and cause fills to fail. Some roads exhibiting problems get maintained; however, road maintenance funds have rapidly shrunk in recent years meaning that system roads that don't get driven much are not maintained. This means that fills that fail may not get repaired, which will in turn chronically supply sediment to nearby streams. Culverts fail to be cleaned, eventually plugging and redirecting water flow over and down roads, eroding the road surface and fills. Roads on steeper grades have a tendency to form channels in the wheel tracks which moves more sediment toward streams. Timber haul during wet weather (winter) has also been a big factor in the degradation of roads and sedimentation.

Appendix B - Road Problems lists roads in the Key portion of the watershed which are exhibiting erosion problems based on a 1995 road condition survey (Phase 2 of the Mt. Adams Access and Travel Management Plan). Roads were listed if they had one or more of the following conditions: 1) culverts 40% or more plugged, 2) erosion ruts of 6 inches or more, and 3) cracked or slumping fills or road cuts (mass wasting indicators). These conditions were found on the majority of the roads surveyed.

Projects Likely To Affect Future Condition

Projects that will likely benefit the future conditions of the watershed would be mostly road related. Decommissioning or storm-proofing roads will help decrease sediment transport over the long term. Effective road maintenance, specifically maintaining culverts will also reduce sedimentation problems. The downside of this is that road maintenance funding has not been able to keep up with maintaining the higher use roads at this time. Temporary roads and log landings that fail to be obliterated after logging, along with native surface roads, have been identified as contributing to the problem. Projects that enhance or decommission these roads would benefit the watershed.

Future Condition

Reducing the road density in the Key watershed should reduce sedimentation and improve fish passage. In non-Key watershed road density should decrease or stay the same. New road designs and reconstruction projects will be designed to meet a 100 year flood event as stated in the ROD (p. C-33 RF-4). Lack of maintenance may have an adverse effect on the watershed, permitting problems to arise on roads left on the system network.

Data Gaps

Road condition surveys results have been completed for Key portion (see Map N and Appendix B), and are ongoing for the non-Key portion of the watershed. The condition of roads when combined with the desired future condition for the road and the condition of the subwatershed, will help determine priorities for road obliteration, decommission, and the limited funds available for road maintenance.

Issue: Fire

Key Processes

Fire regimes of the Pacific Northwest have been described by Agee (1983) and by Evers et al. (1994). They are a function of the growing environment (temperature and moisture patterns), ignition pattern (lightning, human), and plant species characteristics (fuel accumulation, adaptations to fire). Effects of fires can be more precisely described if effects can be grouped by fire regimes.

Fire Groups

Based on information contained in the draft report *Fire Ecology of the Mid Columbia* (Evers et al. 1994), four fire groups occur in this watershed:

- Fire Group 0 - miscellaneous special habitats
- Fire Group 3 - dry grand fir;
- Fire Group 5 - cool, dry lower sub alpine
- Fire Group 8 - warm, moist western hemlock and Pacific silver fir

Fire Group 0

Fire Group 0 consists of a miscellaneous collection of habitats such as scree or talus, forested rock, dry meadows, wet meadows, volcanic deposits, alder glades, and deciduous riparian communities. The habitats are widely dispersed and small in size with the exception being the Big Lava Bed.

Little to no fire activity would or has occurred in this fire group. Group 0 sites burn poorly under normal summer weather conditions. These sites can serve as natural fire barriers. Though the Big Lava Bed falls in this group, it does have pockets of deep soil allowing the development of a denser forest. These areas see fire regimes more typical of Fire Group 3.

Fire Group 3

Fire Group 3 is located primarily within the Key portion of the watershed. This group follows the eastern edge of the Big Lava Beds as far north as South Prairie. It then turns east and includes Little Huckleberry Mountain, Trail Peak, and Guler Mountain to the East. This is primarily the grand fir ecoclass zone (see Map H).

Portions of this fire group probably burned every 25-100 years (Evers et al. 1994). While detailed information about presettlement fire history is scarce, what information we do have seem to support this prediction. Mapped fires and current stand conditions suggest that some stands may have under burned regularly, particularly near ridge tops. These more frequent fires were the result of lightning or Indian burning. The two large stand replacement fires that we know of, occurred in the 1820's and 1939, about a hundred years apart.

Most fires probably included both crown fires and under burning. Which fire type dominated would have varied with fuel moisture and weather conditions at the time of the fire. Fire starts would have burned for weeks to a couple of months. Medium sized fires may have been more common.

Fire Group 5

Fire Group 5 is located along the eastern slopes of Indian Heaven Wilderness and includes the area around Goose Lake and the Forlorn Lakes. Group 5 consists of the high elevation plant associations, that are east of the Cascades crest where huckleberry and beargrass are the major understory plants. This groups comprises the transitional forest between westside and eastside, which are the subalpine fir, mountain hemlock and some of the Pacific silver fir ecoclasses.

Evidence indicates that these stands experienced both low to moderate and high intensity fires. Low to moderate fires would consist of smoldering fires that creep through the duff. Fuel concentrations and/or low canopies favor torching of individual trees or groups of trees.

The torching would create small spot fires that would creep around in the duff until reaching another fuel concentration. Low to moderate fire helps maintain shade tolerant species. This type of fire would create canopy gaps and mineral seedbeds. Root damage to shallow-rooted firs and hemlocks would favor root rot and create additional gaps. The resulting stand would contain a mosaic of age classes and a wide variety of conifer species.

The other type of fire experienced in Group 5 would be a high intensity fire that would occur during a prolonged drought of three years or more. The resulting stand replacing fire would prepare a mineral soil seed bed and shade intolerant conifers. Stand replacing fires east of the Cascade crest would tend to occur in August to early September under strong east wind conditions. Ecology plot data indicates an average fire return interval of 200-700 years.

Native Americans burned many stands in this fire group, as well as in Group 3, in order to stimulate huckleberry production. Sheep herders may have also ignited fires in this fire group to improve forage for sheep.

Fire Group 8

Fire Group 8 is located north of the Big Lava Bed and east of Indian Heaven Wilderness. For this watershed, Fire Group 8 overlaps the Pacific silver fir ecoclass. This area is gently sloped with a cool, moist climate.

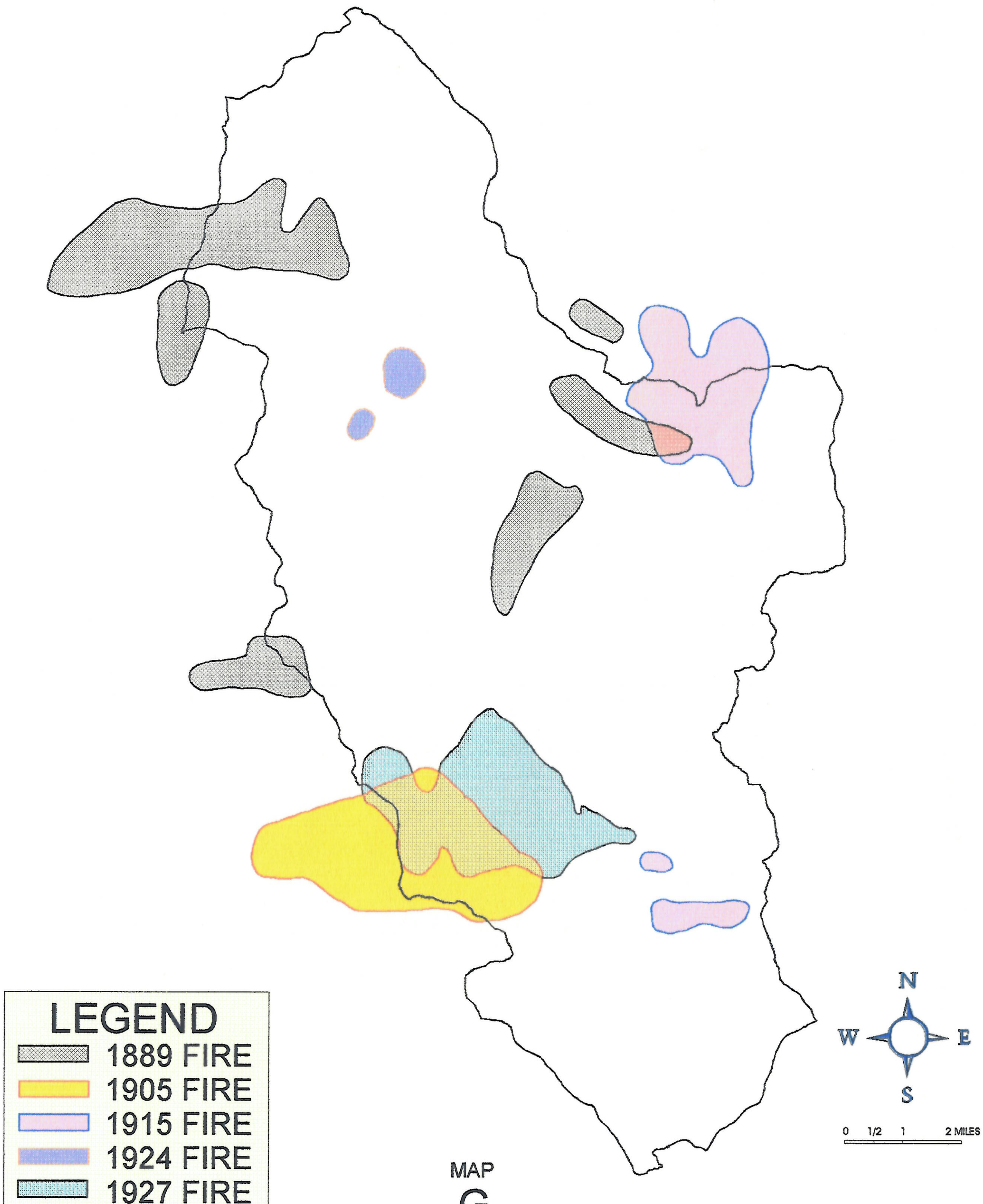
In this ecoclass, prolonged drought dries the forest floor enough to allow fires to start and spread. Smoldering combustion and creeping rates of spread are most common until dry east winds fan the flames into a much higher intensity fire. Ecology plot data indicates an average fire frequency rate in the Pacific silver fir associations to be 170-300 years. We have no records of fires within this fire group within this watershed; however, there were two large fires (Smoky Creek and Twin Buttes Fires) in the early 1920's just north of the watershed boundary. In addition, notes from the McClellan party in 1855 describe the vegetation as park-like with widely spaced ponderosa pine (McClellan 1853). This suggests a much more frequent fire regime.

Fires in this group serve to prepare a mineral soil seedbed. This produces a mosaic of stand structures and age classes across the landscape in addition to affecting within stand species diversity. Fires in this group are generally small (<10 acres) or are very large (>1000 acres) depending upon weather conditions at the time of ignition.

Historical Condition

Historical maps, photographs, and documents indicate that between 1820 and 1940, there were several moderate to large size fires (see Table 1 and Map G). Moderate size fires would be classified as being in the 200-500 acre range, and large fires being between 1000-3000 acres in size. The specific cause of many of these fires is unknown. From about 1850 to 1930, settlers used fire as a way to clear their land. Another source may have been from Native Americans, in particular to maintain and create huckleberry fields (Plummer 1899, French 1957). A third source would have been lighting, which frequents many of the ridges and other high points..

FIRE HISTORY



MAP
G

Table 1. Moderate and Large Fires from Year 1820-1939

Year	Acres	Acres in LWS	Fire Group	Location-Subwatershed
1820-1830	30000+	30000+	3	Little White Salmon River - all but A,B,C,D,E
1880-1897	4253	4100	5	Indian Heaven - A,B
1880-1897	877	300	3	Big Huckleberry - M
1880-1897	800	350	5	Red Mountain - A,DW
1880-1897	1300	1300	3	Little Huckleberry - G,H,LW
1880-1897	1200	1200	3	North Lusk - E,I
1900-1910	6000	3000	3	Grassy Knoll - M,RW,RE
1910-1920	530	530	3	Willard - S,V
1910-1920	110	110	3	Moss Creek - S,RE
1915	3500	1600	3	Trail Peak - I,J,K
1924	350	350	0	Big Lava Bed - F
1924	130	130	3	Big Lava Bed Crater - F
1927	6000	5900	3	Lost Creek - M,RE,RW,S
1939	13220	2500	3	Nester Peak -H,I,K,P,LE,LW

1820 Little White Fire

On a 1899 fire/timber map made by Fred G. Plummer, he notes that much of the Key portions of the Little White Salmon Watershed and areas west to Big Huckleberry Mountain were comprised of forest stands stocked at a very low 2000 board feet/acre or less. Oblique 1910 photographs of the watershed confirm the predominance of young trees and numerous large snags in the area. Today, native stands in these areas are all 140-160 years of age. This suggests that a stand replacing fire occurred in 1820s, and was over 30,000 acres in size.

Reburns

Plummer also maps five other burns dated 1880-1897. They were located at Indian Heaven, Red Mountain, Big Huckleberry Mountain, and Little Huckleberry Mountain. Ethnographic records suggest that all of these sites were historic berry fields used and maintained by Native Americans. Tree ring analysis of western redcedar trees in the vicinity that were peeled by Native Americans to make baskets corroborate Plummer's dates. Another supporting observation is the lack of remnant snags in these areas in the 1910 photographs. Quite possibly any snags that were left over from the 1820s fire were consumed in the subsequent reburns.

In reviewing other historical maps, two additional fires occurred within the watershed sometime between 1880 and 1897. One fire was located in the northern headwaters of Lusk Creek and the other fire just north of the Little White Salmon Watershed. The same theory expressed above could apply to these fires.

Grassy Knoll Fire

Around 1900-1910 there was a fire in the southwestern portion of the watershed centered on Grassy Knoll. In 1927, the same area had another large fire of 3000 acres. Half of the area burned in the 1990-1910 fire was involved in this 1927 fire near Lost Creek.

Lava Beds Fire

Other fires of mention include two fires in 1924, located in the northern half of Big Lava Beds. While one fire occurred in the thicker forests near the crater, the fire near South Prairie occurred in an area of scattered trees.

Nestor Peak Fire

In 1939, the Nester Peak fire started on the east slope of the Monte Cristo Range from logging operations. This fire dropped into the Little White drainage in the area of Homes Creek. The entire fire consumed over 13,000 acres of which 2500 acres were in the Little White Salmon Watershed.

By 1930, fire prevention and suppression became more effective and large fires decreased. Excepting the Nester Peak Fire, the fires that have occurred after this time were generally small in size. These fires were either the result of lightning or escaped logging slash burns.

Current Condition

Ignition Sources

Current ignition sources for fire include lightning, debris burning, smoking, and campfires. Indian burning for huckleberries has been curtailed. The most common ignition source in recent years has been lightning. The area between Little Huckleberry Mountain and Monte Cristo lies in a natural path for thunder storms. The storms move northwards from Mt. Hood and progress up the Little White Salmon River. As they encounter the Monte Cristo Range, they produce lightning. The other sources of fire starts are less frequent and usually occur at lower elevations.

From 1940 to date, there has not been any moderate (100+ acres) or large fires within the watershed boundary. With the advent of fire suppression fires were controlled at very small acreages (1-10 acres), excepting the Nester Peak Fire.

Fuel Modification

Timber harvesting and slash burning have actively modified fuels in the last 40 years. Clearcutting was widely used from the 1940's to the present. Broadcast burning was used as the primary treatment measure for logging slash until the mid 1980's. The prescription called for complete removal of the logging slash to ensure reduction of any fire hazard. Broadcast burns produce high particulate emissions for a short duration. Concern over particulate emissions in the mid-1980s drove the implementation of other fuel treatments.

From the mid-1980's to present, clearcut units have had fuel treatments consisting of low intensity broadcast burns, hand piling, loader piling (also called shovel piling), and in some cases, no treatment at all. Partial cut units have primarily been treated via hand piling, loader piling, or no treatment at all. Little to no underburning has occurred in the watershed.

Fire Group 0

Fire exclusion would have allowed tree invasion in dry meadows and a continuing build up of fuels within riparian communities. However, this would not have a major impact given the long fire intervals in riparian communities. Consequently, while some sites may be more vulnerable to fires than in presettlement time, fires would still be of low intensity with some individual torching.

Fire Group 3

Fire suppression for the last 80 years would have been long enough to interfere with the predicted 25-100 year fire interval in the Key portion of the watershed. This group would now tend more towards crown fires than underburning.

Native stands in the Key portion of the watershed are currently 140-160 year old Douglas-fir. Given that the aspect is generally south, slopes are steep, and there is high brush component in the stands, ground fires already have the potential to get into the canopy.

Down fuel loading is currently light (approximately 20 tons per acre on south aspects and 30 tons per acre on north and west aspects). However, scattered mortality from laminated root rot and Douglas-fir bark beetle is building the down fuel loads. Stand conditions are not susceptible to epidemic outbreaks of pathogens such as spruce budworm as are other areas in the grand fir ecoclass (see the Upper White Salmon Watershed Analysis).

A large portion of the Key watershed has been clearcut harvested. The pre 1980 clearcuts that were broadcast burned would have a low potential for fire. The later clearcuts and partial cuts would have greater downed fuel loads, and though lacking the aerial fuels in the clearcut, they could carry a ground fire to and from adjacent stands.

The subwatersheds that may have a high probability for a fire start are G, H, I, J, K, LW, and P. These subwatersheds have a high percentage of south and east aspects, which tend to dry earlier. They also have a high percentage of land base with a west aspect. The west aspect areas would have the heavier fuel loads, which would potentially create a higher intensity fire.

Vegetative fuel loads are also building on the ridgetop areas which had the frequent burn interval. Succession is increasing the amount of conifer present to the demise of huckleberry and other early seral species. The resulting fires may burn more intensely.

Non-Forest Service Lands

There would be no change from the historic fire intensity in the lower third of the watershed which is mostly privately owned. Forest stands are mostly less than 100 years old as result of past timber harvest or fire at the turn of the century. The shorter rotation lengths practiced on private land more closely resembles the historic fire return interval.

Fire Group 5

Given the length of the predicted fire-return interval (200-700 years), there would be no change from the historical fire regime in the Indian Heaven Wilderness area. Under current stand conditions, most fires would tend to remain either very small or become very large. Large fire development depends on prolonged drought and high winds. Steep topography and strong winds would promote crown fire development under slightly wetter conditions. Torching and spotting play a significant role in fire spread. Unless there is a crown fire involved, fire should remain relatively small. Fuel loads in the large diameter classes (9-20"+) are high in comparison to the smaller size classes. The large, decaying, woody material makes good receptacles of flaming brands. Spread, though, would be limited at the ground level due to the lack of fine fuels. Fuel Model 8 (Anderson 1982) is the primary fuel type represented in this group.

Fire Group 8

Similar to Group 5, there would be little change from the historic fire regime. Under the current stand condition, low rates of spread and low fireline intensities dominate. With that type of fire, prolonged smoldering can create a high severity burn. Under extreme weather conditions (drought, high winds, low humidities, and low fuel moistures), a large fire would be a stand replacing fire. Fuel Model 8 is represented in most of this group with some patches of Fuel Model 10 (Anderson 1982).

Much of the upper watershed that is in Fire Group 8 has been clearcut harvested The pre-1980 clearcuts that were then broadcast burned or machined piled would have a low potential for fire. The later clearcuts and shelterwoods would have greater downed fuel loads, and though lacking the aerial fuels in the clearcuts, they could carry a ground fire to and from adjacent stands.

Projects Likely to Affect Future Condition

Timber harvest reduces total live fuel loading, can increase dead fuel loading, and alters the arrangement of all fuels. The degree of utilization of trees cut and subsequent slash treatment greatly affects short and long term fire hazard. In addition, burning of slash has the potential to create unmanaged wildfires.

Underburning

Underburning seeks to reduce down fuels and live understory fuels. This influences stand composition and reduces the severity of unplanned ignitions. It may also reduce the likelihood of a stand replacing fire. Prescribed fires can also be used to maintain early seral conditions.

Fire Suppression

Fire suppression disrupts the natural fire cycle, adding to the buildup of total fuels and increasing the likelihood of stand replacing fires. In wilderness, research natural areas, and other reserves, where the other tools of vegetation management such as timber harvest and prescribed burning is unavailable or underutilized, fire suppression may increase the likelihood of stand replacing fires.

Increasing use of the National Forest for recreation and miscellaneous forest products collection increases the likelihood of human caused fire starts.

Future Condition

Fire Group 0

While the miscellaneous habitats in this group (i.e. Big Lava Bed) are not likely to see much active management other than fire suppression, this will not cause large deviations from the historic fire regime which is characterized by infrequent, low intensity fires. There is the opportunity to use fire to control encroaching conifers in dry meadows, and otherwise maintain early seral conditions in unique or limited habitats. These areas are likely to intermingle with Fire Group 3 lands which do see more frequent fires. This includes ridgetop areas like Monte Cristo Biological Special Area and Grassy Knoll, as well as the scattered bald knobs with oak and golden chinquapin.

Fire Group 3

The condition described under current conditions would be accentuated in the future. There would be greater likelihood of a large crown fire occurring in that area of the watershed designated Key. Much of the area is now placed in Riparian Reserves. Optimal thermal cover needs in Deer and Elk Winter Range and the proposed Monte Cristo Research Natural Area increase the total area that would be maintain in late-successional and old-growth condition. The area west of the Big Lava Bed is now allocated Late-Successional Reserve and is also in this condition.

Matrix Lands

In the remaining General Forest (Matrix) lands, timber harvest is likely to mimic fire and reduce the potential for stand replacing events in those locations. While the management of residual slash in harvest units is of concern; this may be alleviated by the increasing utilization standards for wood removal. Matrix land is scattered throughout the drainage. The resulting patch pattern may accentuate the current fragmented pattern, yet allow for mature stand connectivity along streams. This pattern does not mimic the pattern resulting from the historic fire regime which created large, even-aged patches, regardless of intermittent streams.

Riparian Reserves

Riparian communities on the mainstem of the Little White Salmon River are likely to retain their structure and late-successional condition over time. The wide hardwood bands along the river act as natural buffer during large stand replacing events. Evers et al., (1984) suggest that the average fire return intervals in sites with devils club and skunk cabbage may easily exceed 300 years. Indeed, there are some riparian conifer communities on the main stem of the Little White Salmon River which escaped early logging and are now 400 years old. However, the intermittent and small perennial streams that feed the Little White Salmon River lack a wide riparian band with hydric vegetation. These riparian zones were consumed with the adjacent uplands in the 1820's era Little White Salmon Fire and 1939 Nester Peak Fire.

Underburning or other vegetative management to reduce fuel loads would reduce the intensity of a widespread fire when it entered a Riparian Reserve area on small perennial and intermittent streams. This may help maintain some of the intended objectives and function of these reserve areas when considering this ecosystem. Thus, underburning and other prescribed fire should be considered in these Riparian Reserves (see ROD S&G p. C-36-37 for FM-1, FM-4, and Other).

The present fire management plan for Indian Heaven Wilderness does allow letting confined fires burn under limited conditions. Thus, that part of the historic fire regime which is comprised of low intensity underburns with occasional torching, would continue unabated. Underburns would reduce some of the fuels accumulated from stand growth. While the large, stand replacing fires would be suppressed, when they did occur, they would be in the natural range of variation for intensity and size.

Fire Group 5

Indian Heaven Wilderness

Fire Group 8, located north of Big Lava Bed, lies within the Matrix allocation. Fires would be aggressively suppressed and timber harvest would continue outside of Riparian Reserves. Unlike the Key portion of the watershed, this area has much longer fire intervals (170-300 years). It also has a flatter topography which does not promote vertical fire spread into the tree canopy. While past fire suppression and continued fire suppression does increase the probability of a stand replacing fire, we are more apt to maintain the ROD prescribed landscape in the foreseeable future in this kind of environment. This would include maintaining riparian reserves in a late successional condition.

Fire Group 8

Matrix

Data Gaps

No fire modeling was conducted for each subwatershed. Fire behavior predictions based on worst case weather events is not available and would be beneficial for long-term fire planning. Data needs would consist of stand exam information, on site validation of fuel loads, and historical weather
information.

Issue: Air Quality

The air quality issue has two facets. The first concern is smoke from within the watershed and its impact on the watershed and nearby urban areas. The second concern is pollution from outside the watershed and its impact to resources within the watershed. Much of the pollution that the watershed is subjected to is from sources outside of the watershed.

The Little White Salmon Watershed includes a portion of Indian Heaven Wilderness, classified as a Class II airshed. This area is located in the northwest corner of the watershed and encompasses 5,777 acres. On the southern boundary lies the Columbia River Gorge National Scenic Area (CRGNSA). The CRGNSA is neither a Class I or a Class II airshed but is recognized as a sensitive area.

This watershed is subject to significant amounts of pollutants due to its location downwind of the highly populated and industrialized regions of western Oregon and Washington. Unfortunately, there is little information available on existing pollutant levels or air pollution effects to air quality related values. There is a concern though that as population and fossil fuel consumption increases, these will pose potential future effects to the wilderness, the Columbia River Gorge, and the watershed proper.

Key Processes

The key processes related to air quality are the non-point and point pollution sources, the pollutants they emit, and the weather which transports these pollutants.

Non-Point Sources

The Portland/Vancouver metropolitan area is approximately 30-40 air miles to the west of the watershed. This area is the main non-point source for industrial and other urban related contaminants. This non-point source area is likely to generate a larger share of the pollutants than other non-point or point sources.

Large agricultural lands are located east of the watershed. These areas are sources for agricultural related contaminates in addition to airborne dust.

Forest and agricultural burning is another non-point source of pollutants. This would include both prescribed burning and wildfires. Both private, state, and federal agencies conduct prescribed burning of wood residues. This occurs in the forest lands surrounding this watershed and within it. The same lands would be subject to natural or human caused wildfires. The burning of grass fields in the Willamette Valley of Oregon is another source of smoke.

Public use within the watershed is another source of pollutants. Recreational campfires, vehicular traffic (commercial and recreational), summer homes and permanent residences contribute contaminants such as wood smoke and carbon monoxide. Household burning of debris and garbage emits mixed substances of undetermined chemical nature.

Point Sources

Point sources include but are not limited to:

- Aluminum smelters in Vancouver, Tacoma, The Dalles, and Goldendale.
- Pulp mills in Longview, Camas and Tacoma.
- Oil refineries in Anacortes and Tacoma.
- Coal fired power plant in Centralia.

Point and non-point sources generate many pollutants. The following pollutants are of primary concern:

- Sulfur: emitted from fossil fuel combustion, ore smelting, steel manufacturing and petroleum refining. Mt. St. Helens and other volcanoes play a role in emission amounts.

- Nitrogen: product of fossil fuel. Main sources are auto and power generating facilities. Natural sources are lightning and Pacific air flow.

- Ozone: considered an anthropogenic pollutant, and is a secondary product. Extreme ozone concentrations are generally confined to elevations below 1200 meters.

- Smoke: generated from wildfire, burning of logging slash, wood stoves, campfires, agricultural grass burning.

Wind

Weather, specifically transport winds, affect air quality in the watershed. The Columbia River Gorge and larger topography has the greatest influence on winds. The winds are generally west and east flowing, transporting non-point and point pollution from sites within the gorge, from the Portland/Vancouver metropolitan areas, and agricultural lands on either side of the gorge.

Historic Condition

Metro Areas

The Portland/Vancouver metropolitan area has been a source of contaminants from the time that these two urban area were settled. Additionally the development of towns east of the watershed, including The Dalles, Goldendale, White Salmon/Bingen, and Hood River have also contributed contaminants.

Prior to increased use for agricultural uses, the dry lands to the east of the watershed were always a source of dust. After the construction of the many dams along the Columbia River, agricultural use increased the potential for chemical contaminants.

Agriculture

Fire has been a historic source of contaminants within and from outside of the watershed. prior to 1930, moderate to large fires occurred in and around the watershed. After the 1930, fire suppression and prevention policies significantly reduced fire occurrence within and around the watershed.

Fire

The area has had some form of influence from the public since the settlement of the area began just prior to the turn of the century. Logging in the area was significant and logging has continued to some degree up to the present.

Current Condition

Metro Areas

Portland/Vancouver metropolitan area is increasing in size and density. Contaminants being delivered into the watershed from these areas is most likely increasing

Smelters

Aluminum smelters in Vancouver, Goldendale and the Dalles continue to contribute contaminants as well.

Agriculture

Agricultural use is increasing to the east, in addition to an increase in rural development. Dust from dry lands is still a source of pollution.

Fire

Prescribed burning as a source of contaminants has diminished from within the watershed due to an increase in utilization standards of logging residue. Prescribed burning must be approved by the Washington State Department of Natural Resources.

Projects Likely To Affect Future Condition

Prescribed burning, prescribed natural fires, or wildfires would affect the watershed through the creation of high levels of particulates. This would cause visibility impairment although there is no known impact to vegetation from smoke (Peterson 1995).

Projects that emit any form of pollutants will to some degree, affect future conditions in the watershed. The degree of affect is unknown at this time although the cumulative affect could be of concern. Projects could include but are limited to; timber harvest, thinning (commercial and pre-commercial) prescribed fire (hazard reduction or site preparation), prescribed natural fire, road maintenance/construction involving machinery, recreation related projects that increase the use of motor vehicles into or through the watershed.

Projects that reduce emissions of pollutants include but are not limited to; increased utilization of logging residue creating a subsequent reduction in prescribed burning, prescribed underburning would create short term pollution but could reduce the possibility of large scale wildfire, road decommissioning which would limit vehicular traffic.

Future Condition

The primary sources of contaminants originate from outside of the watershed and the ROD has virtually no impact on these sources.

Projects originating within the watershed will add to the cumulative impacts of air quality throughout the watershed. Standards and Guidelines of the ROD will require assessment of projects in regards to impacts on air quality.

Data Gaps

The review draft of the Revised Federal Guide for Watershed Analysis cites 14 air quality impacts to the watershed for which to look. These are listed on page 187 of the review draft dated 3/24/95. At this point essentially all 14 can be listed as data gaps.

CRGNSA

Air Quality Monitoring Plan for the Columbia River Gorge National Scenic Area (CRGNSA) is currently being developed and was not available for reference at the time of this writing. Due to the proximity of the this watershed to the CRGNSA, it would seem that the monitoring plan when published would provide substantial data for this watershed.

Pollution

Very little information is available on existing pollution levels. However, the CRGNSA does have a mechanical air monitoring device located on the Washington side of the Gorge. This instrument is capable of detecting levels of ozone and other pollutants. above the threshold of concern. Some work is occurring in the use of lichens to monitor and gauge pollution. Elemental analysis is of lichens correlates well with mechanical air monitors. The CRGNSA does have limited baseline air quality information using lichens.

Little information exists in this watershed of air pollution effects on air quality values such as visibility, aquatic resources or terrestrial resources. One area of growing knowledge is interactions with lichens. Many known lichens are becoming scarce due to the combined affect of changes in air quality and habitat loss. For example, endangered species list in Europe contain hundreds of lichens. Lichens are also sensitive to climatic change. Certain sub-alpine plants (e.g. *Phyllodoce glandiflora*) are sensitive to increasing levels of ozone in the troposphere.

Wilderness Data

A recent report titled Visual Air Quality in the Pacific Northwest, An Analysis of Camera Data 1983-1992 (Boutcher 1994) exists, but focuses primarily on visibility within Wilderness.

No specific citations of air quality impacts to forest wildlife could be found. Degrees of pollutant necessary for particular impact on each species and individual animals are unknown.

Issue: Biodiversity

The geography of the Little White Salmon Watershed, with its location at the junction of the crest of the Cascades and the Columbia River, produces a diverse variety of plant communities and associated wildlife habitats. Plant communities range from warm, dry, grand fir forest at low elevations to high elevation subalpine communities. Interspersed are numerous unique environments such as the Big Lava Beds, South Prairie, and high elevation huckleberry fields. These habitats support uncommon and rare species such as golden chinquapin, Oregon white oak, chinquapin hairstreak butterfly, western gray squirrel, mountain quail, and Larch Mountain salamander.

Big Lava Beds

The Big Lava Beds, a quaternary lava flow covering 16,000 acres of the Little White Salmon Watershed, is one of Washington's most remarkable geologic phenomena (Kruckeberg 1980). The vegetation inhabiting this massive and unusual craggy landform is equally remarkable. Of particular mention is the array of cryptogams (Franklin 1995). Big Lava Bed is large enough that the old-growth forest isolated in the center and the narrow bands of the forest in the surrounding flat and sloping terrain are important corridors for flora and fauna. Big Lava Beds is of great interest hydrologically and may have a significant influence on the character of waterflow out of the Little White Salmon River.

The Columbia River provides the only east-west sea-level passage for plants, animals, and people in all of Oregon and Washington. Because of this, it has been an extremely important migratory route for plants, some of which have found suitable micro-niches outside their normal range. This is especially true for certain plants in the Little White Salmon Watershed, which has habitat that is at once drier than watersheds to the west, and milder than watersheds to the east. Eight sensitive plant species, constituting 71 populations, occur in the Little White Salmon Watershed:

Columbia River

- Golden chinquapin (*Chrysolepis chrysophylla*)
- Clustered lady's slipper (*Cypripedium fasciculatum*)
- Branching montia (*Montia diffusa*)
- Pine broomrape (*Orobanche pinorum*)
- Barrett's penstemon (*Penstemon barrettiae*)
- Fringed pinesap (*Pleuricospora fimbriolata*)
- Pale blue-eyed grass (*Sisyrinchium sarmentosum*)
- Adder's tongue (*Ophioglossum vulgatum*)

Sensitive Plant Species

Golden chinquapin, branching montia, and pine broomrape are at the northern periphery of their natural range. The Little White Salmon Watershed contains the vast majority (roughly 80%) of the former two species for the state of Washington, and over half the individuals of pale blue-eyed grass in the world. Therefore, the watershed is not only rich in sensitive plant populations relative to surrounding watersheds, it houses genetically and evolutionary significant occurrences of these species. Distinct and marginal populations such as these could have experienced different selective pressures and have different genetic composition. These genotypes could be necessary to maintain the species in the event of global warming. Peripheral populations are also most likely to become new species. Within this watershed there are four Botanical Special Interest Areas (South Prairie, Grassy Knoll, Monte Carlo, and Monte Cristo) designed for appreciation and to preserve some of these species. Monte Cristo is further proposed as a Research Natural Area.

Significance of Plant Species

Old-growth still exists in portions of the drainage, and due to timber harvesting over the past century, it has become Washington State priority habitat. Old-growth in the watershed has not been thoroughly examined for plant and fungal species listed as survey and manage in the ROD.

Old-Growth

Despite the high biodiversity at the landscape level, a large portion of the watershed is comprised of forested stands with low in-stand diversity. Much of the Key portion of the watershed is dominated by mid to late-successional Douglas-fir stands which originated after wildfire and/or timber harvest. These stands are even-aged with closed canopy resulting in relatively low structural diversity and species richness.

Key Processes

Ecological Zones or Ecoclasses

One of the fundamental indicators of the high biodiversity present within the watershed as whole is the variety of plant communities represented. Forested ecological zones (ecoclass) which have been documented in the watershed include: Douglas-fir, grand fir, western redcedar, western hemlock, Pacific silver fir, and mountain hemlock. It is likely that inclusions exist from the subalpine fir zone as well (see Map H). This ecological variety is a reflection of the breadth of environmental conditions, particularly sharp temperature and moisture gradients. The climate on the east slopes of the Cascade Range combines features of both maritime and continental regimes. Dominant characteristics are the rain shadow effects of the Cascade crest, elevation-related temperature differences, and very low summer precipitation. Elevation within the analysis area ranges from about 100 feet above sea level at

Drano Lake on the Columbia River to approximately 5,800 feet at Lemei Rock in Indian Heaven Wilderness.

The Douglas-fir zone occurs on the warmest and driest sites in the analysis area. This zone includes vegetation where the effective moisture is insufficient to support grand fir establishment. These Douglas-fir sites are limited to the steep, predominantly low elevation south-facing slopes and ridges near the Little White Salmon River. The grand fir zone is common throughout the Key portion of the watershed including high elevations on southerly slopes in the Monte Cristo Range. Except for the small amount of Douglas-fir zone, the grand fir zone is considered to be the driest on the Gifford Pinchot National Forest. The upper elevation limit of the grand fir zone occurs where abundant moisture and cool temperature allow development of stands dominated by Pacific silver fir, subalpine fir, or mountain hemlock. The western hemlock and western redcedar zones occur in limited locations, mostly along the Little White Salmon River and major tributaries where moisture availability is increased. The Pacific silver fir zones are found at higher elevation, cooler sites with greater amounts of precipitation. Pacific silver fir zone associations occur on the northerly slopes of Little Huckleberry Mountain, the upper elevations of Big Huckleberry Mountain, and north of the Monte Cristo Range extending to approximately the 4,000 foot elevation east of Indian Heaven. The mountain hemlock zone occurs at the highest elevations, typically above about 4,000 feet into Indian Heaven Wilderness. These are characterized as cold sites with deep snowpacks and short growing seasons. There also may be inclusions of the subalpine fir zone in the areas where cold air accumulates.

Succession

Following a major disturbance, all ecoclasses follow a successional path. For the forested zones, succession was separated into early, middle, late, and old-growth classes. Additional disturbance can either advance or reset succession. Disturbance, like all changes, is inevitable.

Fire

Fire was probably the most important process influencing pre-settlement vegetation. *Fire Ecology of the Mid-Columbia* by Louisa Evers and others (1994) addresses the role of fire on the Mt. Hood and Gifford Pinchot National Forests. Fire regimes were separated into fire groups which largely correspond with plant ecoclasses. The four fire groups present in the watershed area Group O (miscellaneous special habitats), Group 3 (dry grand fir); Group 5 (cool, dry lower subalpine), and Group 8 (cool moist Pacific silver fir). Stand replacing fires in all groups would reset succession. Underburns with occasional torching has likely advanced succession within the subalpine and Pacific silver fir ecoclasses (refer to the Fire Issue presented earlier in this report).

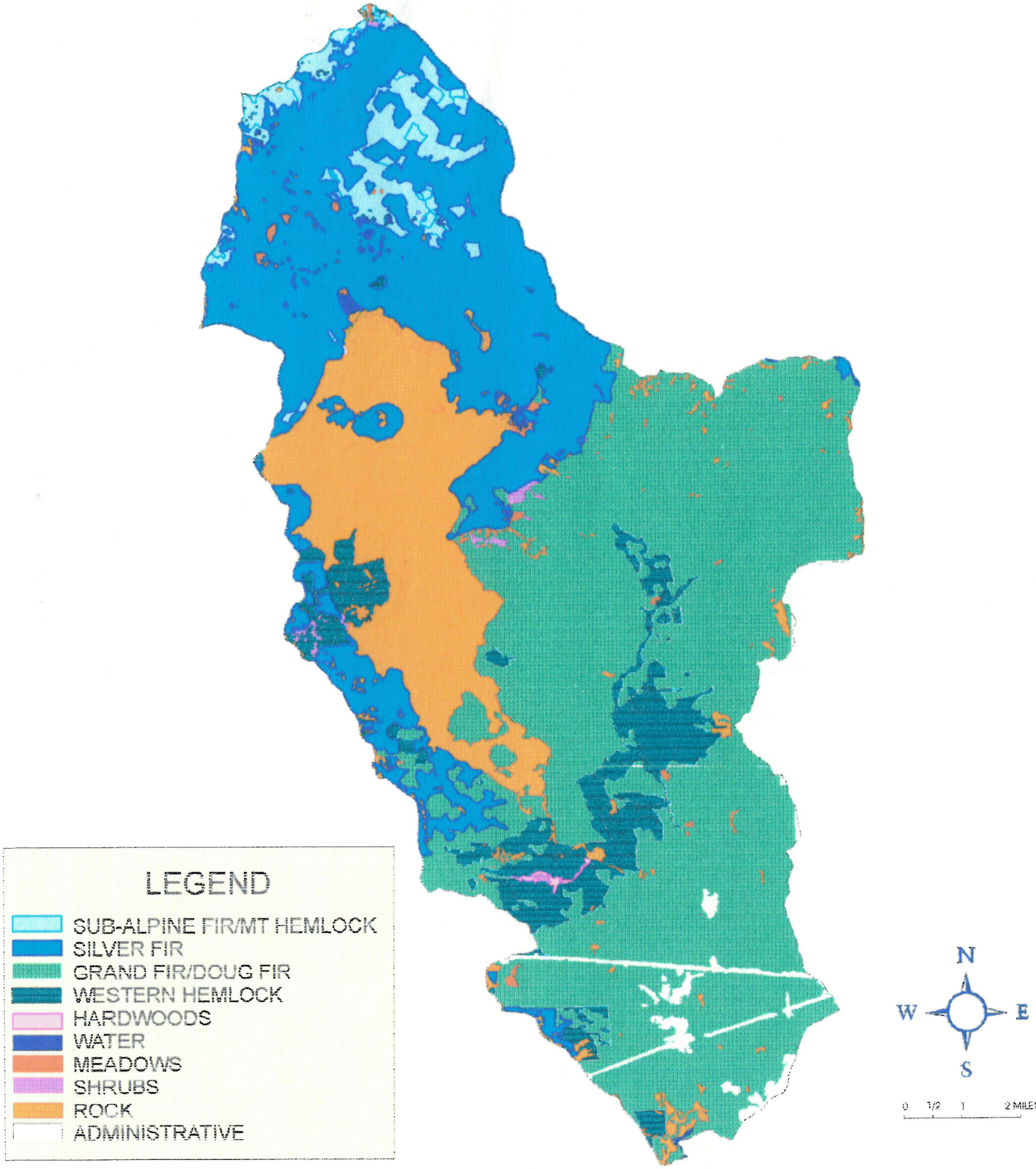
Forest Pathogens

The dominant pathogens affecting forest health within the watershed are western white pine blister rust, laminated root disease, and Douglas-fir beetle.

- **Blister rust** (*Cronartium ribicola*): Blister rust is an introduced disease affecting western white pine trees. *Ribes spp.* (currents and gooseberries) are alternate hosts. This disease has caused large-scale mortality of white pine over many years. White pine occurs primarily in the Pacific silver fir and mountain hemlock zones, although there are trace amounts present in the grand fir zone.

- **Laminated Root Rot** (*Phellinus weirii*): This disease causes mortality to Douglas-fir and grand fir. Western hemlock and western redcedar have low to moderate susceptibility while hardwoods and pine species are immune. Laminated root rot causes mortality in pockets, from a few trees up to 2-3 acres in size in this vicinity. Trees weakened by the disease are often attacked by bark beetles. The disease continues to spread by root contact gradually until it encounters areas with immune species or no susceptible root system.

ECOCLASS GROUPINGS



MAP
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* **Douglas-Fir Bark Beetle** (*Dendroctunus pseudotsugae*): This bark beetle attacks groups of Douglas-fir trees weakened by various stress factors including disease or overstocking. Outbreaks often occur after periods of prolonged drought. The most recent large scale outbreak was in the mid-1970's followed by salvage harvest. As stands in the Key portion of the watershed increase in relative density, the Douglas-fir beetle has potential to cause widespread mortality in the future.

Humans

The analysis area has a long history of human use which has greatly influenced the vegetation and associated habitats now present. Perhaps the most important human activities include management of fire (ignitions and suppression), homesteading, grazing, and timber harvest.

Native American Fires

Prior to settlement, large-scale natural fires periodically burned throughout the analysis area. In addition, it is likely that Native Americans purposefully maintained large burns by either leaving their drying logs smoldering after leaving the berry fields or by directly setting fire to berry patches at the end of the berry season. The intent was to maintain huckleberry production at high elevation sites. Since about 1910, fire suppression efforts were initiated which have curtailed the occurrence of large scale stand-replacement fires. Therefore, many areas that were once maintained as early-successional communities have advanced to a middle to late-successional condition.

Grazing

The earliest grazing involved large numbers of Native American horses in the mid-1800s as noted by Gibbs (1855). Grazing on what later became the Columbia National Forest began as early as the 1880s. Sheep were the first livestock brought into the area, with cattle following near the turn of the century. Estimates of numbers of sheep in the Mt. Adams area in the year 1900 ranged from 100,00 to 150,00. Overgrazing was identified as a problem by the 1920s in the South Prairie and Little Huckleberry Mountain ridgeline. Numbers of grazing animals were reduced starting in the 1930s. Today, grazing activities include about 200 cattle in the Ice Cave Allotment. There has been no grazing in the Twin Buttes Allotment since 1991. Prior to 1991, 800-1,100 sheep grazed every year in the Little White Salmon portion of the Twin Buttes Allotment. Grazing could occur within the Twin Buttes Allotment in the future if the current permittee or a new one utilizes the grazing permit.

Homesteading

Due to its low elevation and fertile soils, the Little White Salmon Valley was extensively homesteaded in the late 1800s and early 1900s. This early homesteading activity established the land ownership patterns in the valley. Those lands that were homesteaded are now under private ownership, while lands not homesteaded are federal lands. The private lands were the first to be logged in the late 1800's for land clearing and to provide forest products to local markets.

Timber Harvest

The earliest logging within the watershed occurred in the 1880s near the Columbia River for fuelwood. Mills were established in the 1890s for the manufacture of shingles and lumber. Flumes were constructed to transport many wood products from the settled portion of the Little White Salmon Valley down the steep terrain to the Columbia River.

Logging on the National Forest began in the 1920s associated with the salvage of the Lost Creek Fires. Selective logging of Douglas-fir was conducted in the late 1930s and 1940s. The first clearcutting was in the vicinity of South Prairie on a small-scale in the 1940s. This harvest method then became prevalent in the 1950s into the 1990s. Shelterwood harvest began in the late 1960s on high elevation plateaus between Peterson Prairie and Indian Heaven to ameliorate frost damage to conifer regeneration.

The earliest reforestation efforts were associated with the Nester Peak Burn (a.k.a. Willard Burn) of 1939. Conifers were planted throughout the burn area during the 1940s including ponderosa pine, Douglas-fir, and Port-Orford cedar.

Historical Condition

Unique Forest and Non-Forest Habitats

Unique forest habitats and other non-forest ecoclassess certainly occurred historically. Unique habitats containing Oregon white oak (*Quercus garryana*) and golden chinquapin (*Chrysolepis chrysophylla*) each have obligate, sensitive faunal associates, as do certain dry meadows, grassy balds, wet meadows, talus areas, pyroclastic and other rocky areas, lakes and ponds, and subalpine areas all within the watershed. Certain of these habitats (e.g. Oregon white oak, golden chinquapin and subalpine areas) may have been more common in the geologic past or before forest management activities, but others habitats (e.g. grassy balds, wet meadows, talus areas, lakes and ponds, pyroclastic and other rocky areas) are historically and pre-historically limited in size and widely distributed.

Historical Seral Distribution

The Regional Ecosystem Assessment Report (REAP) completed in 1993 characterizes various ecosystem components in pre-settlement times. This report provides a description of the historical range of natural conditions for the different successional forest stages. The historical range of natural conditions for the Hood-Wind Subbasin are presented in Table 2.

Current Conditions

All forest successional stages are represented in the watershed analysis area (see Map I). For both federal and non-federal land there are 16,870 acres of early-successional (seedling and sapling size up to 5 inches DBH); 24,840 acres of mid-successional (5-21 inches DBH); 15,180 acres of late-successional (stands exceed 80 years old and 21 inches DBH); and 14,160 acres of stands meeting the Region 6 old-growth definitions. Table 2 lists the acreages of these seral stages by ecoclass for comparison against the historic range of conditions for the larger Hood -Wind River Basin

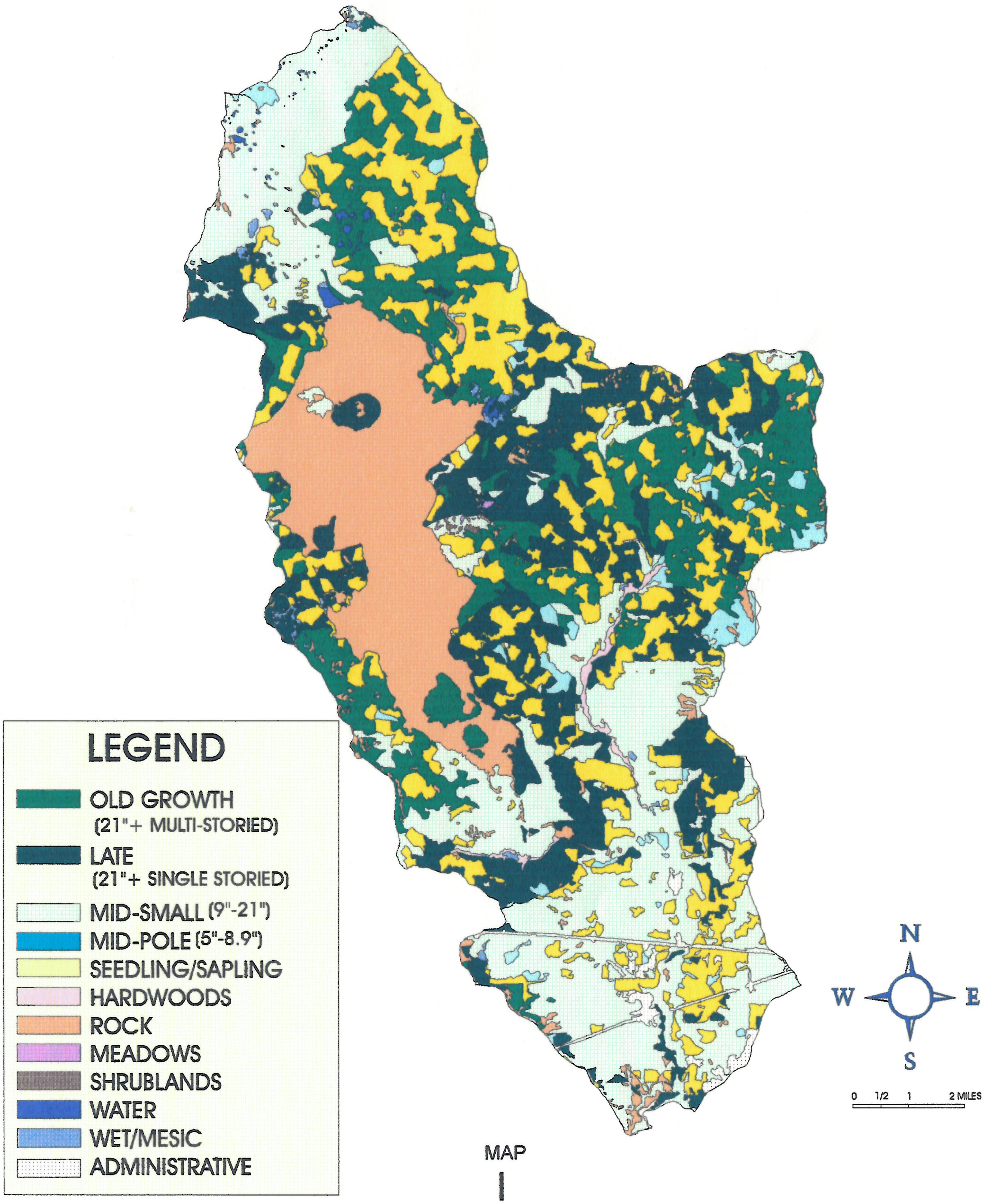
Table 2. Comparison of Current Vegetation to Historic Range by Ecoclass.

Ecoclass	Successional Stage	Current Acres	Current %	Historic Range
Pacific Silver Fir	Late/Old	9,287	43%	30-70%
Pacific Silver Fir	Middle	6,449	30%	NA
Pacific Silver Fir	Early	5,754	27%	10-25%
		Total 21,490		
Western Hemlock	Late/Old	2,905	44%	35-70%
Western Hemlock	Middle	2,525	38%	NA
Western Hemlock	Early	1,169	18%	10-20%
		Total 6,559		
Grand Fir	Late/Old	15,339	38%	10-90%
Grand Fir	Middle	15,006	38%	NA
Grand Fir	Early	9,479	24%	15-50%
Total		Total 39,824		
Mountain Hemlock	Late-Old	1,811	58%	5-65%
Mountain Hemlock	Middle	864	27%	NA
Mountain Hemlock	Early	467	15%	10-45%
Total		Total 3,142		

Notes:

1. Historic Range from REAP Figure #34 (page 95) ; rounded to nearest 5%
2. Pacific silver fir series = CF
3. Western hemlock series = CH
4. Grand fir series = CD, CW
5. Mountain hemlock series = CM, CA, CE, CL
6. Late-successional forest is inclusive of stands meeting Regional old-growth definitions plus stands 80 years old with 21 inch trees (per FEMAT, USDA-FS et al., 1993)).

CURRENT VEGETATION



MAP
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Early-Successional Vegetation

For early-successional vegetation, all ecological zones fall within the estimated historic range except for within the Pacific silver fir zone where the current acreage of early-successional vegetation exceeds the historic range.

There are several differences between the early-successional communities of presettlement times and present-day communities. The vast majority of the current early-successional stands originated following timber harvest within the last 20 years. With today's aggressive reforestation efforts, these stands spend less time in the early-successional stage than in the past. Historical fire events created large openings, which in turn may have been great distances from seed sources. Combined with the dense woody shrubs that develop following disturbances in the grand fir zone, which retard conifer regeneration establishment, stands likely remained in an early seral condition many decades longer than now. In addition, early-successional communities created by fire normally had a snag (and subsequent down log) component whereas most of the harvested lands do not contain snags.

Late-Successional and Old-Growth

All ecological zones fall within the historic range for late-successional forest. Late-successional and old-growth forests are located mostly in the Pacific silver fir zone and mid to upper elevations in the grand fir zone. In the Pacific silver fir and mountain hemlock zones, the stands are generally well into the old-growth stage with many dominant trees ranging from 200-300+ years old. The Regional definition calls for at least 7 trees per acre greater than 200 years old and greater than 25 inches DBH for site class 4.

Much of the native forest in the Key portion of the watershed is transitional between late-successional and old-growth. Fire histories indicate that much of the drainage burned in a large fire in the 1820s. Some of the stands have 150 year-old trees and some don't depending on how long the area took to reforest. The Regional (R6) old-growth definition for the grand fir zone lists 150 years as the minimum age. Consequently, these stands are classed and mapped as a mosaic of late-successional and old-growth forest. However, they are more similar than different, and more aptly described as late-successional given that Douglas-fir comprises 90% of the stocking with the remainder being shade tolerant grand fir or western hemlock.

Mid-Successional

Mid-successional pole-sized stands include areas that regenerated following wildfire, or plantations which have trees 5 inches or greater in diameter (DBH). Pole-sized stands are under-represented in the database since the District has not had adequate funding to inventory and record stands as they develop from sapling into pole-size. Mid-successional small tree stands (9-21 inches DBH) are situated mostly in the Little White Salmon drainage originating after wildfires of the late 1800s to 1939, and in the Indian Heaven Wilderness and vicinity. Much of the area on private land is in mid-successional forest which originated following wildfires and/or early logging The REAP did not determine a historic range of conditions for mid-successional forest.

Patch Sizes

The REAP also did not determine the historic distribution and arrangement of stands. However, this may inferred from historical disturbance, namely fire. Patch sizes in presettlement vegetation communities were quite variable, but large patches tended to dominate the landscape. The large patches were either or both late and early patches in any given point in time as dictated primarily by fire occurrence. Present day forest fires are largely suppressed, and timber harvest is now the dominant force to reset forests to an early seral condition. Patch sizes associated with timber harvest tend to be smaller and more dispersed than those in presettlement conditions. Presently, a large range of patch sizes still exists, but a high frequency of small patches tend to dominate the landscape.

Fragmentation

Compared to pre-settlement conditions, the current landscape pattern contains dispersed, uniform patches that lead to a landscape which is much more fragmented. The pre-settlement conditions tended to have more areas where large patches dominated. Fragmentation did exist at times to some degree in the pre-settlement landscape, but was probably more localized in any one given period of time and not spread across the landscape as uniformly as it is now. Fragmentation caused by current harvest patterns highlights the importance of connectivity between habitat patches. The exception to this fragmentation pattern is in the mountain hemlock zone which contains Indian Heaven Wilderness. Additional discussion on fragmentation is presented under the Threatened, Endangered, and Sensitive Animal Issue.

Shapes of forested patches in a managed landscape tend to have straight, more uniform edges than the irregular boundaries of natural disturbances. Patch edges of today tend to have high contrast as opposed to a more transitional, low contrast edge situation in the past.

Composition and Structure

Structure and composition of forested stands within the analysis area are closely correlated with the seral stage and ecological zones in which they occur. Plant communities within the grand fir zone generally have a much lower structural diversity and species richness than the Pacific silver fir and mountain hemlock zones. Late-successional and old-growth forests within the grand fir zone originated following large scale stand-replacement fires. Stands tend to be even-aged, composed almost exclusively of Douglas-fir with a minor component of other species including western hemlock, western redcedar, grand fir, noble fir, Pacific yew, red alder, black cottonwood, Oregon white oak, golden chinquapin, lodgepole pine, western white pine, and ponderosa pine. Because stands are late-successional or making the transition to old-growth, vertical structure is still developing and canopy gaps are not frequent except in root disease pockets or small bark beetle infestation areas. As conifer tree densities increase, the probability of insect outbreak will also increase. The threat would be primarily from Douglas-fir bark beetle. The threat of epidemic outbreaks of spruce budworm is not nearly as high as other eastside grand fir zones (i.e. upper White Salmon River Watershed) where there are higher tree densities and a high percentage of grand fir. Understories here are comprised of woody shrubs with low amounts of shade tolerant conifers.

Fire occurrence in the Pacific silver fir and mountain hemlock zones is much more infrequent, and often more of a mosaic burn as opposed to stand replacement fire. This is because of the cooler temperatures and more abundant moisture. Most stands meet the Regional old-growth definition, containing a variety of species and a well-developed vertical canopy structure. Many stands have overstory trees that are 200-300 years old. Gaps have formed in the canopy, allowing conifer regeneration and other early successional vegetation to be present.

Unique Habitats

In addition to the dominant forest ecological zones, there are approximately 400 acres of hardwood-dominated stands, 50 acres of meadows, 110 acres of shrublands, 400 acres of wetlands, and 13,200 acres of rocky areas (mostly included in the 16,000 acre Big Lava Beds Special Interest Area). It should be noted that the Big Lava Beds supports some forest vegetation including scattered conifers of several species.

These other ecoclasses are recognized as unique communities, most of which are habitats for several threatened, endangered, sensitive and otherwise unusual plant and animal species. The species associated with many of these unique habitats may be found in the *Wildlife Habitat Analysis for the Mt. Hood and Gifford Pinchot National Forest* by Kim Meller (1995).

Unique botanical areas are often visited by people. These areas are attractive because of their aesthetic wildflower displays, because of their proximity or remoteness, because unusual plants and plant communities can be found only in these areas, because of the way they are managed, or because of the importance of their genetic contributions of outlying populations.

The following few pages provide details on the unique habitats that are present.

Oregon white oak

Oregon white oak (*Quercus garryana)* is present on the warmest, driest sites in the watershed. In most cases, oaks are early seral. Oak is intolerant of shade and is eliminated once overtopped by conifers. Once more abundant because of drier climate, more frequent and free-roaming fires, oaks were heavily harvested by early euro-american settlers, contributing to the scarcity of large specimens in the drainage.

Oak woodlands are identified as a priority habitat by the Washington Department of Fish and Wildlife. Oak provides habitat for the western gray squirrel, California mountain kingsnakes, and for common blue cup (*Githopsis specularioides*), all sensitive species listed by the Regional Forester and Washington State. Mountain quail, a candidate for federal listing, utilizes oak-conifer woodlands, and has been seen in the watershed.

Oak woodlands also give rise to unique herbaceous, lichen, and mushroom communities. Big game and other fauna utilize the grasses; squirrels and other rodents feed heavily on mushrooms; and lichens are important nesting material for birds and other forest fauna. A survey of the lichens associated with oaks in and around the watershed revealed an abundance of gelatinous lichens, *Sticta fulignosa*, and *Normadina pulchella* (Davis 1995) The latter two species are uncommon or rare. No surveys for mushrooms was conducted.

Other Hardwoods

The Forest Plan identifies hardwood stands as special habitat for wildlife (page 2-74). The vegetation database lists about 400 acres in the analysis area as hardwood communities. These areas are situated along the Little White Salmon River and Lost Creek (south), composed mostly of red alder mixed with black cottonwood. There are a wide variety of birds, mammals, reptiles, and amphibians associated with hardwood wetlands.

Big Lava Bed

The Big Lava Bed is a unique 16,000 acre geological feature allocated as a Geologic Special Interest Area. It has been proposed as a Research Natural Area; however, no efforts are underway to this end. It is a relatively young lava flow (about 8,000 years old) with very little soil development. The overall impact is of an extremely hot and craggy moonscape, carpeted with unusual lichen life-forms. Scattered conifers are present throughout, mostly lodgepole pine, Douglas-fir, western white pine, and subalpine fir. Golden chinquapin and fringed pinesap (both sensitive species) occur within the thickly forested islands at the south end of the Lava Beds. So does a pair of northern spotted owls. Larch Mountain Salamander (sensitive species) has been sighted near the Big Lava Beds. In addition, caves are present in the lava beds which are a priority habitat identified by the Washington Department of Fish and Wildlife. Townsend's big-eared bats which are on the Regional Forester's sensitive species list utilizes such caves. The Big Lava Beds provide a valuable educational and scientific opportunity to see how this relatively newly-formed landscape is colonized.

Late-Successional / Old-Growth Forest

Much of the native mature forest is in the late-successional stage, tending to the old-growth stage in the Pacific silver fir zone. The watershed contains approximately 27,900 acres of late-successional forest of which 14,160 acres would further be described as old-growth. Late-successional forest constitutes 41% of the capable forest land in the entire watershed, and 49% of the capable forest lands within the subset of federal land (relative to the ROD guideline to maintain 15% of the late-successional and old-growth forests on federal lands within fifth field watersheds). Such stands are unique due to larger tree size, age, varied canopy structure, large snags, down wood, and species diversity. These forests are listed as a Washington State priority habitat. Old-growth and late-successional forests are also important for a wide variety of fauna and flora, many of which are threatened, endangered, or sensitive. Some of the many plant and animal species dependent on late-successional and old-growth forest include survey and manage species, fringed pinesap, neotropical birds, bald eagles, northern spotted owls, bats, and many others.

ROD Survey and Manage Species

The survey and manage protocol of the ROD is designed to benefit amphibians, mammals, brophytes, mollusks, vascular plants, fungi, lichens, and arthropods, which due to lack of information about their distribution, may not be adequately protected by the ROD's reserve network. Survey strategies have not been developed for many of these species; however, recent surveys to develop baseline information for the Little White DEMO (Subwatersheds G and LW) have discovered several of these species including *Allotropa virgata, Cladonia norvegica, Lobaria pulmonaria,* and *Buxbaumii piperi. Albetrellis flettii,* a mushroom, has been found in Subwatershed A. Two other species are suspected to occur in the watershed; *Lobaria oregana,* another mushroom, is associated with oak trees and, *Hydrotheria venosa*, is an aquatic lichen indicative of high water quality.

Riparian Areas

These areas are adjacent to standing or flowing water, and contain elements of both aquatic and terrestrial ecosystems which mutually influence each other. Riparian habitat contains structural and compositional diversity of natural vegetation. Riparian areas typically receive high use by wildlife such as breeding habitat and wildlife movement corridors. Several Washington State sensitive species of amphibians are suspected to occur in riparian areas in this watershed. Band-tailed pigeons are associated with coniferous and deciduous wetlands.

Talus

Rocky talus slopes in a forested settings are a specialized habitat for several plant and animal species such as snakes and amphibians. The Larch Mountain Salamander (state listed sensitive) is known to inhabit talus slopes adjacent to mature forest. There are also often diverse assemblages of moss and lichens, including the vascular plant Barrett's penstemon.

Winter Range

Low elevation sites, particularly on south slopes that remain relatively warm during the winter with low snow packs are utilized as winter range for deer and elk. Presence of both thermal cover and food sources in close proximity are essential. Winter range is important to overall population viability (see Threatened, Endangered, and Sensitive Animals Issue for greater details on winter range.)

South Prairie

South Prairie has a great diversity of habitats and plant communities, often visited by professional and amateur botanists. There is one main wet, open area dominated by *Sphagnum spp.*, (at least three types) surrounded by a variety of sedge-dominated wetlands. Other notable plants include pale blue-eyed grass (*Sisyrinchium sarmentosum)* and sundew (*Drosera rotundifolia*). The wetlands are kept in an early-successional condition by seasonal flooding, which can be extreme. These wetlands are noticeably drier than the adjacent bogs, influenced by Road 66 and the underlying lava flows. Surrounding the immediate open area is a mixed-conifer old-growth forest of Douglas-fir, grand fir, Pacific silver fir, western hemlock, western white pine, western redcedar, Engelmann spruce, and black cottonwood.

Cranberry Bog

A cranberry (*Vaccinium oxycoccus*) bog also occurs near the large sphagnum bog. Bogs are unusual habitats where acid-tolerating species are found. The cranberry bog is one of a few on the Forest, and has experienced a long history of human use. The vegetation and soil components of the sphagnum bog are highly prized by gardeners and are occasionally collected from the Forest for commercial uses. Sphagnum bogs are also uncommon on the Forest.

Grassy Knoll / Big Huckleberry Area

Grassy Knoll/Big Huckleberry Area is one of the favorite plant viewing areas in the Columbia Gorge as mentioned in *Wildflowers of the Columbia Gorge* (Jolley 1989) and harbors disjunct populations of species not seen elsewhere in the Gorge. Uncommon and indicator plants of note are *Arenaria capillaris, Lonicera utahensis, Silene antirrhina, Cymopterus terebinthinus, Synthris stellata, Physaria alpestris,* and *Aster glaucescens.* Grassy Knoll contains populations of certain plants at the southern and western limits of their range. Both areas are now within a Late-Successional Reserve with Grassy Knoll further designated a Botanical Special Interest Area. Two trail systems access the Grassy Knoll/Big Huckleberry area, whose open ridgetops are the largest such opening on the Forest. The ridge communities may have evolved with a consistent fire regime (accentuated by Native Americans), 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 the event that they are fire dependent.

Monte Carlo / Monte Cristo

Monte Carlo and Monte Cristo are both allocated Botanical Special Interest Areas in the Forest Plan. Monte Cristo is also being considered as a Research Natural Area in conjunction with Washington Department of Natural Resource lands to the east, and therefore is of interest to the scientific community. Uncommon and indicator plants of note are *Lonicera conjugialis, Lesquerella occidentalis, Lomatium watsonii, Ribes lacustre, Ribes lobbii, Convulvulus nyctagineus, Navarretia divaricata, Helianthella uniflora,* and *Corylanthes capitatus.* It is one of the driest areas on the Forest, receiving less than 60 inches of annual precipitation. The area supports a flora which includes many species generally found further east, and considerably enriches the Forest's species diversity. These ridge communities may have evolved with a frequent fire regime, or it is likely that exposure, thin soils, and high elevation have prevented the growth of large trees. These communities and the plants of interest need to be monitored for decline in the event that they are fire dependent.

Other Early-Successional Communities

Other early-successional communities (in addition to the Monte Cristo, Monte Carlo, Grassy Knoll) include meadow and shrub lands. Meadows of all types (dry, moist, and wet) are habitat for several unique plant and animal species. High elevation huckleberry fields were more abundant prior to fire suppression. Much of the area once occupied by berry field are now conifer forest as a result of ecological succession. The huckleberry fields have cultural significance as they have been used for possibly thousands of years. They also receive high recreational use for present-day berry picking. The mountain bluebird which is a sensitive species is associated with these open areas where snags are present.

Oklahoma Vicinity

Oklahoma Campground lies in a mix of late-successional forest, riparian moist meadows, and dry meadows. At one time, this was a homestead site and the location of a Forest Service guard station. Several sightings of sensitive species have been made here including mountain quail and rocky mountain salamander. Golden chinquapin and Oregon white oak are also present in the Oklahoma vicinity.

Sensitive Plants

The Washington Natural Heritage Program in cooperation with the Gifford Pinchot National Forest lists eight different species totaling 71 populations of sensitive plants in the watershed. In addition, intermediate bladderwort (*Utricularia intermedia*) is highly suspected to occur. These species are listed below with additional information, if known, of the processes affecting their existence, the current condition of the populations, and the significance of the occurrence. In most cases, historical data on these species do not exist. For all nine species, except fringed pinesap which has a conservation strategy, there are prominent data gaps. Not having these data 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. All other management projects are potentially deleterious to these populations of sensitive plants.

Barrett's Penstemon

Barrett's penstemon (*Penstemon barrettae*)
This species is a local endemic, restricted to the Columbia Gorge, and known from 14 populations. There is only one population of Barrett's penstemon on the Forest. It is genetically unique as it is the northernmost occurrence and the population highest in elevation. The site is an old rock pit which supports several other species of penstemon. In

1991, one of the two individuals of Barrette's penstemon which comprise this population was crushed by a falling rock. It survived, but no new individuals of this species have been seen. Penstemons tend to hybridize when in close proximity. Barrett's penstemon at this site is threatened primarily by falling rock and hybridization with other penstemons, namely *Penstemon rupicola* and *Penstemon fruticosa.*

Branching Montia

Branching montia (*Montia diffusa*)
Branching montia appears to be a fire-dependent species of moist, herb-rich forested sites. The Little White Salmon watershed houses 60% of the known populations in the state of Washington. It reaches the northern terminus of its natural range here. Several of the populations have been observed to have a marked decrease between 1988 (200+ individuals) and 1991(50 individuals) (sighting reports on file at Mt. Adams Ranger District and with the Washington State Natural Heritage Program). Threats could include canopy closure, competition from other herbs, and/or low recruitment. Seeds may persist in the soil for long periods of time. Reintroduction of fire to some of these sites would likely result in revitalization of the populations of branching montia. Information and monitoring on these sites is wanting.

Golden Chinquapin

Golden chinquapin (*Chrysolepis chrysophylla*)
This broad-leaf evergreen tree occurs in the south half of the watershed in several general locations. The most continuous group is centered at the southern end of the Big Lava Bed. More extensive, but not continuous is a number of individuals clumped and scattered in the greater Lusk Creek area. Several small and isolated occurrences are just east of South Prairie and in Willard. The vast majority these chinquapin are immature plants of seedling and sapling size. The few mature individuals are located in and around the northern section of the narrow lave tongue, north of Road 6605.

Damage to individual trees has been observed as black pustules on the leaves, and may be resulting 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 the golden hairstreak (*Habrodais grunus herri*), a rare butterfly extremely limited in its range. The only two sites of Washington's rarest butterfly are in this watershed. The first sighting for golden hairstreak in Washington was south of the Big Lava Bed (Pyle 1989) and another site was later discovered along Road 8600.130. These populations are unique and a range extension for the species. The butterfly is little known, and probably dispersed throughout chinquapin stands. In the larval stage (June to September in Washington), golden hairstreak feed only upon the new leaves of golden chinquapin and is vulnerable (Raven 1995). Potential threats to the golden hairstreak include: 1) any damage to chinquapin populations; 2) applications of herbicides or pesticides, especially BTK (*Bacillus thurigiensis kurstake*); and 3) vehicle use of roads near known populations as adults frequent roadsides and are easily injured by traffic and heavy road dust coats the larvae, chinquapin leaves, and nectar resources. In 1989, a visit to the Big Lava Bed stand (the only proven hairstreak colony) disclosed damage in the wake of a nearby, small clear-cut. Trees were broken and otherwise stressed. Nectar resources, particularly goldenrod and pearly everlasting, near chinquapin groves need to be protected also.

A conservation management strategy for golden chinquapin and the golden hairstreak is currently underway. Since the primary populations of this species of the Forest occur within this watershed, completion of this report should be funded and executed.

Clustered lady's slipper (*Cypripedium fasciculatum*)

Clustered Lady's Slipper

This rare orchid is known from two sites on the Gifford Pinchot National Forest, both of which occur in this watershed. Clustered lady's slipper ranges over seven states, and it has been listed as a rare plant in all of them. It occurs in open Douglas-fir, ponderosa pine and lodgepole pine forests in our area. For successful germination, a fungal relationship must be established with the seed. In Oregon populations, large, dead Douglas-fir snags were always present in the few populations of clustered lady's slipper that had a high recruitment of newly germinated plants. One of the only large populations of this orchid in the Pacific northwest had a partially catastrophic fire about 75-100 years ago (Kagan 1990). However, a very recent and hot fire may kill the plant, or its fungus (USDA-Forest Service et al., 1993). This plant has a poorly understood but apparent reliance on wild fire.

Pine broomrape (*Orobanche pinorum*)

Pine Broomrape

Pine broomrape is a parasite, completely dependent on its host, oceanspray. There are three locations in the watershed. A Conservation Strategy for this species on the Gifford Pinchot National Forest is underway.

Oceanspray co-exists with fire, but appears intolerant of multiple burns (McMurray 1987). Pine broomrape appears to be less tolerant of a closed canopy than is oceanspray. In the watershed, pine broomrape generally will be found on gravely, south-facing slopes that may be associated with fires.

It is not clear whether or why this species is decreasing in vigor across its range. No action is recommended until further evidence can be gathered to support a management regime. The three populations that occur in the watershed have not been revisited. Periodic visits to sensitive plant sites are always recommended.

Pale blue-eyed grass (*Sisyrinchium sarmentosum*)

Pale Blue-Eyed Grass

Until 1987, the Mt. Adams Ranger District managed all the known populations of pale blue-eyed grass. A draft conservation strategy for this species was written for the Gifford Pinchot National Forest in 1991.

Most of the populations world-wide, and the largest populations, are in and around the meadow complex at South Prairie. Although the meadows are of natural origin, they have undergone various disturbances, including grazing and some manipulation of the hydrology. Pale blue-eyed grass has co-existed with grazing for some time, but it is not known whether grazing contributes to its overall viability. Lodgepole pine appears to be encroaching upon the meadow, and may be shading-out some of the populations. The draft conservation strategy calls for continued monitoring of some of the sites. Some data have been collected and need analysis. Analysis should be done concurrently with continued data collection, and the study design should be re-assessed for suitability.

Fringed pinesap (*Pluericospora fimbriolata*)

Fringed Pinesap

There are 28 documented populations of fringed pinesap in the Little White Salmon Watershed. This species realizes its northern extremity in Washington State.

Fringed pinesap is a plant that depends on hypogeal fungi in order to obtain carbohydrates. It grows in older coniferous forests, from 100 to 1000 years old, 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). Four common ectomycorrhizal fungi have been found in association with fringed pinesap roots: *Elaphomysec muricatus, Truncocolumella citrina, Rhizopogon vinicolor,* and *Cenococcum geophilum* (Kaye et al., 1991).

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. One of those 25 acre sites is in the Little White Salmon Watershed north of Mann Butte (Section 2, T5N, R9E).

Adder's tongue

Adder's tongue (*Ophioglossum vulgatum*)
Adder's tongue is the sporophyte of a primitive fern. It has mycorrhizal roots and grows in meadows and woods. A label at the Washington State University Ownbey Herbarium states that it has been seen once in 1895 by Suksdorf in the Berry Creek tributary of the Little White Salmon River.

Intermediate Bladderwort

Intermediate bladderwort (*Utricularia intermedia*)
It is highly suspected that intermediate bladderwort occurs in the swamp area of South Prairie. Other *Utricularia* species have been spotted there, and the clear, shallow water needed for its growth exists. This carnivorous plant is an indicator of good water quality. An entire survey of the swamp is needed. Only two other populations of this plant are known on the forest.

Plant Biodiversity by Subwatershed

Of the elements diagnostic of unique plant communities within subwatersheds, the following were used: occurrence of sensitive plants, overall species diversity, occurrence of uncommon plants, occurrence of uncommon communities, and occurrence of special habitats. Each of these features were attributed a rating from 0-3, as shown in Table 3.

Table 3. Native Plant Biodiversity Index per Subwatershed (0=none, 2=medium, 3=high (after Gamon 1981)).

Subwatershed	Sensitive Plants	Overall Diversity	Uncommon Plants	Uncommon Communities	Special Habitats	Total Score
10A	0	3	1	3	3	10
10B	0	3	2	3	3	11
10C	1	2	1	3	2	9
10DS	0	1	1	3	0	5
10DW	0	2	1	3	1	7
10E	3	3	3	3	2	14
10F	1	1	1	3	2	8
10G	3	3	3	3	3	15
10H	3	3	3	3	2	14
10I	3	3	1	2	3	12
10J	1	3	3	3	3	13
10K	2	3	3	2	1	11
10LE	0	1	1	3	1	6
10P	1	1	1	2	1	6
10Q	1	1	1	2	1	6
10RE	3	3	1	2	3	12
10RW	1	2	3	3	2	11
10S	2	3	1	2	3	11
10V	0	2	1	1	1	5

Noxious Weeds

Noxious weeds are non-native, invasive plants that interfere with natural biodiversity and a number of physical and biological cycles within the watershed. Weed presence decreases water quality by influencing surface runoff and sediment yield (Brotherson and Field 1987; Lacey et al. 1989). Historically, weeds have never been as severe a problem as they are today, and without affirmative action, they will continue to increase exponentially.

Road traffic and foraging animals, especially grazing livestock, disperse weeds. Soil-disturbing management actions exacerbate the weed problem, as weeds are most prevalent in the early seral condition. Some management actions can be mitigated to lessen the likelihood of weed introduction and can be combined with eradication efforts.

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 require immediate treatment and those that need to be treated eventually. A list of noxious weeds for Skamania County and maps of the surveys are on file at Mt. Adams Ranger District.

The following noxious weeds have been documented along roadways within the Little White Salmon Watershed and are listed below per Washington State classifications:

Class A Weeds	none
Class B Weeds	Diffuse knapweed (*Centaurea diffusa*) Spotted knapweed (*Centaurea maculosa*) Oxeye daisy (*Chrysanthemum leucanthemum*) Scotch broom (*Cytisus scoparius*) Tansy ragwort (*Senecio jacobaea*)
Class C Weeds	Canada thistle (*Circium arvense*) St John's wort (*Hypericum perforatum*)

Class A weeds require immediate eradication efforts. Class B weeds require active control. Class C weeds require monitoring and project work with the eventual goal of elimination.

Projects Likely To Affect Future Condition

- Timber harvest and associated activities (slash disposal, reforestation).
- Thinning.
- White pine bough pruning.
- Special Forest Products sales.
- Grazing.
- Monte Cristo RNA establishment.
- Continued fire suppression.

Future Condition

- Reduced levels of old-growth and late-successional forest in the Matrix.
- Reduced levels of early-successional stages overall in the watershed due to less timber harvest activity than occurred prior to the ROD.
- Increased levels of old-growth and late-successional forest in the Riparian Reserves, Late-Successional Reserve, Research Natural Area (proposed), and Wilderness.
- Early-successional unique habitats may advance to later successional stages in the absence of disturbance.
- Fire suppression will continue on most lands.
- Grazing could increase by about 1,000 sheep if the Twin Buttes Allotment is re-activated.
- Douglas-fir beetle activity could increase in no-harvest allocations within the grand fir and Douglas-fir zones.
- White pine blister rust mortality should decrease as the pruning program continues.
- Laminated root disease will decrease in the Matrix as diseased areas are regenerated to resistant and immune species. The root disease will increase in no-harvest allocations.

Data Gaps

- Inadequate inventory on small (< 1 acre) wetlands. This would affect survey and manage species inventories and could reduce the amount of Matrix land available for timber harvest.
- Inadequate inventory information on successional stages, primarily plantations which have advanced from early- to mid-succession. This may affect timber inventory and hydrologic modeling (i.e. ARPs) that rely on size classes or successional stages.
- Inadequate inventory information on species presence and distribution for unique and TES plants and animals. This could affect future project locations and mitigation.

Issue: Threatened, Endangered, or Sensitive Animals

Sensitive animals are identified by the Forest Service to ensure that species do not become threatened or endangered because of Forest Service actions, while Federal listed (threatened and endangered) and proposed (candidate) animal species are identified by the USFWS due to accelerated rates of direct and indirect human-caused mortality.

Direct human-caused mortality included the over harvest of certain TES species resulting from legally-sanctioned bounties (gray wolf), trapping (Pacific fisher), and poaching.

Indirect human-caused mortality of TES species has involved ecological changes as well as habitat modification and degradation.

Ecological changes resulted from introducing competitors (sheep and cattle) and predators (bullfrogs and brook trout). This in turn has affected other organisms on which TES species depend.

Habitat Changes

Landscape modification in this watershed has involved several types of habitat changes on which TES species depend. Habitat changes inevitably benefit some species while acting against others. Forage production (early-successional forest) for deer often is at the expense of nesting/foraging habitat (late-successional forest) for northern spotted owl.

- Road construction increases human access, increases sedimentation to stream and wetland-related species like mollusks and amphibians, and increases amphibian and reptilian exposure to vehicles along migration corridors.

- Forest practices include fire suppression: this has reduced already limited and unique Oregon white oak and golden chinquapin woodlands and favored Douglas-fir trees; clear-cut harvesting and fragmentation continues to reduce interior late-successional habitat and key habitat elements such as snags (bats and birds) and coarse woody debris; timber harvest of special habitats without replacement occurred within western redcedar stands at Shingle mountain and Lost Creek; pre-1990 reforestation practices favored replanting clearcuts with predominately Douglas-fir; and herbicide use to control growth of unwanted vegetation (huckleberry and *Ceanothus*) competing with commercial tree seedlings.

- A rock claim has removed lava rock which serves as habitat for amphibians and bats within the Big Lava Bed where collapsed lava tubes contain perennial ponds.

- Dispersed recreational camping sites expanding in Forlorn Lakes impacts habitat for amphibians where potholes are scattered throughout the area.

Key Processes

Direct Human Caused Effects

Direct wildlife mortality has occurred across the landscape. Cougar, coyote and bear were the focus of efforts designed to reduce their numbers and distribution. Government sponsored bounties (shooting, trapping, poisoning), sport and subsistence hunting (legal and illegal), and traffic collision are the key forces affecting the large carnivore community. The decline in population levels of large carnivores (e.g. fisher and cougar) has likely allowed population levels of prey species such as porcupine to increase. As a function of an increased porcupine level, the potential for porcupine damage to areas with young confers is also greater. Deer and elk populations have likely also increased but the degree of change is unknown.

Bounty Based Harvest

Large carnivores such as cougar, coyote, and bear have been the focus of bounty based harvesting. These carnivores were viewed as competitors for game animals (deer and elk), a threat to livestock or agriculture, and or a threat to human safety. Regarding game animals, the basic theme was that removal of large carnivores would result in more game animals being available for people. If there was a surplus (more game animals than necessary to carry the population through the winter), then it should go to people rather than carnivorous wildlife.

Sport and Subsistence Hunting

Deer and elk hunting continues as an intensive and extensive human activity. Mostly male animals are harvested but females are also taken and most hunting occurs in close proximity to roads. Though the proportion of hunters in the human population appears to be declining, the actual number of hunters in the field is still considered high. Technological advances (vehicular access, clothing, weaponry, communication systems) have steadily increased the odds of hunter success. It is believed that a significant portion of hunting mortality is not ever accounted for. This is due to fatally wounded animals leaving the hunting site and avoiding capture.

The Little White Salmon River Watershed overlaps Washington Department of Fish and Wildlife Game Management Units 572 (Siouxon), 574 (Wind River) and 576 (White Salmon). GMU 574 contains approximately 65% of the watershed, GMU 572 approximately 30% and GMU 576 approximately 5%. Table 4 and Figures 1 and 2 summarize deer and elk harvest data (Bender 1995).

Table 4 Deer and Elk Harvest Data

YEAR	UNIT	Number of ELK	% Male	Number of DEER	% Male
1982	572 - Siouxon			35	94
1982	574 - Wind River			29	100
1982	576 - White Salmon			8	100
1983	572 - Siouxon	214	86	295	100
1983	574 - Wind River	52	42	367	83
1983	576 -White Salmon	33	55	607	96
1989	572 - Siouxon	183	75	382	91
1989	574 - Wind River	70	53	257	100
1989	576 - White Salmon	53	51	504	91
1990	572 - Siouxon				
1990	574 - Wind River				
1990	576 - White Salmon				
1991	572 - Siouxon	166	62	434	86
1991	574 - Wind River	125	69	220	97
1991	576 - White Salmon	52	56	474	88
1992	572 - Siouxon	184	68	413	85
1992	574 - Wind River	141	30	339	99
1992	576 - White Salmon	47	49	544	89
1993	572 - Siouxon	129	78	352	87
1993	574 - Wind River	58	60	139	98
1993	576 - White Salmon	65	66	285	95
1994	572 - Siouxon	156	60	345	91
1994	574 - Wind River	92	34	287	99
1994	576 - White Salmon	85	53	339	95

Figure 1 Roosevelt Elk Harvest

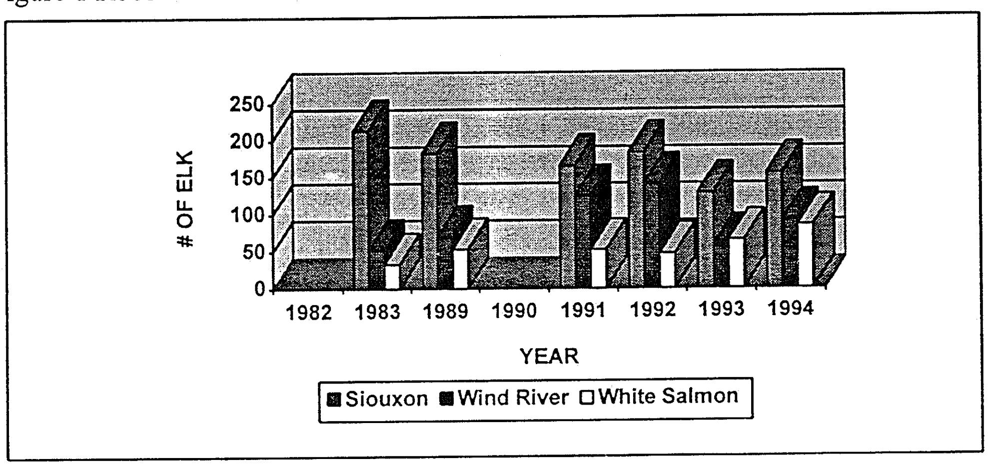
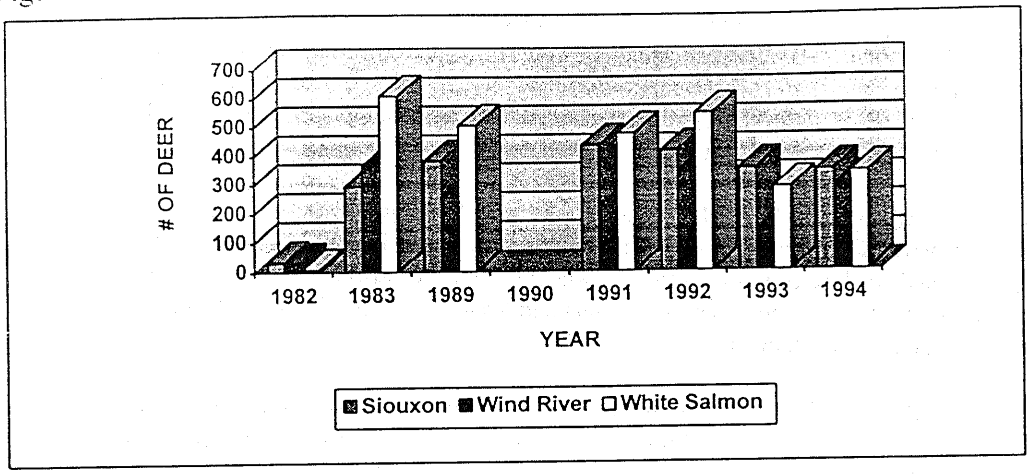


Figure 2. Black-Tailed Deer Harvest



Collision with Vehicles

Collisions between wildlife and motor vehicles most often include deer, elk, small birds, small mammals, and herptiles. The number of collisions between wildlife and motor vehicles is unknown, especially with regards to small animals. It is suspected that a large percentage of collisions involving deer and elk result in fatally injured animals leaving the collision site and not being detected as a mortality collision.

Indirect Human Caused Effects

Predator Introduction

The introduction of non-endemic species such as the bullfrog (*Bufo catesbiana*) is expected to cause a decrease in the number and distribution of some species of frog (*Rana* spp.) and salamander (Ambystomatidae family). The bullfrog's larger size, more aggressive character, and predatory behavior, tends to displace endemic species. Introduction of fish into areas where they hadn't been before, increases predation on young amphibians in particular. The species affected by bullfrog are also likely affected by the introduction of fish.

Roads

Wildlife harassment is directly associated with roads. As roads provide access into an area, wildlife experiences displacement, injury, and or loss/degradation of habitat. Displacement occurs when an animal's human proximity threshold is crossed. Proximity is in terms of physical, audio, and/or visual distances which vary by individual animal, species, and time of year. The net result, however, is generally the same. Wildlife use declines as human access increases; the reverse is also true. Injury can occur from both premeditated (i.e. hunting, trapping) and accidental avenues. Habitat loss and degradation occurs first in the roadway where complete vegetative alteration occurs then secondarily via sediment production which can detrimentally affect wetland associated species such as mollusks and amphibians. Roads can create dispersal barriers and or obstacles for small scale dispersing organisms such as amphibians. Roads can also facilitate for larger organisms such as deer and elk. Travel along roads may be less energy demanding but it also increases the odds of contact with people which most often translates into harassment of some form. Snags and down-logs tend to get removed for firewood. Roads serve as a key dispersal avenue for noxious weeds such as tansy ragwort. Invasion by noxious reduces habitat quality.

Forestry Practices

Fire suppression promotes vegetative succession towards the middle and late-successional stages. Unique habitats such as of Oregon oak and chinquapin are often associated with early successional stages. As such, these unique habitats would tend to decline with time and would do so at rates which exceed those at which they are created. Wildlife species such as western gray squirrel and the golden hairstreak butterfly would lose ground in proportion to the loss of habitat.

Large-scale, frequent, and intensive timber harvesting decreases biodiversity: tree species composition simplified, the amount and distribution of late successional forest is reduced and fragmented, decrease in snag and coarse woody debris habitat decrease, and late successional interior forest habitat (habitat fragmentation and isolation) is lost. Because this type of habitat alteration is not one that the wildlife community evolved with, some species (i.e., northern spotted owl) are in poor condition.

Extensive salvage logging in the 1970s focused on trees killed by Douglas fir bark beetle. These trees would have served as snag and down woody debris habitat. Their loss affects the snag associated wildlife community such as woodpeckers and salamanders. The numerous open skid roads also provide access for hunters and firewood cutters further reducing snag and down woody debris habitat.

Harvesting without replacement of limited habitats such as old-growth Douglas-fir forest and western redcedar pockets (Shingle Mountain and Lost Creek) reduces habitat diversity at the landscape scale and directly affects late-successional forest species such as northern spotted owl, pileated woodpecker, and flying squirrel.

Extensive herbicide spraying in the late 1960s followed by more limited manual application in the 1970s and early 1980s temporarily decreased habitat components of *Ceanothus* and *Vaccinium* shrubs. These shrub species are an important diet component of wintering deer and elk. Though herbicide application ceased in 1983, the possibility exists that wetlands and associated wildlife (e.g. salamanders) may harbor concentrations of herbicide by-products or components such as carcinogenic dioxins.

Recreation

The increase in the number of dispersed campsites in riparian areas likely reduces habitat quality for wildlife. The causative process is one whereby the amount, type and distribution of riparian vegetation is reduced while the amount and type of pollutants introduced into the area increases. Riparian habitat is an essential link between the aquatic and terrestrial habitats.

Increases in motorized winter recreation may impact wintering wildlife. Snowmobile drivers tend to follow existing trails. As such, tracks made by a limited entry guide, promotes additional snowmobile activity. Most snowmobile users are well meaning and have no intent of causing detrimental impact on wildlife. Even small scale, limited duration harassment can be lethal. Mortality can result because wintering wildlife is subsisting on a minimal maintenance diet (low nutritional value forage), may be pregnant, and/or may have carried over low fat reserves (post rut males). The duration and intensity of each winter varies making it difficult to predict how much harassment can be absorbed without resulting in mortality. Winter survivors are the core of a healthy population.

Historical Condition

Carnivore Community

Primarily as a function of available prey and less human harassment, the carnivore community is believed to have had a greater species diversity (e.g. gray wolf, wolverine, and grizzly bear) and likely more animals per species than we have today.

Late-Successional Community

The late-successional conifer forest community is believed to have had larger, and more contiguous habitat areas. Because of the connectivity of habitat and the expected higher degree of interior forest, these larger habitat areas were likely better able to support a more stable and resilient wildlife community than today. Species were likely not stacked into higher density distributions. The lesser density would be expected to contribute to greater productivity because more energy was used in direct reproduction than into territorial (inter- and intra-specific) defense. Species such as northern spotted owl, brown creeper (*Certhia americana*), and goshawk (*Accipiter gentilis*) may have existed at lesser densities than today but were better able to exchange genetic information and were better adapted to changing environmental conditions. As a portion of their landscape became unsuitable, say because of fire, the population as a whole was still able to provide individuals to re-colonize most parts of the landscape.

Early-Successional Community

The early-successional conifer forest community is expected to have acted much as the late-successional community except that different wildlife species (e.g. deer, porcupine, red tailed hawk, ground squirrel) would be involved.

Snag Community

The snag associated wildlife community would also behave as the late-successional community. More and larger snags and down woody debris is likely to have been present than today. Burned areas would produce an initial flush of snags, then would drop off dramatically as snags fell over. Snag pockets of varying sizes and stages of decay would be present across the landscape. The snag community is expected to have had more species and greater numbers than today. Because of the area's dry climate, it is possible that Williamson's *(Sphyrapicus thyroideus)* and Lewis' (*Melanerpes lewis*) woodpeckers were present in this landscape. These species are presently associated with habitats of a more frequent fire interval.

Existing Condition

Fragmentation

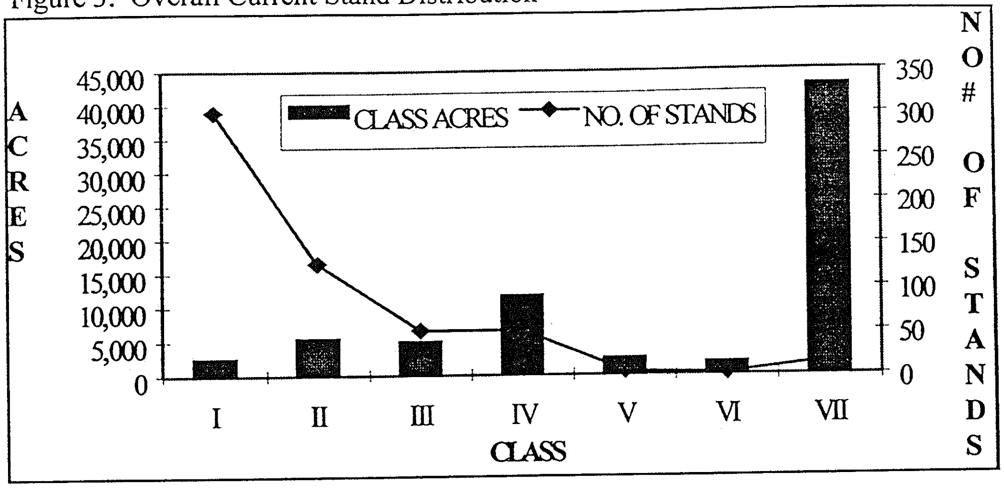
Historic landscape disturbances such as fire, wind, and insect/fungal pathogens shaped and maintained forests in variety of sizes and successional stages. Stand replacement fires in this watershed tended to create a landscape dominated in total area by discrete patches 500 to over 1000 acres in size. An entire patch or stand would be of the same age class or successional stage.

The historic disturbance regime of fire has been interrupted and timber harvest has become the dominant force affecting the landscape pattern. Dispersed setting clearcuts, the dominant forest practice from 1950 to 1990, emphasized a mosaic of evenly distributed, forty acre timber harvest areas. This practice fragmented the historical landscape that was dominated by patches large in area. It also tended to maximize edge habitat while minimizing interior habitat are dependent wildlife. Edge habitat is closely associated with hunted wildlife species, e.g. deer, elk, grouse, quail. Wildlife species more closely associated with interior habitat include such species northern spotted owl and Hammond's flycatcher. A landscape that is heavily fragmented would be expected to have a greater proportion of patches or stands 25-65 acres in size.

Stand Distribution

An attempt was made to quantify the current landscape pattern and the level of fragementation that has occurred in the watershed. Current forest patches or stands have been grouped into seven classes: I <26 ac., II 26-65 ac., III 66-125 ac., IV 126-500 ac., V 501-750 ac., VI 751-1000 ac., VII >1000 ac. Based on these divisions the total area and number of stands by stand class were plotted in order to describe the overall stand distribution (Figure 3).

Figure 3. Overall Current Stand Distribution



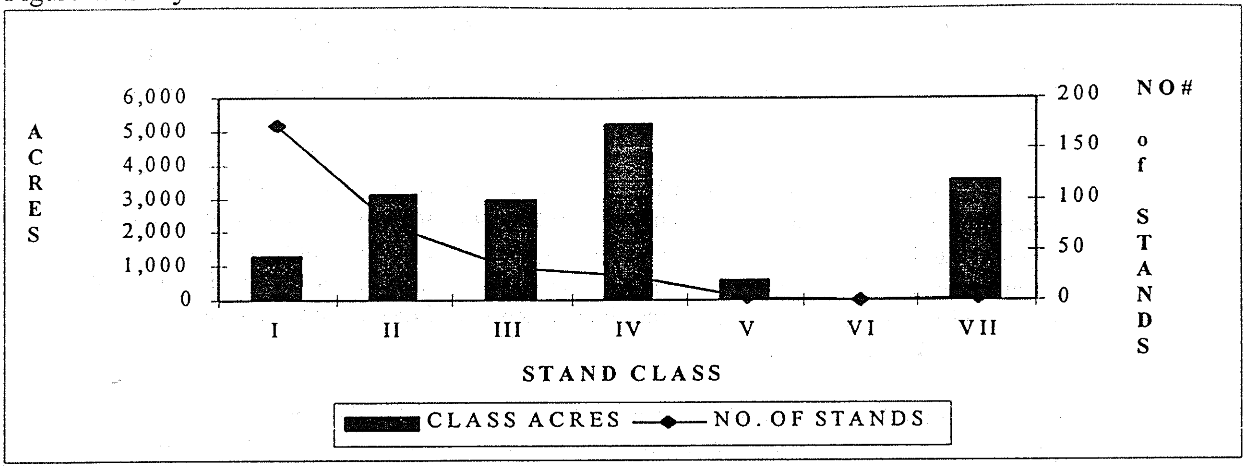
By preponderance of acreage, Class VII (>1000 ac.) stands dominate the landscape. By number of stands, Class I (<26 ac.) dominates the landscape. The historic disturbance regime is expected to have generated a similar condition: numerous small area stands and fewer large area stands. An oddity though, is the skewing of total acres (42,667 ac.) in the Class VII condition. Expected would be a more diverse distribution of total acres in more of the Classes. Fires and insect outbreaks would be expected to have caused numerous small area stands as well as fewer large area stands. Stand replacement fires of several thousand acres frequented this landscape, yet the resultant condition of greater acreage in each stand area class are not evident.

Successional Stage

The second step of the fragmentation analysis focused on fragmentation when viewed by successional stage. Of particular emphasis are the distribution of stands in the early-successional (Figure 4) and the late-successional/old-growth stages (Figure 5).

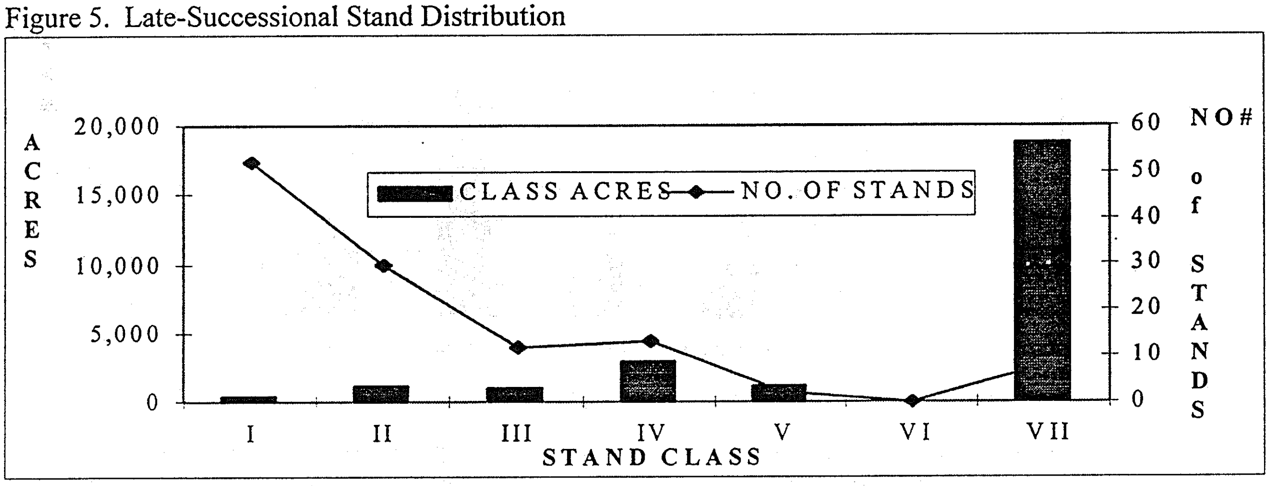
The current early-successional stand condition is one dominated in number of stands by Class I and by the lack of stands in Classes V-VII. Most of the early-successional stands are less than 65 acres (Class I and II) and are not contiguous to each other. This discontinuity/fragmentation, can be alleviated by placing new harvest areas in close proximity to the existing early-successional stands. The resultant condition would be of fewer stands but an increased acreage. Note the relative low number of stands greater than 500 acres (Class V-VII) The historic disturbance regime would likely have generated more stands in this size range.

Figure 4. Early-Successional Stand Distribution



The current late-successional (late and old-growth stages combined) stand distribution is one dominated in number of stands by small (<65 ac.) patches (see Figure 5). Dominance in total acres is in Class VII. There appears to be a relatively large number of stands that are less than 66 acres. However, these small area stands account for a small proportion of the late-successional habitat in the landscape. The vast majority of the late-successional landscape appears to be inter-connected, though the nature of the connection between stands is variable and includes narrow corridors with a limited interior habitat function (see Map I - Current Vegetation).

Figure 5. Late-Successional Stand Distribution



Late-successional interior habitat is considerably less than total late-successional habitat: 10,413 acres verses 29,340 acres. Mean stand area of interior habitat is also lower: 21 acres verses 221 acres. The number of stands is also different between interior and total habitat: 495 stands verses 118 stands. These differences reflect edge effect and an expected influence of adjacent habitat of a different successional stage. Vegetation manipulation projects can improve the interior habitat condition by not decreasing stands offering interior habitat and by accelerating the development of adjacent habitat.

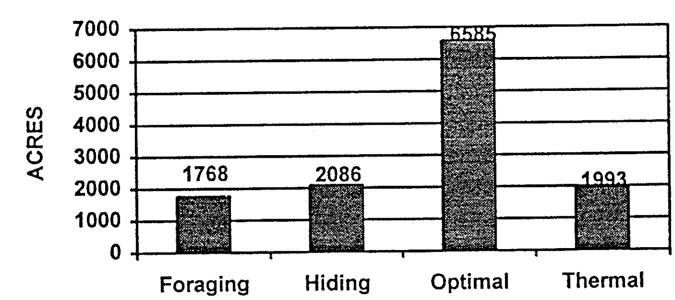
Deer and Elk Winter Range

Forest Plan allocated (6,363 acres) and additional biological (6,485 acres) winter range for elk and deer occur within the watershed. The biological winter range includes areas added as a result of analysis under this watershed analysis. Map J depicts winter range within this watershed. Forest Plan allocated winter range includes lands up to 2,200 feet in elevation on south and west facing slopes, and other areas that deer/elk use during an average winter The current late-successional (late and old-growth stages combined(USDA-FS 1990). Biological winter range includes areas these animals use during an average winter (at least 30 contiguous days of <20° F, and >12 inches snow depth for deer or 18 inches for elk) (Scharpf 1995).

Several wetlands within the watershed serve as elk calving areas. Deer tend to be more of an upland species than elk, and forested travel corridors along the ridge systems and saddles are important to their management. Increasing human winter-recreation opportunities (snowmobile outfitter guides) may pressure over-wintering elk and deer herds. Road density and effective road closures, which reduce human access and disturbance, continue to be a concern to elk and deer management.

Habitat conditions for the deer/elk winter range (Forest Plan allocated plus known winter concentration areas) indicate that forage conditions may be approaching a limiting stage. Optimal cover habitat however, does contribute forage and cover resources as does parts of the Big Lava Bed. Approximately 14% of the winter range is considered to function primarily as forage habitat, 16% hiding cover, 51% optimal cover, and 15% thermal cover. (See Figure 6)(habitat definitions per Witmer et al., 1985) Across most of the winter range, forage habitat is situated close to cover. Furthermore, cover habitat is distributed across the landscape and is sufficiently inter-connected as likely to maintain effective travel corridors.

Figure 6 Current Habitat Conditions for Deer and Elk Winter Range

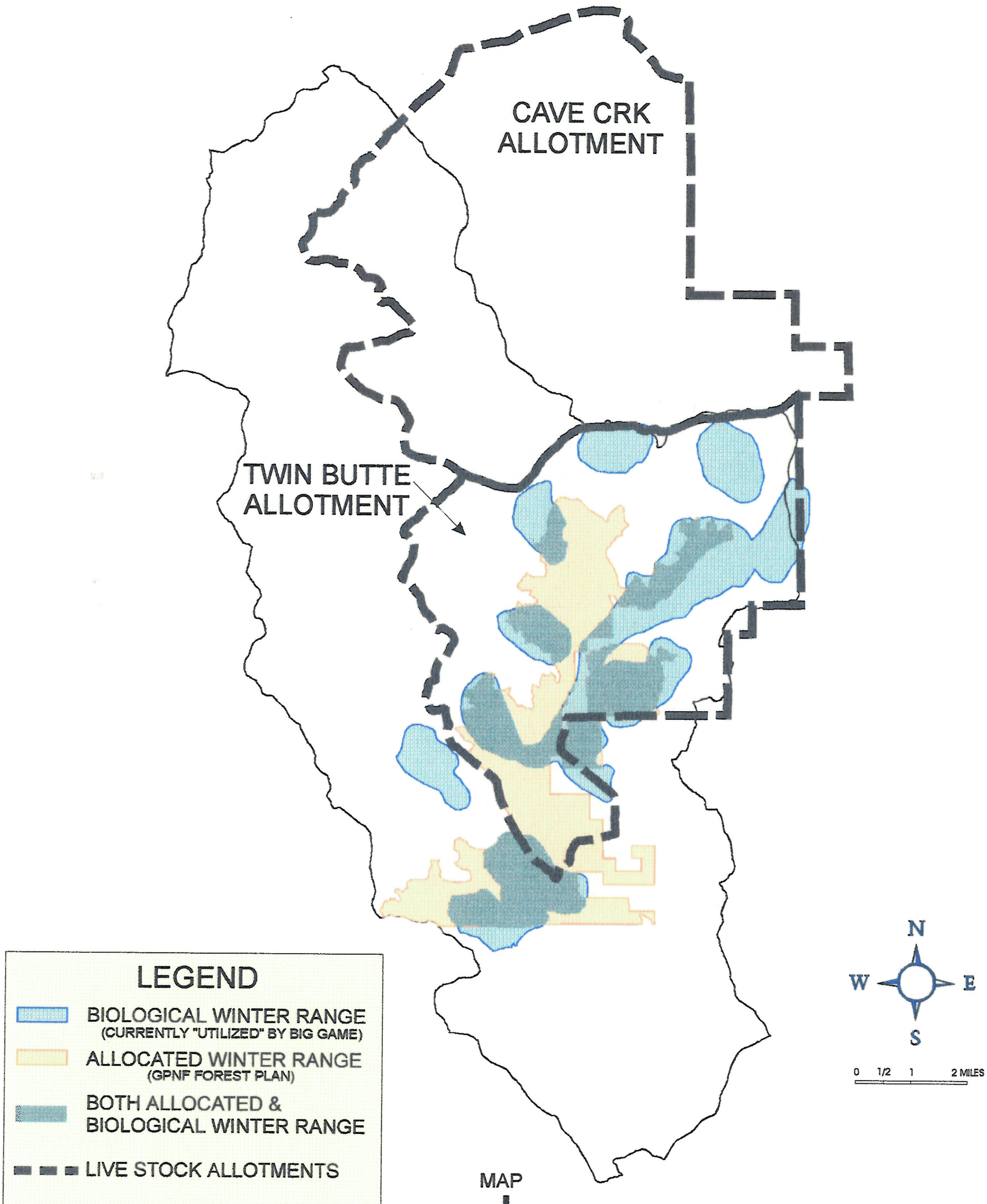


Snags

Snags are continuously coming into and going out of the population. When a high intensity fire disturbance affects the landscape, there is a sudden flush of large diameter snags which then steadily decay and fall down. The total number of snags declines for an approximate 25 year period after which snag recruitment resumes again from the latest cohort. These initial new snags are numerous but small (less than 8 inch diameter). Nine inch diameter snags tend to enter the stand at about year 50; 21 inch diameter snags start occurring at about year 85.

Snags are grouped into five stages (Neitro et al. 1985). In general, stage 1 has the most recently dead trees and stage 5 has the most decayed. Table 5 summarizes the five stages of snag development and their attributes.

BIG GAME WINTER RANGE AND LIVESTOCK RANGE ALLOTMENTS



MAP
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Table 5 Snag Stages and Attributes

STAGE:	1 (hard snag)	2 (hard snag)	3	4 (soft snag)	5 (soft snag)
Snag Attribute					
Branches Present:	All	Few large	Stubs only	Few stubs	None
Top:	Pointed	Broken	Broken	Broken	Broken
Bark 0Remaining:	100%	less	less	less	20%
Sapwood:	Hard, original color	Advanced decay, fibrous, firm to soft, light brown color	Fibrous, soft, light to reddish brown color	Cubical, soft, reddish to dark brown color	Gone
Heartwood:	Sound, hard, original color	Sound at base, incipient decay in outer edge of upper bole, hard, light to reddish brown	Incipient decay at base, advanced decay throughout upper bole, fibrous, hard to firm, reddish brown	Advanced decay at base. Sloughing from upper bole, fibrous to cubical, soft, dark reddish brown	Sloughing, cubical, soft, dark brown; or fibrous, very soft, dark reddish brown, encased in hardened shell

Stand exam data for a sample of the late-successional stands in the watershed were averaged to determine an estimate of the number, size, and condition of snags (see Table 6). The early and middle-successional stands outside of Indian Heaven Wilderness are largely devoid of large snags. Most of these stands originated following timber harvest or fires that were salvaged and then planted. Snags from the previous stand or fire would have been felled, and the current regeneration is generally too young to have recruited its own large snags.

Table 6 Estimated Snag Resource in Late-Successional Stands

TIME FRAME	SNAG TYPE	>8.9" DBH	> 20.9" DBH (subset of >8.9"DBH)
Existing snag	1-5	36	9
Future snag	1	57	17

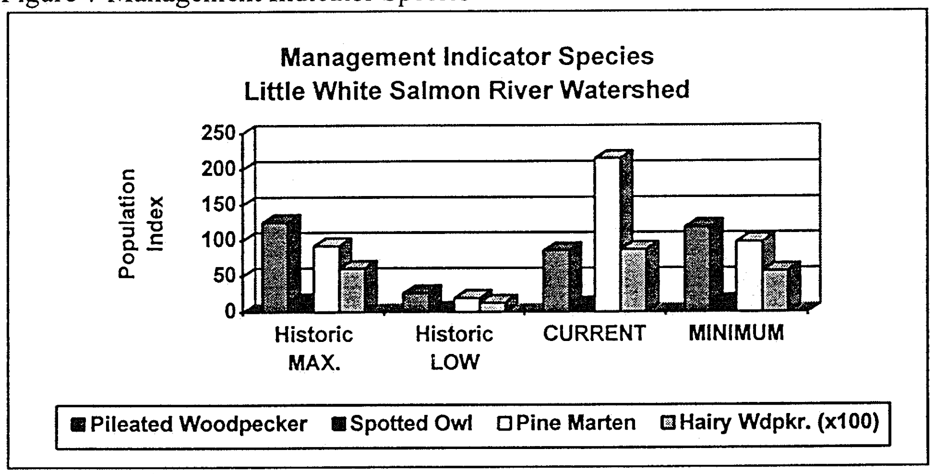
Management Indicator Species (MIS)

Pileated woodpecker, northern spotted owl, hairy woodpecker and pine marten are present across the landscape. These species are used as indicators of how their community is doing. The late-successional forest community is represented by the pileated woodpecker and northern spotted owl; the mid-successional stage by pine marten; the early-successional stage by hairy woodpecker. Table 7 and Figure 7 depict historic, existing and projected levels of the indicator species and indirectly the communities these species represent. Population levels are based on habitat capability. Historic levels are based on the REAP for the Hood-Wind Subbasin.

Table 7 Population Levels forManagement Indicator Species Based on Habitat Capability

MIS	Historic MAX.	Historic LOW	CURRENT	MINIMUM
Pileated Woodpecker	126	26	86	118
Spotted Owl	14	3	10	13
Pine Marten	92	19	215	98
Hairy Wdpkr. (x100)	60	12	87	57

Figure 7 Management Indicator Species



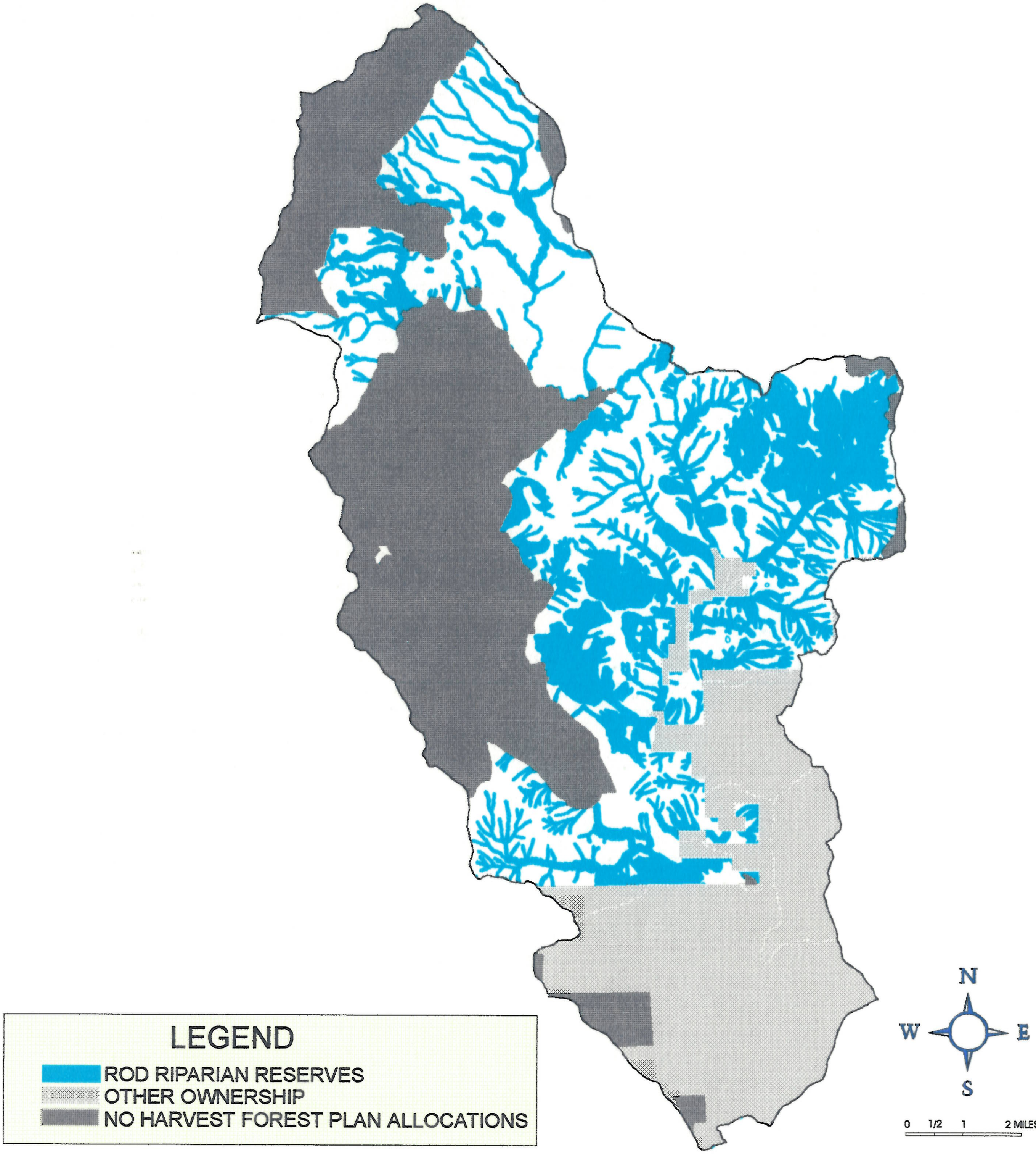
The MIS calculation suggests that the hairy woodpecker, and the community it represents, is above the historic maximum levels, and that the other three MIS are within the historic range of variability. The projected minimum level assumes that the only late-successional habitat remaining in the watershed would be the non-harvest allocations (e.g., riparian reserve, LSRs, wilderness) (see Map K). The minimum condition demonstrates that under the ROD for this watershed, wildlife community levels are likely to remain intact and within the historic range of variability.

Note that pine marten levels are projected as being greater now than in the past. The pine marten dilemma might be explained by the fact that suitable habitat includes mid-successional and late-successional forest.

It is also interesting to note that the predicted population level of spotted owls (10 pairs) based on the current habitat condition is five pairs less than is known to actually be present in the watershed. Numerous explanations may apply here:

- The MIS model may be underestimating capability.
- The actual population is at an insupportable level and might be in the process of falling sharply.
- The higher actual population reflects immigration from surrounding watersheds whose capability to support spotted owls has declined.

NO HARVEST AREAS



MAP
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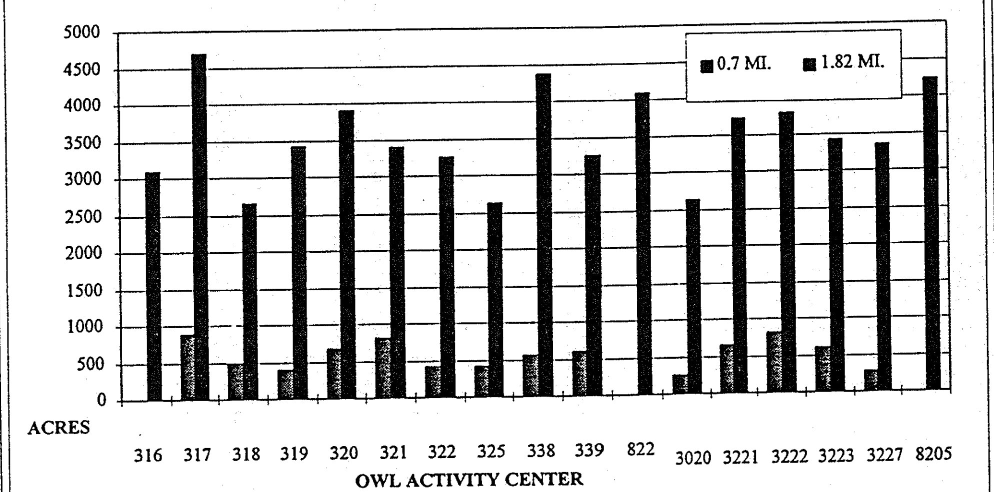
TES Species

Northern Spotted Owl

Activity Centers

Surveys for the northern spotted owl have been conducted across the watershed over the last five years. It is likely that 85% of the spotted owl sites have been located. Seventeen spotted owl activity centers are either completely or partially contained within the Little White Salmon River watershed. Six activity centers (that is, areas within 0.7 miles of observed owl activity) are at or below the incipient take threshold (that is, less than 40% of their areas are suitable for nesting, roosting, or foraging as determined by the USFWS); these are activity centers 318, 319, 322, 325, 3020, and 3227. Three of these six centers are below threshold at both the 0.7 and 1.82 mile. radius: 318, 325, 3020. The remaining centers cross the 0.7 mile threshold only. Activity centers with no habitat shown at the 0.7 mile radius are those which overlap into the watershed only at the 1.82 mi. radius.

Figure 8 Spotted Owl Habitat Levels



Dispersal/Connectivity

Dispersal/connectivity function of the watershed for the northern spotted owl was evaluated using the 50-11-40 rule (see Table 8). Eleven of the of 28 quarter-townships within this watershed do not meet the 50-11-40 condition. Of these 11 quarter townships, four have a significant portion (>35%) of National Forest land, while the others are mostly non-federal. Also note that vegetation data was largely incomplete (missing >35% of the data) on three of the quarter township which are dominated by non-federal land. Within the 11 quarter townships not meeting the 50-11-40 condition, dispersal conditions are expected to be poor and not conducive of spotted owl dispersal.

Dispersal/connectivity function was also evaluated by the system of reserves in place under the Gifford Pinchot National Forest Land and Resource Management Plan as amended by the President's Forest Plan. In particular, the network of Riparian Reserves is assumed to provide a dispersal function for spotted owls and other late-successional species. Approximately 44% of the watershed is in a federal non-harvest allocation such as Riparian Reserves, Late-Successional Reserves, and Wilderness. These non-harvest areas appear sufficiently well distributed across the landscape as to provide a high degree of potential dispersal avenues in the future (see Map J). Yet, many of the riparian corridors are currently fragmented by timber harvest. As suggested by the 50-11-40 results, current dispersal conditions would be poor in 11 of the 27 quarter townships.

Table 8 50-11-40 Condition by Quarter Township

Qtr. Twnshp	Twnshp Ac.	NFS Ac.	Percent of Twnshp: NFS	TOTAL ACRES W/VEG DATA	Percent of Twnshp W/Veg Data	NON-CAPABLE Acres	CAPABLE ACRES	ACRES MEETING 50/11/40 (subset of CAP ac.)	Percent of Capable Meeting 50-11-40
0310SW	4,270	0	0%	1,219	29%	296	923	0	0%
0310NW	5,511	0	0%	3,835	70%	212	3,623	0	0%
0410SW	5,605	0	0%	700	12%	0	700	0	0%
0309SE	3,651	234	6%	3,464	95%	703	2,761	195	7%
0309NE	5,543	2	0%	5,535	100%	519	5,016	1,410	28%
0608NE	6,149	6,149	100%	6,149	100%	988	5,161	1,861	36%
0609SW	5,754	5,754	100%	5,754	100%	25	5,729	2,353	41%
0410NW	5,651	781	14%	834	15%	69	766	339	44%
0409SE	5,635	1,882	33%	5,631	100%	76	5,555	2,561	46%
0409NE	5,894	3,932	67%	5,894	100%	70	5,824	2,748	47%
0509NE	5,547	5,548	100%	5,548	100%	131	5,417	2,611	48%
0609NW	5,757	5,757	100%	5,757	100%	64	5,693	2,828	50%
0509NW	5,556	5,556	100%	5,556	100%	453	5,103	2,571	50%
0510NW	5,709	4,188	73%	4,408	77%	23	4,170	2,220	53%
0508NW	4,835	4,835	100%	4,835	100%	127	4,708	3,054	65%
0309SW	5,014	3,866	77%	4,345	87%	732	3,613	2,403	67%
0309NW	5,692	2,717	48%	5,213	92%	653	4,560	3,074	67%
0510SW	5,900	3,990	68%	3,991	68%	73	3,918	2,682	68%
0409NW	5,943	5,943	100%	5,943	100%	1,607	4,337	3,011	69%
0509SE	5,814	5,800	100%	5,814	100%	43	5,772	4,044	70%
0608SE	6,166	6,166	100%	6,166	100%	233	5,933	4,213	71%
0508SE	6,054	6,040	100%	6,046	100%	4,096	1,950	1,464	75%
0408NE	7,000	6,984	100%	6,996	100%	2,224	4,772	3,722	78%
0409SW	5,786	5,742	99%	5,782	100%	912	4,870	3,827	79%
0608SW	4,880	4,877	100%	4,877	100%	153	4,723	3,825	81%
0408SE	5,759	5,756	100%	5,757	100%	527	5,230	4,344	83%
0508NE	6,116	6,116	100%	6,116	100%	1,841	4,275	3,567	83%
0509SW	5,797	5,797	100%	5,797	100%	2,017	3,780	3,200	85%

Grizzly Bear

No evidence of grizzly bear (*Ursus arctos*) activity in the 20th century is known. The most likely place where Wilderness (20,690 acre) and the Big Lava Bed (12,500 acre). These locations have low human presence and support grizzly bear prey. Most of the wilderness elevation is in the 4,000-5,100 feet range with normal snow accumulations of 5-7 feet. Berry fields and meadows are abundant in the wilderness. The Big Lava Bed is lower in elevation and relief (2,000-4,000 feet) than the wilderness. Snow accumulation is also considerably less in the Big Lava Bed, but the Big Lava Bed contains numerous trenches and possible lava tubes which could serve as den habitat. Vegetation on the lava bed is sparse, and is generally dominated by lodgepole pine and bear grass. Deer and elk winter range is present within this watershed. Other than the lowest reach of the Little White Salmon River, streams in this watershed are not anadromous.

Bald Eagle

Bald eagle (*Haliaetus leucocephalus)* activity was monitored by Washington Department of Fish & Wildlife during the winter of 1994. The findings indicated a strong tendency to predominantly use the lower portion of the Little White Salmon River. No nesting behavior was reported. The use period is essentially December through February. Feeding and roosting activity was focused close to the Columbia River. There are no known nest sites within the watershed. Potential use of areas beyond 2 miles of the mouth of the Little White Salmon grizzly bear's could be at least partially supported, are Indian Heaven River is considered very low. There is no record of past occurrence nor nesting of bald eagle within the watershed

Given the lack of prey and the limited availability of potential nest trees close to the anadromous portion of the river, the watershed was considered as having a low potential value for bald eagle. As such, the relationship of this watershed to the *Bald Eagle Recovery Plan* (USDI-FWS 1986) was not assessed.

Gray Wolf

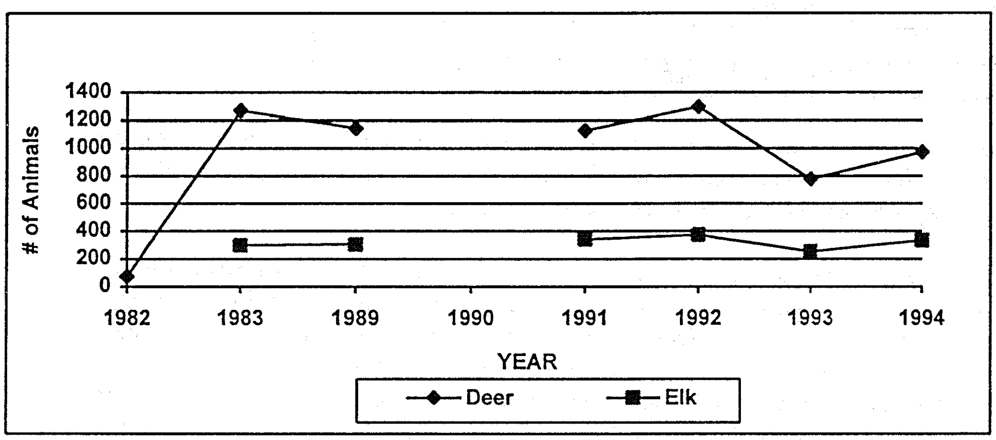
Presence and distribution of gray wolf (*Canis lupus*) was estimated by searching the Gifford Pinchot NF Wildlife Sightings database and by reviewing recent field notes that would not have been loaded into the database as yet. Nocturnal surveying for spotted owls has occurred within various parts of the watershed for last five years. No contact, audio nor visual, with wolf has occurred. No den or rendezvous sites are known for this watershed.

A 1993 sighting in the southeastern portion of the watershed (T5N R10E Sec 18) was located. The contact included audio, scat, and foot track evidence. The observer indicated that scat and tracks had been seen in the same area two weeks earlier. The observer noted that the wolf left when an airplane passed by. No records were located to indicate whether additional search efforts had been conducted.

Prey Base

Deer and elk are present year-round within the watershed. This portion of the watershed is believed to contain almost entire, if not so, home ranges (summer and winter) for several herds of deer and elk. Seasonal movement within this 10x15 square mile portion of the watershed appears to be limited to an elevation range of 1400-2200 feet in the winter, and 3000-4600 feet in the summer. The size of the deer and elk population is unknown. Harvest data in itself is not necessarily an accurate indicator of population levels but can be used as a rough gauge of what the populations might be doing. Assuming that the number of hunters and the degree of hunter access to deer/elk areas for the measurement period is about the same, then the harvest data suggest a decline in deer numbers and no-change in elk numbers.

Figure 9 Deer and Elk Harvest: GMUs 572, 574, and 576



The smaller sized prey base includes beaver (*Castor canadensis*), squirrels, rabbits, mice, voles, porcupine, and shrew. Population size for these species is unknown.

Potential for human wolf Interactions

The potential for wolf interaction with humans is estimated to be a function of road density, especially open roads. As road density increases, so does the likelihood that contact would occur between humans and wolves. Road densities in excess of two miles per square mile are considered to likely result in wildlife harassment. Most (19 out of 23) subwatersheds have greater than two miles of existing roads per square mile. Densities range from 0.2 to 4.62 miles per square mile. Open road densities was calculated for deer and elk winter range, and it varied from 0.9 to 4.6 miles per square mile. Again, most (18 out of 23) subwatersheds have densities above the 2.0 miles per square mile threshold. The following table summarizes open road densities by subwatershed.

Table 9 Open Road Densities by Subwatershed

Subwatershed	Name	Road Mi/Sq Mi
10A	Hdwtrs Goose Lk	0.91
10B	Dry Cr.	1.44
10C	Lost Cr (north)	2.39
10DE	NE Lava Bed Tribs	3.76
10DS	NW Lava Bed Tribs	4.62
10DW	Goose Lk.	2.66
10E	South Prairie	3.39
10F	Big Lava Bed	0.16
10G	Little Huckleberry	3.74
10H	W.Fk.Lusk Cr.	0.73
10I	Lusk Cr,	2.59
10J	Hdwtrs LWS R.	2.47
10K	Beetle Cr.	3.09
10LE	Homes Cr.	2.32
10LW	Berry Cr.	1.39
10M	Big Huckleberry	2.09
10P	Middle LWS R.	2.37
10Q	Timber Head	2.47
10RE	Lava Cr.	2.39
10RW	Lost Cr. (south)	3.16
10S	Moss Cr.	4.26
10V	Lapham Cr.	4.47
10W	Cabbage Cr.	2.05
10	LWS Watershed	2.27

Both Indian Heaven Wilderness and the Big Lava Bed are big enough and without roads that the potential for wolf interactions within humans is low. Both of these areas contain a prey base for gray wolf and could support an undetermined number of wolves.

Peregrine Falcon

Potential peregrine falcon (*Falco peregrinus*) eyrie sites within this watershed appear quite low. No peregrine falcon sighting records were located. Specific surveys for this species were not conducted. However, given the number of biologists to work in the watershed over the last decade, and given the falcon's appearance and behavioral traits, it seems more probable than not that a contact would have been made. The fact is that no recorded contacts have been made and potential nesting habitat appears limiting. Prey base is likely not limiting in this watershed.

Amphibians

As a function of surface water drainage patterns, it is believed that the amphibian community is divided into two portions: the northern third and the southern two-thirds. Establishment of the Big Lava Bed approximately 8,000 years ago effectively filled in a suspected north-south stream course that may have linked the surface of the entire watershed. As is, approximately a third of the watershed feeds into the Big Lava Bed, and one to two streams exit at the southern end. The lava bed is approximately 2 by 9 miles in size and has a north-south elongated orientation. Stream entry and exit points are known but their specific relationship to each other is not.

Sightings

Nine amphibian species have been documented as being present within the Little White Salmon Watershed. The Gifford Pinchot National Forest wildlife sightings database yielded 24 records of amphibian observations dating back to 1983. The following species were recorded: northwestern salamander (*Ambystoma gracile*), tailed frog (*Ascaphus truei*), western toad (Bufo boreas), Pacific giant salamander (*Dicamptodon sp*), Cascades frog (*Rana cascadae*), and Olympic salamander (*Rhyacotriton olympicus*).

Review of recent field notes, whose contents have not yet been entered into the database, yielded additional amphibian contacts for the watershed. During July 1995, approximately 30 person-hours were expended in conducting limited sampling in portions of the north fork of Berry Creek, South Prairie, and other ponds/wetlands. Cascades frog, tailed frog, Pacific giant salamander, and newt (*Taricha granulosa*) were seen at the confluence of small tributaries to the north fork of Berry Creek. Microhabitats in use included small ponds and moist areas with rocks or logs, as well as the creek itself. Sampling at South Prairie bog yielded Cascade and tailed frogs, and is believed to be excellent breeding habitat for amphibians. A rubber boa (*Charina bottae*) specimen, approximately 24" long, was collected along FS road 1800 in T5N R10E. Approximately six to ten (6-10) larval stage salamanders were observed in a pond (10'W x 20'L x 5' D) locacted in T5N, R10E, Sec 30. These salamanders are suspected of being a combination of the following species: roughskin newt, tiger salamander (*Ambystoma tigrinum*) and northwestern salamander. This pond resulted from an excavation to create an unloading/loading bench and ramp for trailer carried tractor equipment.

Because of the presence of habitat, the following species, in addition to those previously mentioned, are considered likely to be present.

Table 10 Amphibians and Reptiles Likely to be Present (not confirmed)

Cope's giant salamander	*D. ensatus*
long-toed salamander	*A. macrodactylum*
ensatina	*Ensatina eschscholtzii*
western redback salamander	*Plethodon vehiculum*
racer	*Coluber constrictor*
western terrestrial garter snake	*T. elegans*
northern alligator lizard	*Elgaria coerulea*
red-legged frog	*R. aurora*
bullfrog	*R. catesbeiana*
Van Dyke's salamander	*P. vandykei*
Larch Mt. salamander	*P. larselli*
northwestern garter snake	*Thamnophis ordinoides*
gopher snake	*Pituophis melanoleucus*
common garter snake	*T. sirtalis*
western pond turtle	*Clemmys marmorata*
western rattlesnake	*Crotalus viridis*

Projects Likely To Affect Future Condition

Timber Harvest

Timber harvest is likely the most active, by intensity and frequency, force to influence the future condition of this landscape. Harvest and replanting prescriptions can facilitate attainment and maintenance of the desired future condition by aggregating project sites to create 200-300 acre contiguous, similar successional stage stands. Replanting can provide species and stocking diversity.

Fire

Fire management can be used to maintain and or reintroduce vegetative gaps across the landscape. Fire applications include the following:

- Control the rate of conifer encroachment into meadows and oak woodlands.
- Create, maintain and or consume the snag resource.
- Create and maintain diversity into tree stocking density.
- Prevent catastrophic fires in Late Successional Reserves (LSRs) by controlling fuel and ladder buildup.
- Protect known spotted owl activity centers from stand replacement fire.

Roads

Road management can maintain a through access system for motorized traffic at less than two miles per square mile, provide non-motorized (hiking, bicycling, animal transport) roads evenly across the landscape at a two to three miles per square mile, repair high sediment yielding access routes, allow motorized access in less than fifteen percent of the deer and elk winter range, and install and maintain travel control devices

Future Condition

The future condition, in comparison to the last 75 years, of the Little White Salmon River Watershed is one with decreased timber harvest and roads. Approximately 56% of the watershed is available for programmed timber harvest. Within this 56% of the landscape is where timber harvest operations are expected to occur. Timber harvest is expected to differ from historic practices in that a greater degree of habitat retention within harvest units would occur (e.g. green tree retention, coarse woody debris, riparian habitat). Diversity within logged areas may increase because of the plantings of diverse plant species, pre-commercial thinning which favors minor species components, use of more varied tree spacing, and maintenance of existing low tree stocking microsites.

Non-harvest areas would include Riparian Reserves (a combination of adjoining aquatic, edge and upland habitats) Late Successional Reserves, green tree retention areas, Wilderness, and Research Natural Areas. Late-successional forest is expected to remain primarily in these non-harvest areas. This quantity and distribution of late-successional forest in non-harvest allocation is considered sufficient in area and connectivity to maintain the animal community composition within the historic range of variability, and may even occur at higher levels than exist today as indicated by habitat capability levels for Management Indicator Species. Within these non-harvest areas diversity in successional stages is likely dependent on use of a managed disturbance force such as fire. In the absence of disturbance, successional diversity is expected to be dominated by the later stages. Habitats such as oak woodlands and upland meadows would be lost from the landscape as conifers advanced their dominance via succession. Dispersal conditions within the four (0608NE, 0609SW, 0409NE, 0509NE) of the eleven quarter-townships not presently meeting the 50-11-40 rule are expected to improve and then remain at or above the 50-11-40 rule threshold. Federal ownership within these four quarter-townships is at least 67%.

Because of the requirement that there not be a net increase in road density within the Key portion of the watershed, road density within this part of the watershed is expected to decrease. New road construction is expected to occur only if and equivalent amount of road is removed. Because wildlife harassment is closely related to open road density, wildlife harassment is also expected to decrease. Road density within the non-Key portion is expected to remain about the same. As a result of decreasing road maintenance, traffic speed and volume are also likely to decrease. Collisions between wildlife and vehicles are considered proportional to vehicular speed and volume. As such, declines in road maintenance are expected to reduce the number of collisions between wildlife and vehicles.

Data Gaps

- Inventories of species presence, distribution, abundance, and condition (TES species, deer, elk, puma, and bear).
- Surveys within non-harvest areas which are expected to serve as biologic reserves from which to re-colonize disturbed sites and maintain population stability. Such places include Indian Heaven Wilderness and the Big Lava Bed in this watershed.
- An extensive, intensive and accurate snag habitat assessment
- Assessment of potential chemical residue (herbicide leftovers) in wetlands and inhabiting species (e.g. amphibians).
- Effectiveness of wildlife dispersal corridors. Are riparian reserves functioning as dispersal corridors?
- Is the Columbia River functioning as a dispersal barrier (OR-WA) to large home range species such as the northern spotted owl, deer, elk, cougar...?
- Validation of wildlife habitat relationships and MIS model
- Inventory and mapping of wetlands and other unique habitats that are less than one acre in size.
- Evaluation of population trends for MIS and the communities they represent.
- Need for and effectiveness of controlling noxious weeds and invading wildlife species (e.g. bullfrog and barred owl).
- Potential for the spread of disease from livestock (sheep, cattle, horses) to wildlife. It is possible that domestic animals and wildlife may be carrying impairing disease(s) and or parasites.

Issue: Basin Hydrology

Past activities, including timber harvest, road construction, and water development projects, may have altered hillslope and instream hydrologic processes in the Little White Salmon 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 roads construction. Increased peak streamflows can degrade fish habitat, water quality, and channel condition, and extreme low flows can affect water quality and water availability for fish culture. Increased peak streamflows may be of particular concern for the Little White Salmon 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 Processes

Peak Flows

Forest Cover

Most of the large peak streamflows occurring in the Little White Salmon River are associated with rain-on-snow conditions. The largest streamflow events on record have occurred during the December through February period, when snow would be present over part of the watershed. 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 wind speed and air turbulence over the snowpack. As incrementally more of the watershed is put into an open condition by either 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.

Water Routing

In addition to the effect of forest cover removal, peak streamflows can be affected by alteration of water routing in a watershed by roads 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 ephemeral, intermittent, or perennial stream 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.

Water Quality and Fish Habitat

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.

Rain-on Snow

In the Little White Salmon 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. Although rain-on-snow is not limited to this elevation zone, these are the elevations where it most commonly occurs. Because the hydrology of the Big Lava Bed has not yet been studied, it is unknown how peak streamflows are affected by it. However, because there is no apparent unobstructed channel inlet or outlet from the lava bed, it is presumed that there is at least some buffering occurring there.

Low Flows

Summertime low flows in the Little White Salmon are primarily maintained by a combination of summer precipitation, subsurface recharge, and flow from wetlands or wet meadows where moisture once retained is slowly released. Changes in summer low flows can occur in response to a number of environmental or climatic changes. During drought periods, less annual precipitation causes a reduction in subsurface recharge. Following a change in vegetative cover in the watershed, more or less water may be available for streamflow because of the change in evapotranspiration. Direct losses or extraction of water from streams and changes in the hydrology of wetlands or wet meadows which generally act to store water can also affect summer low flows. Underlying geology and subsurface water tables can also affect low flows by either contributing water or allowing water losses from streams.

Low Flow Impact

A change in summer low flows is important because water quantity is very closely tied with water quality, and 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 (or subterranean flow) stream reaches.

Historic Conditions

Peak Flows

Historically, magnitude and frequency of peak streamflows was a function of both climatic events and vegetative conditions on the watershed. Stand replacement fires, or large scale insect/disease outbreaks were the most important disturbances that affected vegetation at a large scale, and consequently would affect snow accumulation, snowmelt, and peak streamflows. In the Little White Salmon watershed, historic vegetation records indicate that a stand replacement fire covering essentially the entire watershed occurred in the early 1800's (see Fire Issue). Since that time there have been a number of smaller stand replacement fires ranging from 200-3,000 acres in size. Stand replacement-type fires in the Little White Salmon have a recurrence interval on the order of 10s to 100s of years, with sizes ranging from just a few acres to encompassing the entire watershed in the most extreme case.

Following these types of large-scale upland disturbances, rain-on-snow-driven peak streamflows would have increased, particularly when a large portion of any given watershed or subwatershed was affected by the fire. The most extreme cases would be expected to occur when the disturbance was closely followed by sequences of snow accumulation and particularly strong storm conditions.

Stream Channels

Although changes in peak streamflows could be relatively large when the entire watershed was burned, 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 stream channels historically may have been in a more stable condition, with higher levels of woody debris in the channel, and more large standing trees along streambanks. Historically, fire may have removed much of the vegetation from the watershed, but in many cases would avoid or burn less intensely in the moist 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, slowing water velocities, and contributing to in-channel structure and stability.

Low Flows

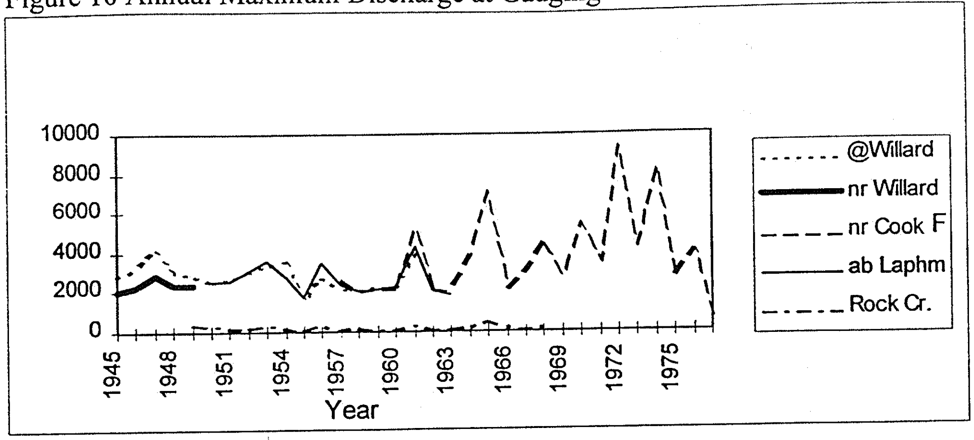
Historic variability in summer low flows occurred through differences in annual and seasonal precipitation and climatic conditions, and in response to large-scale vegetative disturbances such as fire. Following a large-scale fire, summer low flows would be expected to increase for some period, as water "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 re-colonizing the watershed. For example, dense re-colonization of the riparian area by phreatophytes could actually reduce instream flows by direct uptake of water from streamside areas. In addition to actual changes in summer flow, the effective flow from a fisheries standpoint may have been decreased following large fires or episodes of 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).

Current Condition

Peak Flows

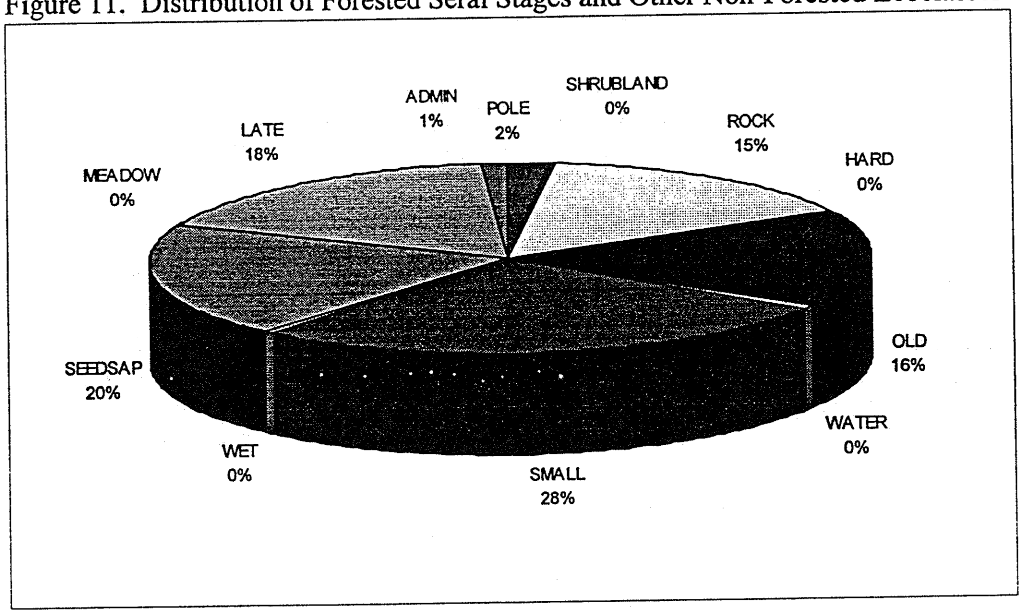
Streamflow has been measured by the U.S. Geological Survey (USGS) for a combined total of 32 years at five locations in the Little White Salmon Watershed. The longest period of record at any one of these sites is on the Little White Salmon River near Cook, Washington. This station lies just upstream of the Little White Salmon Fish Hatchery, and was operated from 1957-1977. The largest streamflow event recorded at that site occurred on January 21, 1972, and measured 9,250 cubic feet per second (cfs). Based on analysis of local streamflow records, this flood had an estimated recurrence interval of 50 years. Two years after this event, the second largest flood recorded at that site occurred on January 15, 1974 with a discharge of 8,120 cfs. These events, possibly coupled with a relatively large event in 1978 resulted in dramatic changes to some stream reaches in the watershed (see Riparian/Channel Condition Issue). Annual maximum peak flows for the period of record of all gauging stations in the Little White Salmon Watershed are plotted in Figure 10.

Figure 10 Annual Maximum Discharge at Gauging Stations 1945-1977



Since the early 1900's, the Forest Service has been involved in fire suppression, and consequently there have been no large (> 100 acre) fires in the Little White Salmon watershed since the 1930's (see Fire section of this report). During this time period, logging activities have replaced fire as the dominant disturbance element affecting basin hydrology in the watershed. Currently approximately 1/5 of the watershed is in an early-successional condition as represented by the seedling-sapling stands (Seedsap) in Figure 11.

Figure 11. Distribution of Forested Seral Stages and Other Non-Forested Ecoclasses



ARP

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 increased peak streamflows is raised. A fully hydrologically mature watershed has an ARP of 100, whereas a watershed that is fully hydrologically immature (i.e. recently clearcut) has an ARP of 0. Table 11 presents the ARP's for each of the subwatersheds and for the entire Little White Salmon Watershed.

In addition to the effect timber harvest has had on vegetation and hydrologic maturity in the watershed, road development has further increased the potential for elevated peak streamflows. Currently there is an average of 2.8 miles of (mapped) roads per square mile (Table 11). Road surveys have identified numerous roads in the watershed that are not mapped, and that are not included in these calculations of road density. Because of this, actual road densities in the watershed are generally higher that what is presented here. As road density increases, so does the drainage density of the watershed. An increase in drainage density effectively reduces the time it takes water to move from hillsplopes into stream channels, which can affect both the timing and magnitude of peak streamflows.

Table 11. Subwatershed Aggregate Recovery Percentage (ARP) and Road Density.

Subwatershed	Name	Acres	ARP	Road Miles	Road mi/sq mi
10A	Hdwtrs Goose Lk	3069	95	4.8	1.0
10B	Dry Cr.	4568	86	13.2	1.9
10C	Lost Cr (north)	7559	67	34.0	2.9
10DE	NE Lava Bed Tribs	1408	83	9.0	4.1
10DS	NW Lava Bed Tribs	723	66	5.9	5.2
10DW	Goose Lk.	1435	92	6.6	2.9
10E	South Prairie	2856	76	16.1	3.7
10F	Big Lava Bed	12807	100	3.4	0.2
10G	Little Huckleberry	2162	75	14.7	4.4
10H	W.Fk.Lusk Cr.	1942	87	3.4	1.1
10I	Lusk Cr,	3695	79	17.5	3.1
10J	Hdwtrs LWS R.	3224	79	14.4	2.9
10K	Beetle Cr.	3796	66	23.9	4.0
10LE	Homes Cr.	1333	56	6.8	3.3
10LW	Berry Cr.	2129	78	7.2	2.1
10M	Big Huckleberry	4470	78	18.7	2.7
10P	Middle LWS R.	2515	75	13.5	3.5
10Q	Timber Head	3733	74	15.6	2.7
10RE	Lava Cr.	2481	92	9.8	2.6
10RW	Lost Cr. (south)	2722	87	13.7	3.2
10S	Moss Cr.	13469	79	92.6	4.4
10V	Lapham Cr.	2151	67	15.2	4.6
10W	Cabbage Cr.	2216	66	11.8	3.4
10	LWS Watershed	86462	81	372.0	2.8

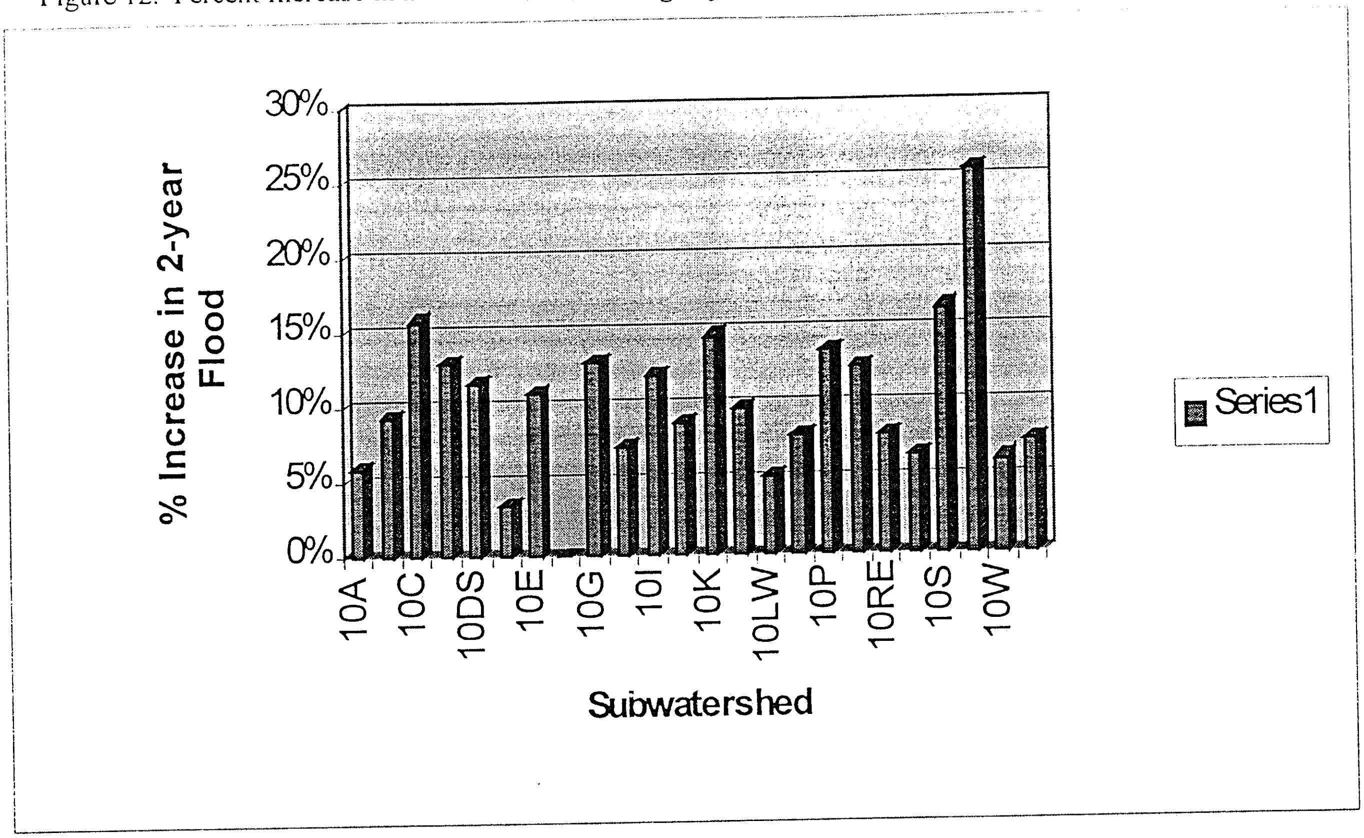
Peak Flows

Potential changes in peak streamflows based on vegetative seral conditions in the watershed were modeled using the State of Washington's hydrologic change module. The model calculates differences in predicted peak flows 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.

Predicted Flows

The model was run for each subwatershed and for the entire Little White Salmon Watershed. Peak flows were calculated for the 2-year, 5-year, and 50-year streamflow events, under both "average" and "enhanced" storm conditions ("enhanced" conditions are when air temperatures and windspeeds are increased an increment above presumed "average" conditions). Predicted streamflows under current conditions are compared against those predicted under fully forested conditions to show the change in predicted peak streamflows up to the present time. Figure 10 compares predicted flow increases under current vegetative conditions for the enhanced storm conditions during a 2-year event. Enhanced conditions are used because it was found through comparison with locally collected data that these conditions are more reflective of actual winter storm conditions in the Little White Salmon Watershed.

Figure 12. Percent Increase in 2-Year Flood Discharge by Subwatershed



Subwatersheds C, DE, DS, E, G, I, K, P, Q,, S, and V predicted peak flows exceed 10%

Under enhanced weather conditions, predicted peak flow increases with current vegetative conditions range from 0% in the lava beds to 26% in Lapham Creek. Much of the Lapham Creek subwatershed is on private land, so vegetative data there is only estimated from air photos and limited ground truthing. Peak flows for the entire Little White Salmon Watershed are predicted to have increased 8% under current conditions using this model. Increases of less than 10% are considered insignificant when using this model because they are less than the expected error associated with the modeling method and with making field streamflow measurements (Washington Depatment of Natural Resources). Predicted increases of greater than 10% were found for subwatersheds C, DE, DS, E, G, I, K, P, Q, S, and V. An additional level of analysis is required on these subwatersheds to assess actual effects of peak flow increases.

Low Flows

Summer low flows have been measured at a number of different locations and over different time periods in the watershed by the Forest Service and USGS. Over the time periods monitored, there has been an extremely wide range of low flow conditions. From 1945-1949, the USGS operated a gauging station on the Little White Salmon near Willard, and recorded low flows as low as 11 cubic feet per second (cfs) in September of 1947. Forest Service monitoring of the Little White Salmon (above Lava Creek), and of Lava Creek occurred from the mid 1970s through the present, though data collection has been somewhat sporadic over the years. Lowest of the annual minimum flows recorded during the 1980s ranged from 23 cfs to 113 cfs on the Little White Salmon above Lava Creek. Lowest flows on Lava Creek ranged from 42 cfs in 1984 to less than one cfs in 1987. Since 1987, there have been no discharge measurements made on the Little White Salmon River.

Low Flow Predictability Difficult

The limited data that has been collected on summer low flows in the Little White Salmon Watershed highlights the wide variability in minimum annual low flow conditions. Changes or trends in low flow would be extremely difficult to detect with the wide range of background conditions, and the number of factors influencing summer low flows. However, it is presumed that summer flows are lower now than under historic conditions due to water diversion or extraction from streams and springs in the watershed. Table 12 shows the existing consumptive water rights out for the Little White Salmon River and tributary streams (as of August, 1995). It is unknown how many of these rights are active and how many are withdrawing the full amount of the water right at this time. The Washington Department of Ecology is now preparing a publication listing the current surface and subsurface water rights and projected future water use needs for the Little White Salmon River and Wind River Watersheds. Minimum instream flows for the Little White Salmon River were not available at the time of this report. There has been no known monitoring done to assess the effects of these water uses on low flow or on fish habitat during low flow conditions in the watershed.

Table 12. Summary of Water Rights for Consumptive Uses in the Little White Salmon Watershed, 1995.

Tributary Source or Stream	Instantaneous* Flow (cfs)
Berry Cr.	2.02
Bunker Cr.	5.29
Dry Cr.	50
Hows Cr.	6
Lapham Cr.	0.2
Lost Cr. (north)	5.0
Little White Salmon R.	160.5
Moss Cr.	15.66
Moss Cr. Springs	1.5
Rock Cr.	6.35
Rock Cr. Unn. Springs	0.35
Spencer Cr.	0.21
Squaw Cr.	0.61
Unn. Cr. Rock Cr.	0.12
Unn. Spring Berry Cr.	0.2
Unn. Spring Little White Salmon R.	1.83
Unn. Spring Whiskey Cr.	0.06
Unn. Spring Lapham Cr.	1.24
Whiskey Spring	0.06
Total for Watershed (cfs)	252.2

*Some of these rights also have and annual maximum established

In addition to the water withdrawals described above, there may be some water lost from the watershed through eastward dipping geologic features that may be routing subsurface water out of the watershed. It is because of this potential that the City of White Salmon has extended their municipal watershed boundary from the Buck Creek Watershed over the topographic watershed divide between Monte Carlo and Timber Head and into the Little White Salmon Watershed (see Map C). The municipal watershed line, as now proposed, includes several square miles of the Little White Salmon Watershed along the eastern watershed divide.

Projects Likely To Affect Future Condition

- Timber harvest.
- Plantation thinning.
- Road construction.
- Road decommissioning.
- Additional water rights granted.

Future Condition

- Young conifer stands throughout the watershed will continue to develop toward hydrologic maturity.
- Hydrologically mature stands in matrix lands will continue to be harvested.
- Net result of the above two processes will move some subwatersheds more toward hydrologic maturity, and some toward more hydrologically immature conditions.
- Road decommissioning in the Key portion of the watershed will help restore hydrologic function of the hillslopes there.
- Peak streamflows may be increased in subwatersheds with timber available to harvest, and decreased in those that are dominated by young stands or are otherwise unavailable for timber harvest.
- Low flows may slowly be reduced over time in the lower watershed as more people move into the watershed, and domestic water use is increased.

Data Gaps

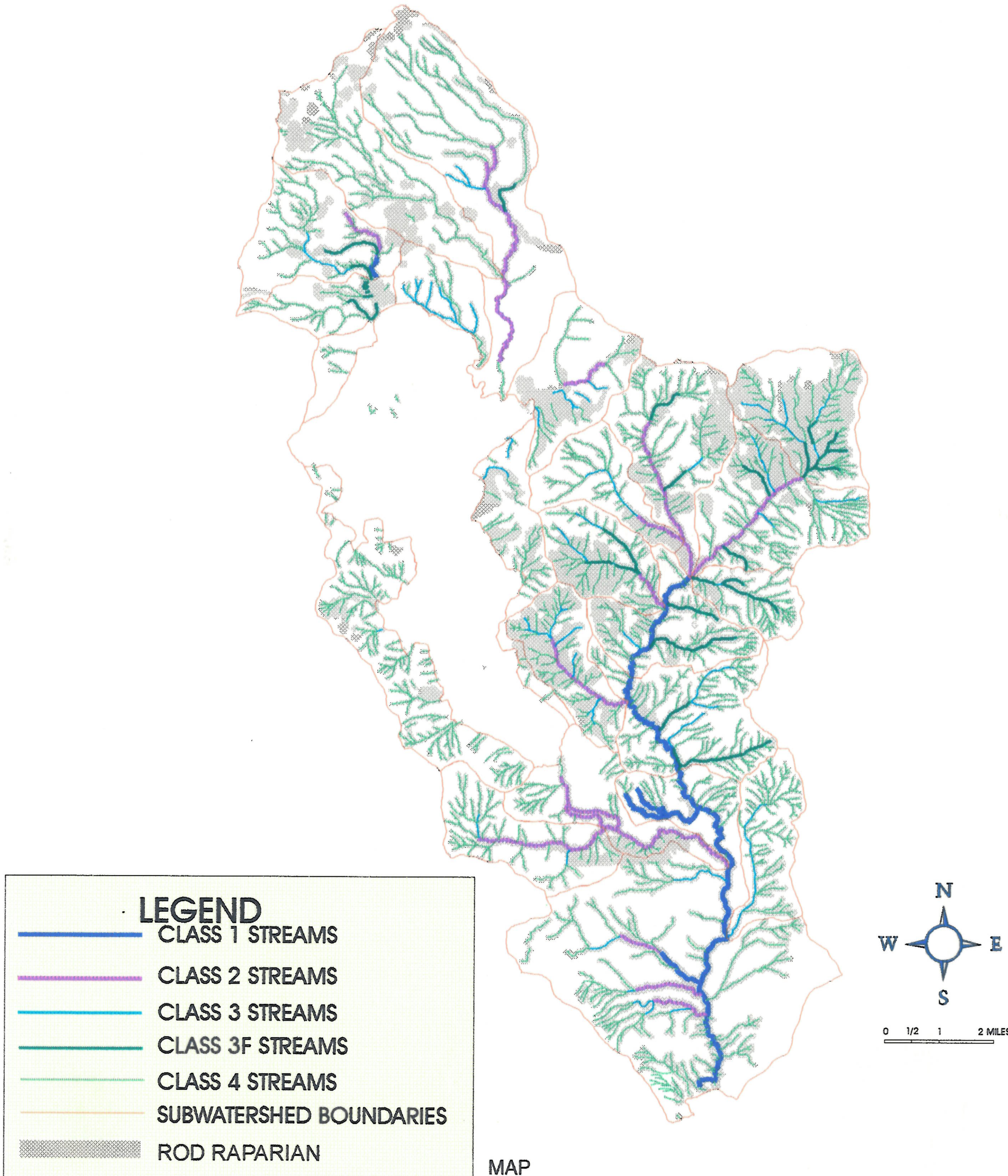
- Climatic and streamflow data: Needed at subwatershed levels to detect changes in peak and low streamflows and validate models.
- Additional stream surveys: Needed to assess instream conditions.
- Water routing through Big Lava Bed: Needed to assess the effects of the lava bed on water quality, and peak flows.
- Rate and process of water movement through eastward dipping geologic beds: Needed to determine the extent to which water moves from the Little White Salmon Watershed into the Buck Creek Watershed, and to help assess the potential for land use activities in the Little White to affect water quality, quantity or timing of flows in the Buck Creek municipal watershed.
- Amount and timing of water withdrawals: Needed to assess effects of water development on instream flows.

Issue: Riparian/Channel Condition

Key Processes

Channel conditions are a reflection of the type of channel, conditions within the riparian area, and upslope condition of the watershed (see Map L - Streams and Riparian Reserves). 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.

STREAMS AND RIPARIAN RESERVES



MAP L

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.

Channel Gradients

Channel gradients are a primary element used in channel typing, and a key factor in assessing channel response to disturbance such as high flows, bank disturbance, and riparian vegetation removal. Higher gradient channels can be sediment source areas, as well as having a great capacity for transporting delivered sediment to downstream reaches. Primary disturbance processes in these channels include avalanches, debris torrents, and other mass wasting. Lower gradient channels are generally bounded by material that has been deposited over time by the stream. This alluvial material is much less resistant to erosion and bank cutting than the large boulder and bedrock reaches that are more common upstream, and thus movement of the channel, or changes in channel geometry can occur more frequently in these low gradient channel types. Without the large rock component in the channel bed and banks, these systems rely heavily on streamside vegetation for channel stability. Because these stream reaches are lower energy areas, recovery from disturbance can take very long periods of time.

Historic Condition

Historic riparian and channel conditions can generally be indexed to large-scale upland disturbances or to local disturbance in the riparian area. Because of the relatively stable nature of the Little White Salmon Watershed with respect to mass wasting (see Mass Wasting Issue), fire and flooding were probably the largest factors affecting channel condition and channel change over time. Large-scale fire indirectly affected channel conditions by reducing forest cover and thus influencing peak streamflows (see Basin Hydrology Issue), but also had a direct effect on conditions in the riparian area when it burned riparian vegetation. Flooding clearly plays an important role in channel condition, but may play an even larger role when floods are enhanced (i.e. following large scale vegetative removal) and when riparian vegetation has been removed or reduced. It is when the occurrence of upslope disturbance is complemented by disturbance to the riparian areas when stream systems are most likely to be affected. This is particularly true when these disturbance processes are followed by major climatic events.

Woody Debris

While potentially removing much or all of the forest cover from a relatively large area, fires often affect riparian areas to a lesser degree because of the higher moisture regimes and relative vigor of the riparian vegetation. Subsequent to large-scale or intense fires, woody debris and sediment inputs to the stream system were increased. Scorched or exposed trees in riparian areas were blown over or fell into the stream. Woody debris recruited into stream channels in this way, along with the large wood that had previously been in the channels played an important role in stabilizing the channel during subsequent high streamflow events. Large wood in the system would have helped armor streambanks, reduce stream velocities, and provide locations for intermediate sediment storage throughout the channel network. Additionally, unburned green trees in the riparian area maintained their root systems which are critical elements in maintaining stable streambanks in some channel types.

Riparian Vegetation

The REAP identified a range of natural conditions for early and late-successional vegetation in the riparian area. At any given time over history, REAP estimated that 5-30% of riparian areas in watersheds in the Hood-Wind Subbasin would have been comprised of early-successional vegetation. Similarly, 23-92% of the riparian area at any given time would have been dominated by late-successional vegetation.

Current Condition

From the late 1800s to the present, fire has been replaced by timber harvest and associated activities as the dominant disturbance process affecting riparian conditions in the Little White Salmon Watershed. Past harvest practices allowed for timber harvest along streams, and road construction which often followed stream systems and required felling of additional trees in the riparian area. In addition, fisheries biologists of the time considered woody debris in the stream channel as impediments to fish passage, and required logging operations on Forest lands to remove woody debris from streams. The combination of these practices resulted in the conversion of many riparian areas to early-successional conditions, and the loss of large standing and down conifers in the riparian area and stream channel.

Grazing

Livestock grazing has been introduced over the past 100 or more years in the watershed as well (see grazing discussion under the Biodiversity Issue). Livestock use of this watershed has primarily been by sheep and a lessor number of cattle. Under prolonged or concentrated livestock use, direct effects of grazing animals on riparian conditions can include physical trampling and breaking down of channel banks, degradation of water quality, and changes in riparian vegetative structure, density and composition. In extreme cases, or in sensitive channel types such as those flowing through meadow systems (e.g. Rosgen E type channels), major changes in channel morphology can result. Stream downcutting and gully formation in these situations can lead to lowering of subsurface water levels, and consequently alter vegetative conditions in the meadow. Some channel types present in the Little White Salmon Watershed would be sensitive to this type of disturbance, but present levels of livestock use are generally not high in the watershed.

Riparian Vegetation

Currently, 21 percent of the riparian area in the Little White Salmon Watershed is in an early-successional condition. Table 13 shows the percent of the riparian area in each subwatershed in an early-successional condition. The values that are shaded fall outside of the historic range of natural condition. Because of the lack of fire over the recent past, the amount of riparian area in an early-successional condition is an indication of the degree of timber harvest that has recently (last 30 years) occurred in the riparian zone. In systems where there is a high percent of the riparian area in an early-successional condition, channel stability may be reduced by a lack of well established root systems of large conifers, and overall condition of the riparian reserve may be somewhat lower than desired. This is particularly true where early-successional conditions are along channel types that rely heavily on tree root systems for their bank stability. Depending on the age of these stands, there may also be a correlation with the amount of large woody debris in streams in those areas, since in previous decades, timber harvest contracts would have included provisions for stream clean-out of woody debris in streams flowing through or along the edge of harvest units.

Table 13 Percent of the Riparian area in Early and Late Seral Condition

Subwatershed	Name	% Riparian Early-Seral *	% Riparian Late-Seral **
10A	Hdwtrs Goose Lk	3	8
10B	Dry Cr.	26	2
10C	Lost Cr (north)	34	1
10DE	NE Lava Bed Tribs	24	0
10DS	NW Lava Bed Tribs	49	4
10DW	Goose Lk.	6	45
10E	South Prairie	21	50
10F	Big Lava Bed	2	28
10G	Little Huckleberry	31	22
10H	W.Fk.Lusk Cr.	23	59
10I	Lusk Cr,	25	26
10J	Hdwtrs LWS R.	15	18
10K	Beetle Cr.	29	10
10LE	Homes Cr.	28	20
10LW	Berry Cr.	36	26
10M	Big Huckleberry	27	15
10P	Middle LWS R.	23	32
10Q	Timber Head	12	18
10RE	Lava Cr.	3	24
10RW	Lost Cr. (south)	14	38
10S	Moss Cr.	13	11
10V	Lapham Cr.	36	24
10W	Cabbage Cr.	44	52
10	LWS Watershed	21	20

* Shaded values fall outside the Range of Natural Conditions for the Hood-Wind Subbasin (5-30%)

** Shaded values fall outside the Range of Natural Conditions for the Hood-Wind Subbasin (23-92%)

Approximately 20 percent of the riparian reserves in the watershed are in a late-successional condition. Table 13 shows percent of the riparian area in each subwatershed in late-succession compared with the historic range of natural condition for the Hood-Wind Subbasin. Values highlighted are those that fall outside of the historic range of natural. Percent of the riparian reserve in late-successional condition provides an indication of the amount of the riparian area where there are large, well established root systems, and a high degree of large woody debris recruitment potential. These areas may also have a relatively large amount of instream large woody debris, because there has been no stream clean-out done there, and because there has been a continued source for recruitment of large wood along the channel. At a very coarse level, subwatersheds with a high percent of late-successional vegetation in the riparian area would suggest a lower potential for channel stability concerns.

Stream Channels

Stream channels in the Little White Salmon Watershed were classified using the Rosgen stream typing system (see Map M). A primary factor in stratifying the stream types is gradient. Most of the tributary streams to the upper Little White Salmon River have very steep upper reaches, and low gradient lower reaches as they approach the mainstem of the Little White Salmon. Stream channels in the northwestern (non-Key) part of this watershed, those that ultimately drain to the lava bed, generally show less variation in their gradient from headwaters to mouth. Topographic relief throughout this part of the watershed is less dramatic than that in the upper mainstem of the Little White Salmon River.

The mainstem of the Little White Salmon River begins in steep terrain at its headwaters, then flows through very low gradient reaches along the valley bottom to Willard. From Willard to the mouth at Drano Lake, the gradient again increases as the stream drops into a steep-walled canyon. Sediment produced in the steep headwaters of the Little White Salmon River and its tributaries is rapidly transported to the low gradient reaches above Willard. Because there is relatively less stream power in these low gradient reaches, sediment from upstream is deposited and stored along the channel here. Once in this part of the system, it can take many years for sediment to be routed through to the lower channel. Because the stream is flowing through alluvial deposits in these lower gradient reaches, much of the channel stability throughout this segment is provided by the riparian vegetation growing along the banks.

Stream Widening and Bar Development

Air photo analysis was used to identify major changes in stream channels in the watershed over the past 30 years. Because time and air photos were limited, only a limited number of reaches were considered in this analysis. A number of stream segments showed stream widening and bar development over the first two decades analyzed. Many of these showed positive vegetative recovery during the last decade, or did not change. Most of the large changes in stream channels occurred between the late 1960s and late 1970s. During and prior to this period, a number of riparian areas on the mainstem of the Little White Salmon River and on tributaries had been harvested without any buffers. Harvested reaches generally showed the greatest response in terms of widening and straightening of the stream channel, in contrast to those streams that retained a large intact conifer component in the riparian area, which generally showed little or no change over time.

Lusk Creek

The channel changes seen in Lusk Creek were probably the most dramatic in the watershed, and can be used to illustrate some of the changes occurring in other similar stream reaches. In the 1960s, reaches in the lower mainstem and South Fork were clearcut, leaving no riparian buffer. Following large flood events of the early 1970s, harvested reaches in lower Lusk Creek changed substantially. The channel more than doubled its width during this time period, and straightened significantly. Between 1979 and 1989, vegetation quickly recovered along the harvested reaches, providing excellent shade by 1989. However, recovery of this reach in terms of regaining its former morphology and meander pattern may take considerably longer. In addition, the changes occurring in this stream also impacted the mainstem of the Little White Salmon River by increasing sediment loading in reaches below the Lusk Creek confluence.

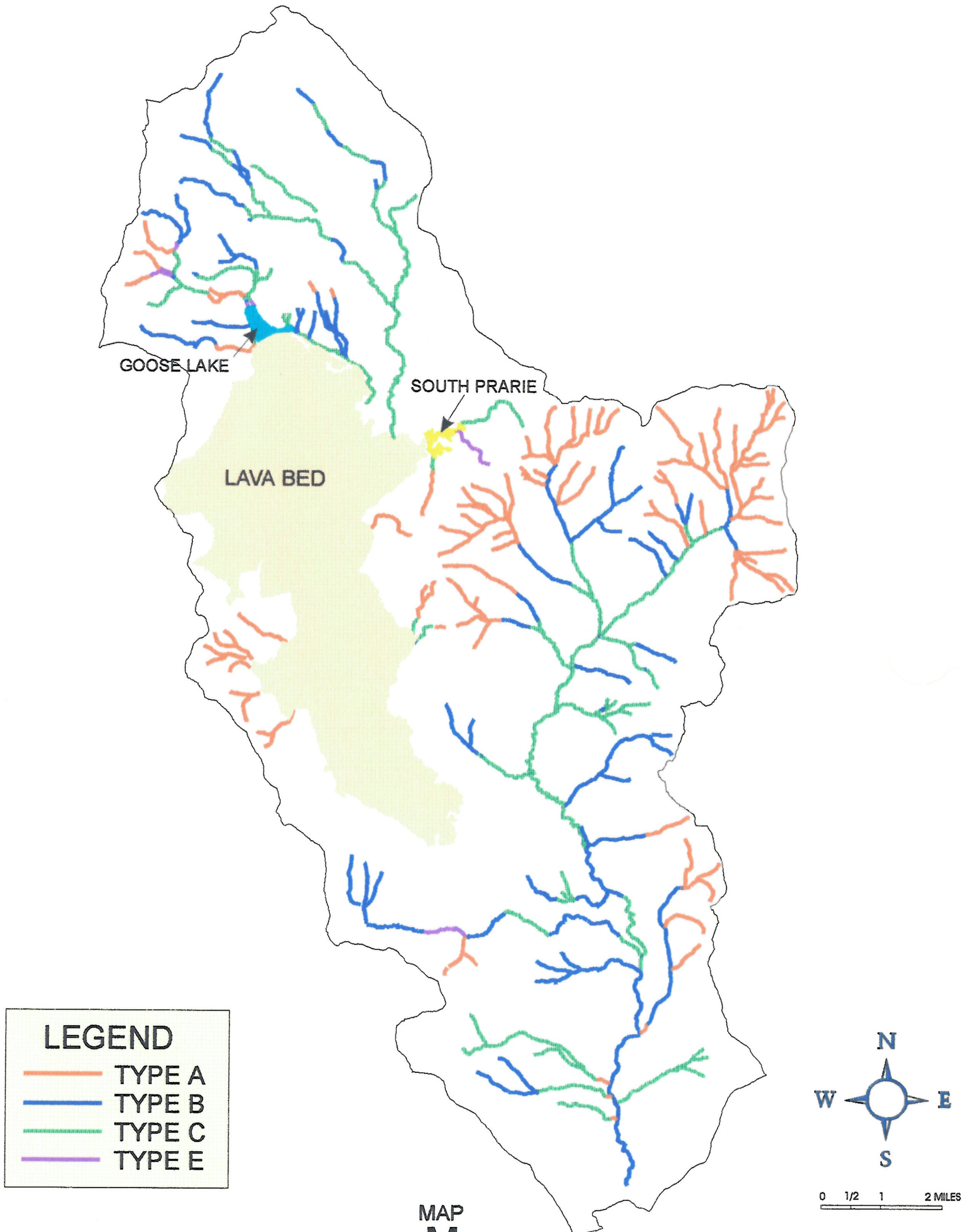
Other Widening

Other streams which showed channel widening or accelerated bar development during the time period analyzed include Berry Creek, Lost Creek (north), the upper mainstem of the Little White Salmon River below Beetle Creek, the middle reaches of the mainstem near the Lusk Creek confluence, the mainstem below the Berry Creek confluence, and particularly below the southernmost crossing of the Forest Road 18 on the mainstem. Results of this limited analysis are insufficient to differentiate or partition effects between those created by timber harvest on channel stability or peak flows, and those that would occur naturally in response to large peak streamflows without the changes in riparian and upland conditions created by timber harvest. It is clear however, that the greatest responses were seen in Rosgen C type channels that were in areas of past timber harvest, and following some of the larger streamflow events.

Projects Likely To Affect Future Condition

- Riparian restoration projects.
- Off-Forest riparian timber harvest, road construction or development.
- Upstream harvest in subwatersheds with potential for increased peak streamflows and C type channels (currently Subwatersheds K and Q).
- Increased grazing in riparian areas.

ROSGEN CHANNEL TYPES



MAP
M

Future Condition

- Stream channels will continue to re-stabilize as riparian vegetation develops.
- Elevated peak streamflows will retard channel re-stabilization processes in some subwatersheds.
- Sediment deposits in the mainstem of the Little White Salmon River will slowly be routed through the system or stabilized in revegatated streambanks.
- The mainstem of the Little White Salmon River will very slowly regain some of its natural meander pattern.
- Stream channels off Forest land may continue to be destabilized by harvest or other activities.

Data Gaps

- Field verification of channel types: Needed to validate interpretations and recommendations.
- Field assessment of current channel conditions: Needed to help determine rates of recovery.

Issue: Water Quality

The 1994 President's Forest Plan identified much of the Little White Salmon Watershed as a Tier II Key Watershed. Tier II Key Watersheds are those watersheds that are important sources of high quality water, though they may not contain at-risk fish stocks. Water quality in the Little White Salmon Watershed is important for instream fisheries, fish hatchery operations, domestic water use, and for aesthetic values along the streams and lakes of the watershed. Although water quality in the Little White Salmon River is considered good, two Federal fish hatcheries at the lower end of the watershed have documented severe problems with sedimentation at the hatchery during high flows events in the past.

Key Processes

All streams and lakes within the Little White Salmon Watershed are rated by the Washington State Department of Ecology as either Class AA (extraordinary), Class A (excellent), or Lake Class. All streams on the National Forest are rated as Class AA, as are all streams that feed lakes within the watershed. Streams and segments of streams below the National Forest boundary are rated as Class A. Specific water quality criteria are established for each of these classes in conformance with the present and potential uses of the water, and for the purpose of maintaining beneficial uses supported by those waters. Criteria of primary interest in forested watersheds such as the Little White Salmon are for water temperature, turbidity, fecal coliform and pH.

Water Temperature

Maximum water temperatures in forested streams are primarily influenced by shade (or lack thereof), and surface area of the stream exposed to direct solar radiation. The amount of shade over a stream is largely a function of riparian vegetative cover, but can also be provided by topographic features and general orientation of the stream. Exposed surface area of the stream is a function of stream width, and the ratio of stream width-to-depth can be important to understanding the effects of direct solar radiation on stream water temperatures. In the Little White Salmon Watershed, water temperatures in streams emanating from near the lower end of the Big Lava Bed are largely controlled by the lava bed itself, which provides total shade to waters moving through or underneath it. These streams tend to remain quite cool throughout the year near where they emerge.

Water temperature is an important parameter in assessing water quality, in large part because it affects dissolved oxygen levels in streams, but also because it can affect metabolic and physiologic processes in fish. As water temperatures are increased, dissolved oxygen levels decrease. Dissolved oxygen is critical for all life stages of fish, and as such, water temperature can be a limiting factor for fish survival and propagation.

Turbidity

Turbidity measurements are used to index the amount of suspended sediment in water. Turbidity of streams is dependent on the availability of a source of fine sediment, and the stream's ability to transport and maintain the sediment in suspension. As such, stream turbidities rise and fall as a function of upslope disturbances such as surface erosion and mass wasting, and instream processes like floods and bed or bank erosion. Turbidity of streams is generally tied closely to stream discharge, because at higher discharges, the stream has greater power to entrain and maintain fine sediment in suspension. It is also during the higher flow periods when surface soil erosion and mass wasting may be increased, or when fine material from these processes is delivered to the stream. The effect of the Big Lava Bed on turbidities is unknown at the present, because the actual routing of water through the lava bed has not been determined. There is undoubtedly some filtering of water as it goes from surface flow above the lava bed, into the lava bed, and then re-emerges (it is thought) in surface channels below the lava bed (Lava Creek, and possibly Moss Creek are two streams thought to drain the Big Lava Bed). Studies done on a lava bed at Mt. St. Helens have found that water actually flows as a stream underneath a lava bed, so would tend to maintain sediment transport processes in those reaches. The degree to which sediment is trapped or filtered as water enters or exits the lava bed has not been determined there, and is unknown in this watershed.

Fecal Coliform

Fecal coliform bacteria counts are used to indicate fecal contamination of water from warm blooded animals, and the possible presence of pathogens associated with the source animal. Fecal coliform levels are a function of the amount of fecal matter input directly or indirectly to the stream or lake, and the time since deposition. Although fecal coliform can survive for a limited time in water, they can live for an extended period while still in the feces, so may continue to affect water quality for extended periods if fecal matter on streambanks is slowly moved into the stream over time. Coliform levels may also be tied to stream discharge, because higher streamflows can remobilize bottom sediments where coliform have settled. Fecal coliform levels are important to determining the suitability of a water body for domestic supply or recreational uses.

pH

The pH is generally included in any water quality characterization because it is an important factor for many of the processes affecting water quality. It also provides an easily measured indicator of one aspect of the overall water quality, and is required for calculating levels of other water quality constituents. In general, pH is not a very sensitive variable to most natural forest processes. It is however, sensitive to activities such as fertilization, some mining activities, and to acid rainfall--all processes that occur or may have occurred to some degree in this watershed. The pH level is important to fisheries, because of the direct and indirect effects that changes in pH can have on fish and other aquatic organisms.

Historical Condition

Water Temperature

Historically, water temperatures in forested streams varied along with the amount and quality of riparian canopy cover. The primary factors affecting riparian canopy cover were fire, insect and disease outbreaks, and debris torrents or large scale flooding that removed riparian vegetation. As percent of the riparian area in an early seral-successional condition is increased, potential for elevated maximum water temperatures is increased. The REAP found that riparian areas in the Hood-Wind Subbasin historically had early-successional vegetation over 5-30% of the riparian area at any given time. This was described as the range of natural conditions. They further described the range of natural conditions for maximum water temperatures to be from 7-20° C. It is likely however, that historic temperatures in Lava and Moss Creeks were at the lower end of this range due to the influence of the Big Lava Bed.

Turbidity

Historic turbidities were linked closely to large scale disturbances including fire, mass wasting, and flooding. Surface soil inputs were negligible under fully forested conditions, but would have increased for a short period following fire. Although the watershed is considered relatively stable in terms of mass wasting, the potential for mass wasting would have increased for a period of time after large-scale or intense fires. Avalanche chutes coming off Big Huckleberry Mountain likely delivered mixed sediments to streams as well, during episodic events. The most frequent cause for changes in turbidity under historic conditions was likely the occurrence of high streamflow events that caused some streambank cutting in lower gradient reaches of the Little White Salmon and in lower reaches of tributary streams. Large deviations in turbidity would have been infrequent, and occurred in response to mass wasting or post-fire surface soil erosion. Between disturbance events, turbidities were probably low for relatively long periods.

Fecal Coliform

Historic fecal coliform levels were a function of the timing, location and concentration of warm-blooded animals in the streams, lakes, and riparian areas.

pH

Historically, pH most likely had a very limited range in this watershed. Seasonal changes in response to leaf drop and litter input would provide background variability. The largest changes in pH likely occurred following periods when large amounts of organic matter were introduced to the streams or lakes (i.e. following fire, blowdown etc.). Degradation of this material would cause short term declines in pH as acids were produced from the decay processes.

Current Condition

Water Temperature

Water temperatures in the Little White Salmon River were monitored by the Forest Service from 1976-1985, and again in 1991 using continuously operating data recording systems. This baseline monitoring station was reactivated in July, 1995, and will be maintained annually through summer months. The sampling station was historically located near the bridge at Willard. Additional long term data have been collected by the USFWS at the Little White Salmon Fish Hatchery (1974-1994). Data from both of these long term stations indicates that maximum water temperatures in the lower Little White Salmon River (below the confluence of Moss and Lava Creeks) have consistently remained below the maximum allowable level established in the state water quality regulations. The maximum recorded temperature at the Forest Service station was 13.9°C in August 1978, though the average annual maximum temperature for the period of record is 9.2°C. Maximum recorded water temperature at the fish hatchery was 9.4°C in August, 1992. The state water quality standard for maximum water temperature is 16°C for streams on the National Forest (class AA), and 18°C for streams or segments of streams below the Forest boundary on private or state lands (class A).

Exceeding State Standards

Water temperatures have not been consistently monitored in upper reaches of the mainstem Little White Salmon River or in any of its tributaries. However, grab samples taken in both Lava and Moss Creeks show these streams as having very cold temperatures near their sources (5°C in June, 1995). It is suspected that this is due at least in large part to the influence of the Big Lava Bed. It is likely that these two streams play an important role in maintaining cool summer temperatures in the lower Little White Salmon River. Upstream of the influence of these two major tributaries, a 1994 stream survey reported water temperatures of 18°C in the upper mainstem of the Little White Salmon River. This exceeds the state water quality standard for class AA waters.

Air photo and field review of segments of the upper mainstem of the Little White Salmon River indicate that much of the channel is exposed to direct solar radiation during summer months. This is due in part to a lack of tall trees along the water's edge, and to the wide unvegetated gravel bars along much of its length. Stream survey data confirm that the channel has a relatively high width-to-depth ratio which further increases its susceptibility to heating. Because there is a lack of water temperature data for most of the tributary streams in the Little White Salmon watershed, seral class of the riparian vegetation is used as a surrogate to help identify streams with a higher potential for water temperature concerns, and to prioritize locations for subsequent field study of water temperature. Approximately 21% of the riparian reserves in the Little White Salmon Watershed are currently in an early-successional condition. Subwatersheds C (Lost Creek), DS (NW Lava Bed Tribs), G (Little Huckleberry), LW (Berry Creek), V (Lapham Creek), and W (Cabbage Creek) are particularly high, having greater than 30% of their riparian areas in early seral vegetation (see Table 13).

Water temperatures have been recorded at six lakes in the watershed during lake surveys in the 1990s (Table 14). In general, water temperatures ranged from 11.1°C at Sahalee Tyee to 24.5°C at Forlorn Lake #4. Water temperature was identified in survey reports as possibly limiting for fisheries in Forlorn Lake #4. However, water temperatures in these lakes were likely high historically during summer months because of their shallow morphology.

Table 14. Surface and Bottom Temperatures for Six Lakes in the Little White Salmon Watershed.

Measurement Location	Goose	Sahalee	Forlorn 1	Forlorn 2	Forlorn 3	Forlorn 4
Surface	21°C	11.1°C	20.2°C	19.8°C	21°C	24.5°C
Bottom	12°C	4°C	14.8°C	19°C	21°C	22.5°C

Turbidity

Sedimentation problem concerns

Turbidity and suspended sediment have been identified as a problem on the Little White Salmon River since at least as early as the late 1960s. District files contain a number of correspondences from the 1960s and 1970s that were initiated by the USFWS and directed to the Forest Service. These letters and memos were in regards to flooding and sedimentation occurring in the Little White Salmon River, and its effects on operations at the Little White Salmon and Willard fish hatcheries. It is unknown to what degree sediment was a problem at the hatcheries prior to 1968.

Hatchery

During a rain-on-snow-driven flood occurring in February 1968, the settling basin at the Willard Hatchery was filled with 300 cubic yards of sediment over a five-day period. The fish raceways were covered with several inches of sediment during the same time period, and the downstream Little White Salmon Hatchery apparently had similar problems. The storm producing this event was at the time estimated to be a 50-year storm, but the streamflow event had a recurrence interval of approximately 10 years. Following this event, the USFWS wrote to the Forest Service asking for them to review upstream activities that might be related to the flooding and sedimentation.

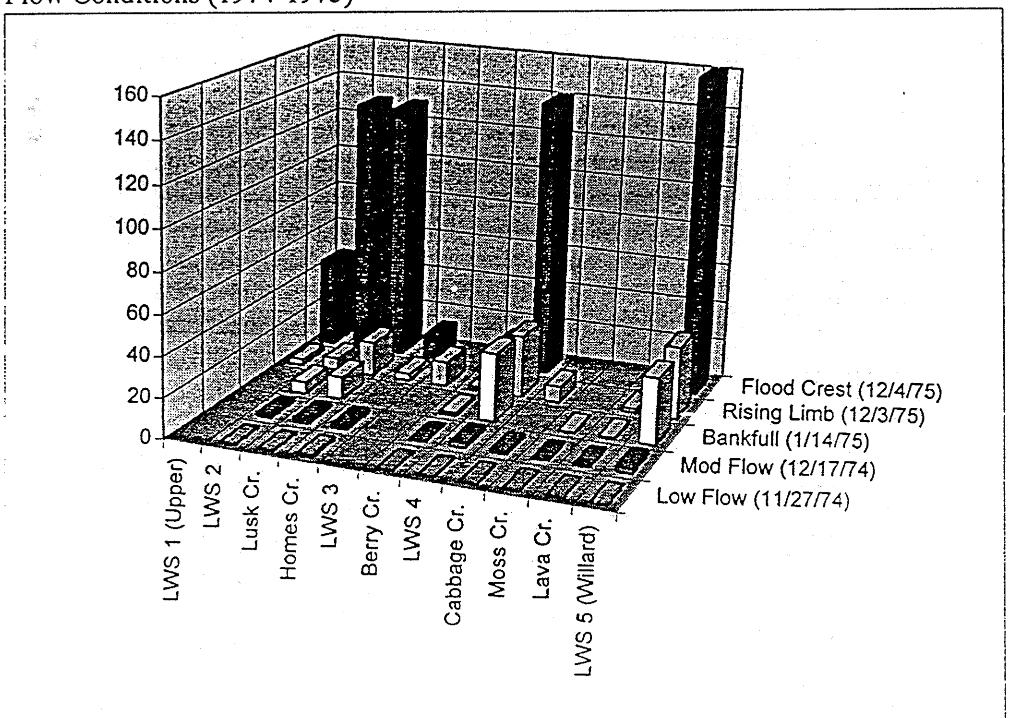
In response to these concerns, the Forest Service conducted a storm damage assessment of the watershed (March, 1968). In general, they noted that Moss Creek, Lava Creek, and Lost Creek had been clear throughout the storm, but that most other tributaries had some turbidity. Lusk Creek, they noted was particularly muddy both during and after the storm. The survey concluded that there were a number of problems with roads and road drainage which contributed to the sediment load, but that the majority of the sediment was coming from stream bank cutting on the lower Little White Salmon River. Following their assessment, a slope failure was found in the Lusk Creek drainage that contributed to the particularly muddy conditions in that stream.

In March of 1974, the USFWS again wrote to the Forest Service in regards to the "high and roiley water" conditions of the previous winter that were causing problems with fish culture at the two hatcheries. Fish and Wildlife felt that problems with flooding and sedimentation at the hatcheries appeared to have "increased substantially" over the previous several years. In retrospect, at least part of their perception of increased flooding and sedimentation was related to a sequence of large flood events that occurred across the region in the 1960s and 1970s. Nevertheless, as pointed out in one of their letters, the fish hatchery had been in place since 1898, and had not previously experienced problems of the scale seen in the 1970s. Based on their observations of the watershed, Fish and Wildlife suggested that sources of the sedimentation problems were roads, undersized culverts, clearcut harvesting along streams, and logging debris in stream channels Following this exchange, the Forest Service agreed to review logging practices, road construction, and culvert standards in the watershed.

Water Quality Monitoring

The Forest Service initiated water quality monitoring in the Little White Salmon Watershed in late 1974. From September 1974 until December 1975, several stations in the watershed were monitored for turbidity during a range of flow conditions. The intent of the monitoring was to locate source areas of sediment that contributed to the downstream problems experienced at the hatcheries. Locations monitored included five stations along the upper mainstem of the Little White Salmon River and six stations on major tributaries, including Lusk, Homes, Berry, Cabbage, Moss, and Lava Creeks. During the monitoring period, turbidity measurements at these sites ranged from 0.17 to 160 NTUs (Nephelometric Turbidity Units). Figure 13 displays the range of turbidities measured at each station, with a qualitative indication of streamflow conditions at the time of monitoring.

Figure 13 Turbidity in the Little White Salmon River and Tribs During a Range of Flow Conditions (1974-1975)



Although extremely limited, this data set does suggest some trends in turbidity in the upper watershed. During low flows, turbidities at all stations monitored were quite low (< 5 NTUs or Nephelometric Turbidity Units). As streamflow levels increased, so did measured turbidity. This pattern is generally accepted since at higher flows more sediment is often made available through streambank cutting, or from upslope erosion processes occurring during the storm. Moreover, during these conditions the stream has greater power to both entrain and maintain sediment in suspension. Comparing turbidity between sampling stations indicates those locations where turbidities increased dramatically during high flows, and those where responses were less substantial. In general, the mainstem of the Little White Salmon River and Lusk Creek stand out as having the highest turbidities during all bankfull or higher flows, while some of the smaller tributaries appear to continue to run with much lower levels of turbidity, even at higher flow. This would tend to support the Forest Service contention in earlier reports and in letters to Fish and Wildlife, that much of the downstream sediment problem was a result of bank cutting on the mainstem.

Culvert Problems

Road systems continue to be a source of sediment in the watershed as evidenced by problems experienced during the winter of 1994-95. In at least two locations this winter, culverts were blocked by sediment and debris, causing water to flow over the road surface. In one of these cases, the overflowing water cut a gully several feet deep in places, and over 100 feet long. This single event introduced hundreds of cubic feet of sediment to a small tributary of the Little White Salmon River. Locations where roads cross intermittent or perennial streams are common locations for sediment introduction. This can occur chronically from cut and fill slopes, or catastrophically when culverts plug, or are inadequate for flow volumes, and cause water to find another route downslope. Table 15 shows the number of places roads cross streams in each subwatershed. The number of crossings per subwatershed is used to index the relative potential for sediment introduction from stream crossings.

Table 15. Number of Road Stream Crossings by ROD Stream Class

		ROD Stream Class			
Subwatershed	Name	Fish Bearing	Non-Fish Perennial	Intermittent	Total
10A	Hdwtrs Goose Lk	1	1	5	7
10B	Dry Cr.	0	0	19	19
10C	Lost Cr (north)	5	2	23	30
10DE	NE Lava Bed Tribs	0	11	9	20
10DS	NW Lava Bed Tribs	0	0	6	6
10DW	Goose Lk.	2	0	11	13
10E	South Prairie	0	5	17	22
10F	Big Lava Bed	0	0	2	2
10G	Little Huckleberry	0	3	18	21
10H	W.Fk.Lusk Cr.	0	1	3	4
10I	Lusk Cr,	7	0	26	33
10J	Hdwtrs LWS R.	5	1	29	35
10K	Beetle Cr.	10	7	70	87
10LE	Homes Cr.	5	1	15	21
10LW	Berry Cr.	3	1	20	24
10M	Big Huckleberry	0	1	51	52
10P	Middle LWS R.	4	1	34	39
10Q	Timber Head	9	4	37	50
10RE	Lava Cr.	5	0	7	12
10RW	Lost Cr. (south)	1	2	23	26
10S	Moss Cr.	30	6	93	129
10V	Lapham Cr.	0	6	39	45
10W	Cabbage Cr.	2	7	26	35
10	LWS Watershed	89	60	583	732

Road condition surveys were conducted in the Key portion of the Little White Salmon during the summer of 1995. This effort was Phase II of the Mt. Adams Ranger District Access and Travel Management Plan. During the survey, numerous culverts were identified throughout the watershed that were completely or partially blocked. Map N shows the locations of all culverts in the Key portion of the Little White Salmon watershed where 40% or more of the culvert is blocked. These situations are potential sites for additional road washouts, gullying of road surfaces, or total fill failure if they are not taken care of in a timely manner. These are the very same types of problems identified by the USFWS and acknowledged by the Forest Service in the early 1970s in the Little White Salmon, and yet they continue to cause problems in the watershed 20 years later.

From the late 1970s through the late 1980s, the Forest Service continued to collect some turbidity data at the baseline station near Willard, though most of it was during summer low flow periods. During summer months, turbidities have been found to be consistently low (< 3 NTUs) over the period monitored. Two winter-month samplings for turbidity yielded results of 216 NTUs during a December flood in 1978, and 33 NTUs during January, 1975 (unknown flow conditions).

Hatchery Water Quality Monitoring

Water quality monitoring has been done by the USFWS at the Cook Fish Hatchery on a bi-weekly basis since 1975. Sample collection is done at the hatchery intake, and has been analyzed by the hatchery for total suspended solids (TSS). Although this is an excellent data set in terms of the period of record and consistency of sampling, its interpretation in terms of trend analysis is somewhat limited by a lack of supporting streamflow data. The gauging station near Cook that had been operated by the USGS was abandoned in 1977, just two years after TSS began being measured at the hatchery.

Data collected at the hatchery over the past two decades shows a general downward trend in TSS in the Little White Salmon River (Figure 14). To begin understanding whether the apparent trend is related to an improvement in watershed condition or is simply following a general downward trend in flood magnitudes over the past two decades, data from the hatchery was plotted against predicted annual maximum discharge on the Little White Salmon River. The predicted discharges were determined by regression of the existing discharge records for the Little White Salmon with that from the Hood River--the closest gauging station still being operated.

These two systems are considerably different because of the influence of Mt. Hood on Hood River flows, but when annual maximum streamflows were plotted against one another (r-square values were just .60), the same general pattern existed in both records. That is, in examining data for years when both gauging stations were operational (1965-1977), years with high annual maximum flows on the Hood River corresponded to years of high annual maximum flows on the Little White Salmon. The same relationship held true for years with low annual maximum flows. Data from the Hood River appeared to do a reasonably good job of predicting general patterns of high or low flows for the Little White Salmon, but was poor at predicting the magnitude of the annual maximums. Despite the very low level of confidence in the predicted flows on the Little White Salmon, this data was used to provide some indication of annual high flows in the region during the period of TSS monitoring.

Figure 14. Comparison of Total Suspended Solids with Predicted Maximum Discharge in the Little White River (1975-1995)

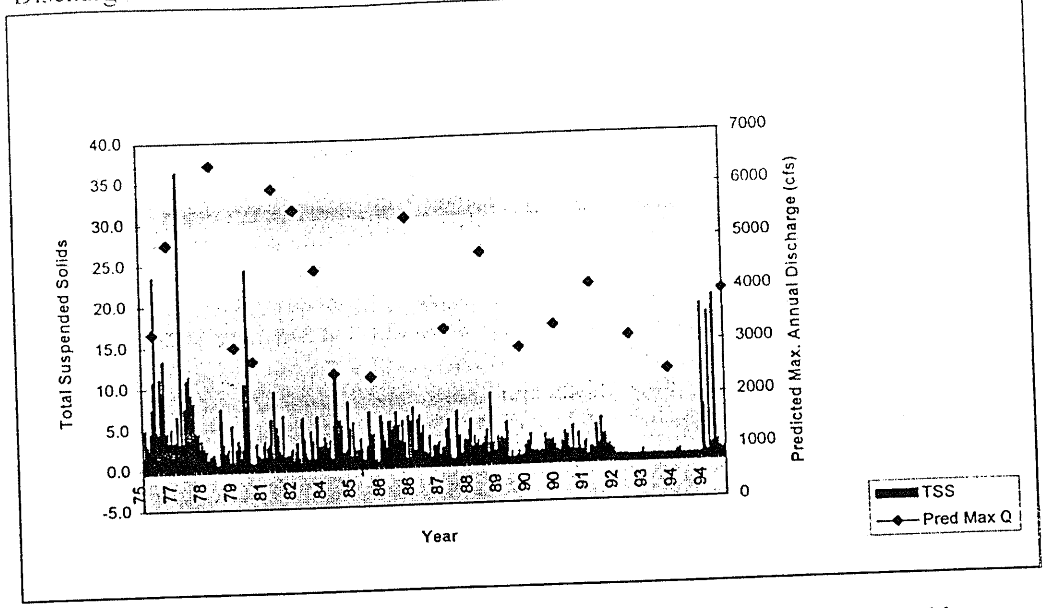


Figure 14 shows an apparent decrease in annual maximum discharge on the Little White Salmon over the same time period when TSS appears to be decreasing. If predicted annual maximum discharges on the Little White Salmon area reasonably close to actual conditions, the past 20 years may be linked as much to a general decrease in the magnitude of annual maximum streamflows as to an improvement of watershed conditions, or a decrease in sediment supplied.

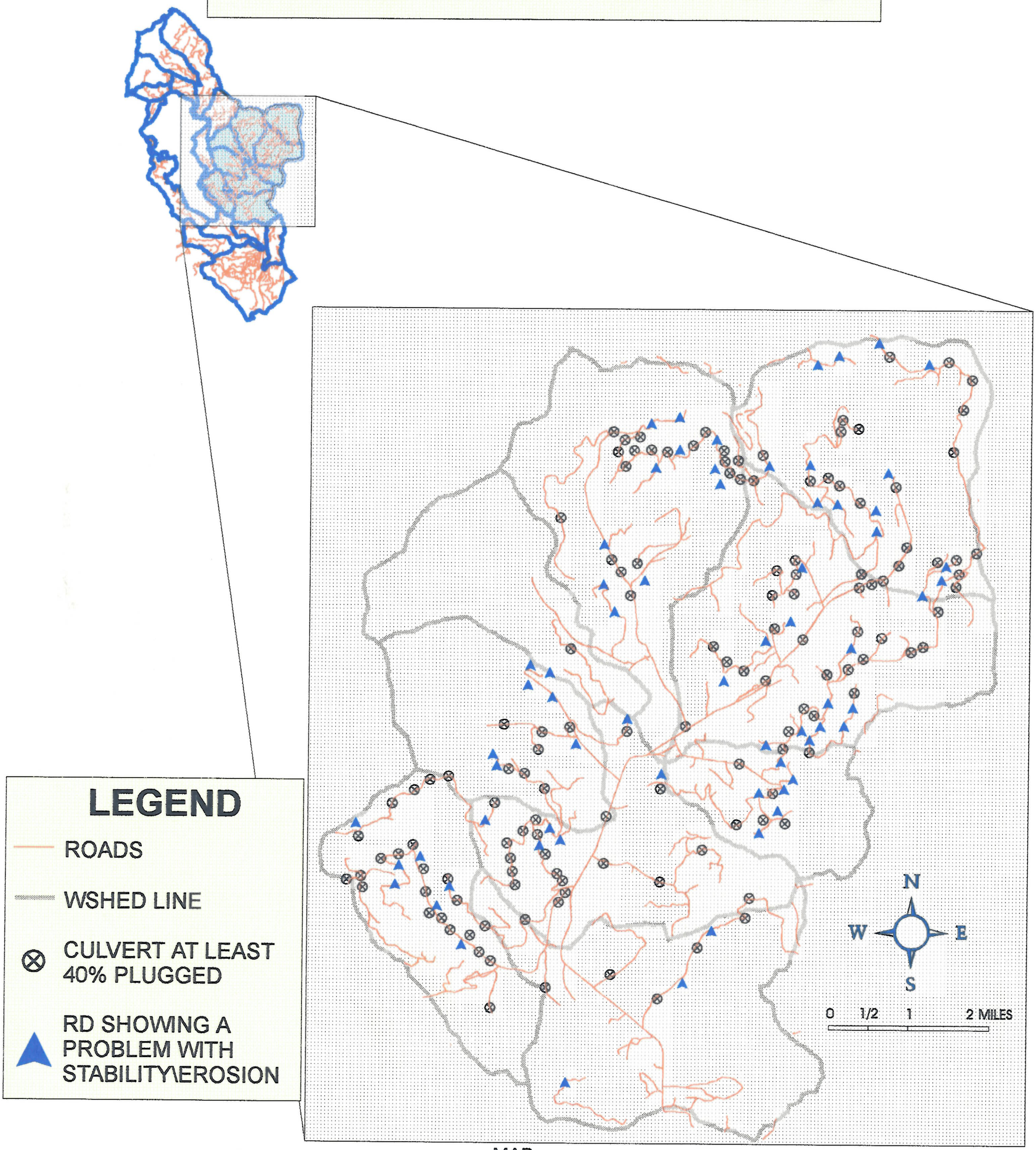
Fecal Coliform

From 1976 to 1980, a total of ten water samples were taken from the Little White Salmon River and analyzed for fecal coliform. The average coliform count in these samples was 28.7 colonies per 100 ml of sample, and the maximum was 43. This is below the established maximum allowable levels in state water quality regulations. As yet no fecal coliform monitoring has been done in any of the lakes in the watershed, most of which receive heavy recreational use. Although established campsites have been pulled back from the lakeshores in many cases, there is continued dispersed use near and in the lakes. Surveys have noted areas near lakeshores where there is evidence of human and animal waste material.

pH

In a 1992 statewide water quality assessment done by the Washington Department of Ecology (Section 305(b) Report), the Little White Salmon River was identified on the 303(d) list as "water quality limited" for pH. The data provided to Ecology for this report was taken by Forest Service personnel during annual summertime monitoring. This data indicated that on three occasions during the period of 1974-1987, pH values were recorded below the state standard of 6.5 on the Little White Salmon River. The lowest of these occurred on July 28, 1987, at a pH of 6.3. State standards for pH on class AA streams allow for pH in the range of 6.5 to 8.0. The data from these early Forest Service monitoring records is considered suspect, in that quality control was not done reliably, and the samples were analyzed for pH in some cases days after the sample had been collected (as indicated in early monitoring notes). Monitoring for pH is best done while in the field, because water samples collected for later

RESULTS OF ROAD CONDITION SURVEYS



MAP
N

pH analysis have the potential for pH values to shift while the sample is sitting. Since 1992, the State has published another statewide water quality assessment, and the Little White Salmon has been removed from the 303(d) list.

Lake surveys have analyzed for pH in five lakes in the watershed during the 1990s. Results of this testing show pH values ranging from 5.9 in Forlorn Lake #4 to 6.6 in Forlorn Lakes #1, and 2 (Table 16). State water quality standards for Lake Class waters allow for no measurable change from natural conditions.

Table 16. The pH for Five Lakes in the Little White Salmon Watershed.

	Sahalee	Forlorn 1	Forlorn 2	Forlorn 3	Forlorn 4
pH	6.4	6.6	6.6	6.1	5.9

Projects Likely To Affect Future Condition

- The pH of lakes may be reduced over time by acid deposition from upwind sources.
- Riparian planting where needed will help reduce water temperatures over time.
- Road maintenance will reduce turbidity and sedimentation.
- Road decommissioning will reduce turbidity and sedimentation over time.
- Mining activities may increase turbidity.
- Increased grazing may increase turbidity and coliform.
- Restoration and increased management of recreation sites may reduce coliform and turbidity.
- Increased water extraction may lead to reduced water quality during summer months.

Likely Future Conditions

- Maximum water temperatures in on-Forest streams with elevated temperatures will continue to decline as harvest in Riparian Reserves is eliminated.
- Maximum water temperatures in lakes are not likely to change.
- Turbidity created by riparian harvest practices and road construction will continue to decline in stream sections on the Forest.
- Turbidity from roads to be decommissioned will decline once revegetated.
- Turbidity from existing roads may increase without increased road maintenance.
- Coliform levels in lakes may decline as campsites are pulled back and toilet facilities are established.
- Coliform levels in streams and lakes may increase without management of increased dispersed camping.
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Data Gaps

- Water temperatures on many streams: Needed to assess condition and restoration needs.
- Turbidity on a consistent basis: Needed to assess conditions, trends, effects of restoration and other projects.
- Streamflow data: Needed to help interpret turbidity data.
- Coliform data: Needed in lakes and streams to assess compliance with state water quality standards, and for trend analysis.
- pH data: Needed to establish background levels and compliance with state water quality standards
- Hydrology of Big Lava Bed: Needed to understand how effects upstream are translated downstream.

Issue: Fish Habitat and Populations

Resident fish populations in the Little White Salmon River watershed streams and lakes have been supplemented by hatchery reared rainbow trout (*Oncorhynchus mycosis*), eastern brook trout *(Salvelinus fontinalis*), cutthroat trout (*Salmo clarki*) and brown trout (*Salmo trutta*). Rainbow trout and possibly cutthroat trout (*Salmo clarki*) are native species in the watershed, and brook trout and brown trout are introduced species.

Anadromous fish species in the watershed include hatchery reared spring and fall chinook (*Oncorhynchus tshawytscha)* and coho salmon (*O.kisutch)*. All native stocks of salmon are extinct. Native trout stocks have most likely been genetically altered by the introduction of non-native strains. It is currently unknown if some trout exist in the basin which are genetically distinct from hatchery stock. Hatchery introductions may have not only changed native stock characteristics, but due to competition and interbreeding, may have also eliminated species which historically inhabited the area.

Degraded fish habitat conditions exist in some areas of the Little White Salmon River watershed. Stream habitat was impacted in the past due to logging through and around streams, road construction, timber harvesting, grazing, and destruction of streamside vegetation. The cumulative effects of these impacts are evident in some streams in the Little White Salmon River. Habitat problems include high water temperatures, lack of pools, stream bottom scouring, sediment deposition, lack of instream large woody debris, high width/depth ratios, and migration barriers. The historical distribution of fish species in the watershed may have been altered by these changed habitat conditions and migration access due to management activities.

Key Processes

The key processes influencing fish species distribution and habitat conditions include: timber harvest, road construction, stream diversions, recreation sites, stock grazing, mass wasting, flooding, low streamflow, and fire. These processes and their effects on streams were discussed previously under the Basin Hydrology, Riparian/Channel Condition, and Water Quality Issues. These processes influence fish rearing and spawning habitat. Summer and winter rearing habitat needs include adequate instream cover, water temperatures, clean water, and habitat diversity for all life stages. Spawning needs include the adequate size and quantity of spawning substrate, clean gravel, and sufficient water flow. The following are specific effects to fish habitat and fish populations from the processes described under the Hydrology Issues:

Riparian Vegetation Removal

Streamside vegetation removal along riparian areas in fishbearing streams can weaken channel banks, remove the source of large woody debris, and change sediment supply. In alluvial channels the removal of bank vegetation and subsequent increased sediment supply cause channels to become wider and shallower with fewer pools and more riffles. This results in a loss of channel structures that confine flow and promote the habitat diversity required by fish populations. Big pools are essential as they tend to stratify thermally in summer, providing cool-water refuges. Harvest along riparian areas removes stream shade which may raise the water temperature in summer, and lower it in the winter.

High Water Temperatures

Unsuitable high water temperatures can lead to disease outbreaks, altered timing of migration, accelerated or retarded maturation, and elevated physiological stress. Physiological stress increases susceptibility to disease and predation, and decreases competitive ability of rearing juveniles. Trout survive best in waters 10-16°C, and temperatures above 25.5°C are lethal (Hunter 1991).

Peak Flow Increases

Increases in stream peak flows can cause streambed scour and accelerate bank erosion adding accelerated rates of sediment deposition to the channel. Increases in sediment supply can cause aggradation, pool filling, and a reduction in gravel quality. Channel aggradation resulting from accelerated erosion can cause underground flow in small streams in summer as water flows subsurface through deep gravels, halting instream movements of fish and increasing mortality.

Accelerated Sediment Input

Sediment in gravels can affect embryological development during incubation or prevent newly hatched fry from emerging. Excessive sediment alters aquatic insect populations, reduces summer rearing capacity in pools, and reduces winter carrying capacity when deposition occurs in interstitial spaces of stream substrates (Bjornn et al. 1977). Excessive turbidity levels decreases sight feeding, clog fish gills, may increase water temperature, and impacts aquatic insect populations.

Lack of Instream Large Woody Debris

Large woody debris greatly increases fish habitat diversity in forest streams. In general, the more habitat diversity (pools, riffles, cover, off-channel and flood-channel habitat), the greater the rearing potential for salmonids. Large woody debris enhances rearing habitat during summer and provides survival cover in off-channel areas in winter. Larege woody debris directs fine sediment from the channel to the flood plains and stores spawning gravel and rubble in the channel. It also provides a source of nutrients and a substrate for biological activity. Loss of instream large woody debris by direct removal along streamsides contributes to a loss of sediment storage sites, fewer and shallower scour pools, and less effective cover for rearing fish (Meehan 1991).

Migration Barriers

Migration barriers in the Little White Salmon Watershed include natural and manmade barriers. Falls are the primary natural barriers, and road culverts and dams are the manmade barriers. Improperly designed road culverts and dams with no fish passage facilities can interfere with upstream fish migration and result in a substantial loss of rearing habitat. Anadromous salmonids migrate upstream and downstream during their life cycles, and resident fish move upstream and downstream as they search for food, shelter, better water quality, and spawning areas. Road culverts can be barriers to migration because of excessive water velocity, insufficient water depth, lack of a pool below the culvert, and high jump height..

Fish Stocking

Fish stocking of resident fish has been occurring in the watershed streams and lakes since at least 1914, and continues today. Hatchery production of anadromous fish began in the drainage in 1896 with the Little White Salmon National Fish Hatchery. Hatchery supplementation affects fish species by introducing non-native strains which interbreed with native strains changing native stock characteristics. Hatchery introductions not only alter native stock characteristics, but due to interbreeding and competition, may also eliminate species which historically inhabited an area.

Fish Harvesting

Fish harvesting of resident fish is occurring in the watershed in most of the fishbearing streams and lakes by recreational angling. Harvesting of hatchery reared salmon is occurring through commercial and recreational fishing in Drano Lake, the Columbia River, and the ocean. An occasional salmon smolt released by the Willard Hatchery is most likely caught by recreational anglers in the canyon area of the Little White Salmon River below the hatchery.

Historical Condition

Anadromous Fish

Historically fall and spring chinook, chum salmon (*O. keta*) and coho were all present in the first 1.9 miles of the river up to the 38 foot barrier falls (Bryant 1949). This river was one of the principle spawning grounds for chinook salmon (Nelson 1990).

Resident Fish

Documentation of historic native species inhabitancy is sketchy for resident fish species. Resident rainbow trout and possibly cutthroat trout existed above the falls in the mainstem and most tributaries of the Little White Salmon River. Washington State Fish and Game historical records show the Little White Salmon River's natural fish population to be rainbow and cutthroat trout, Moss Creek to be rainbow trout, and Lost Creek (south) and Lusk Creek to be cutthroat trout. It is unknown whether these were true "natural" populations, or if this meant they were successfully reproducing at that time. No records exist of historical species in the non-key portion of the watershed (Lost Creek and Goose Lake tributaries), and it is unknown if bull trout (*Salvelinus confluentus*), a federal candidate species, historically inhabited any streams in the watershed. It is also an uncertainty if any of the lakes in the watershed contained fish prior to stocking.

Fish Habitat

Specific data on historic stream channel conditions in the basin does not exist. Due to this data gap comparisons are made to the Range of Natural Conditions (RNC) determined for the Hood-Wind Subbasin. Comparisons were also made against the Columbia River Anadromous Fish Policy Implementation Guide (PIG) Desired Future Conditions (DFC's), (USDA, 1991). The RNC for the Hood-Wind Subbasin are 40-60 pools per mile and stream temperatures ranging from 7-20°C (Table 17). No PIG DFC's specific to this particular watershed has been determined, so the general PIG DFC criteria for good fish habitat was used. These criteria are 80 pieces of large woody debris (LWD) per mile, width to depth ratios less than 10, and stream temperatures less than 16°C (Table 18). The number of pools per mile is based on stream width and therefore varies by stream.

No historical data on lake habitat conditions in this watershed were found.

Table 17. Stream Survey Data Comparison to Hood-Wind RNC and PIG DFC.

	Little White Salmon River	Lost Creek	Goose Lake Creek	Hood-Wind RNC
Stream Length Surveyed	12.6 miles	2.6 miles	1.8 miles	-
# Large Pools per Mile	44.2 (fair)	21.1 (poor)	10.1 (poor)	40-60
Width to Depth Ratio	23:1 (poor)	11:1 (poor)	5:1 (good)	no data
Maximum Temperature C	18°	no data	no data	7-20°
Average # LWD per Mile	7.2 (poor)	14.5 (poor)	6.1 (poor)	no data
Scouring and Deposition	8.3 mi (66%)	1.1 mi (39%)	0.3 mi (14%)	no data

( ) = Columbia River Anadromous Fish Policy Implementation Guide (PIG) Desired Future Condition (DFC) Rating.

Note - no quantitative data exists for other streams in the watershed.

Table18. Columbia River Basin PIG Criteria for DFCs.

	GOOD	FAIR	POOR
# Large Pools per Mile *	100%	50-99%	< 50%
# LWD per Mile	> = 80	40-79	< 40
Width to Depth Ratio	< 10:1	-	> 10:1
Temperature C	< 16°	16-50°	> 20°

* Based on stream width.

Current Condition

Anadromous Fish

In 1896 the Little White Salmon National Fish Hatchery was established at river mile 1.6 to supplement the run of tule fall chinook salmon. This hatchery was the third built on the Columbia River, and the fifth in the nation. In 1938 the Bonneville Dam was built on the Columbia River forming Bonneville Pool below the Little White Salmon River. This inundated much of the salmon spawning grounds in the river below the hatchery site. During the first 20 years of operation at the hatchery only fall chinook salmon were reared. For the next 50 years propagation included chum, coho, sockeye (*O. nerka*), spring chinook, and various species of trout, many of which were obtained from outside the Columbia River basin (Nelson 1990). In 1941 Willard National Fish Hatchery was built at river mile 5.1. In 1965 efforts to rear sockeye, chum, and trout were discontinued. Today the Little White Salmon hatchery produces spring and fall chinook salmon, and the Willard hatchery produces coho salmon. Coho eggs are taken at the Little White Hatchery, but are reared at Willard. Coho smolts are released from the Willard Fish Hatchery and travel the 5.1 miles down to the Columbia River

No anadromous fish species exist in the watershed today with the exception of hatchery reared fall and spring chinook and coho salmon which are present in Drano Lake at the river's confluence with the Columbia River. Steelhead (*O. mykiss*) and other strays from the Columbia River are also present in Drano Lake. All salmon are blocked from upstream migration at the Little White Salmon Hatchery's dam where the river meets Drano lake, therefore no anadromy exists in the river itself. All wild anadromous fish which historically existed above the dam are extinct. The decline of the Little White Salmon River stock of tule fall chinook salmon was due to several factors including the construction of Bonneville Dam, introduction of non-local fish stocks, and longer juvenile rearing time in the hatchery than found in nature. The importation of stocks from distant areas (51% of fall chinook between 1968 and 1983) and subsequent intermingling with native fish, altered their genetic fitness and introduced diseases which contributed to their decline (Nelson, 1990). As Nelson (1990) states "Although well intentioned, the efforts to perpetuate a stock of salmon led instead to it's demise." The hatchery dam is used for collecting chinook salmon and coho salmon for rearing at the hatcheries. There is currently discussion regarding passing steelhead over the dam to use the short reach between the dam and the falls (Doulos 1995).

Resident Fish In Streams

Trout

The known distribution of salmonids in the basin is can be determined from Map L. Class I, II, and III F's are fishbearing waters. The Little White Salmon river is stocked every year with legal size rainbow and eastern brook trout. Earliest records show this river has been stocked every year since 1914. Most of the tributaries to the river are fishbearing due to low stream gradients which allow for upstream migration from the river. Other species stocked in the watershed in the past include cutthroat trout and kokanee (*O. nerka*). Lost Creek (north) is the only other stream in the watershed which has been stocked in the last 15 years; it was last stocked in the early 1980s. It is suspected by the Washington Department of Fish and Wildlife that the rainbow trout in Lost Creek (north) are a native stock with no genetic influence from hatchery stock. No data exists which would indicate that are any other wild stocks, free from hatchery stock genetic influence, present elsewhere in the watershed. Washington Department of Fish and Wildlife records show Berry, Cabbage, Lava, Lost (north), Lost (south), and Lusk Creeks have all been stocked in the past. Table 19 displays fishbearing streams in the watershed, the stream class, the fish species present, current stocking practices, the earliest recorded date and species of first stocking, and what may have been the natural fish population prior to stocking.

Table 19. Fishbearing Streams in the Little White Salmon Watershed.

Stream	Class	Fish Species Present	Presently Stocked	Date First Stocked	First Species Stocked*	Natural Population
Streams on Federal Land (USFS)						
Beetle	II	RB, EB	N	-	-	-
Berry	II	RB, EB	N	1941	RB	-
Cabbage	II	RB, EB	N	1936	CT, RB	-
Goose Lake	II	EB	N	1920	UNK	-
Homes	II	UNK	N	-	-	-
Lava	II	RB, EB	N	1934 1942	RB EB	-
Little White	I	RB, EB	Y	1914	RB, CT	RB, CT
Lost (north)	II	RB, EB	N	1935	EB, CT	-
Lost (south)	II	RB, EB	N	-	-	CT
Lusk	II	RB, EB	N	1941	RB, EB	CT
Moss	I	RB, EB	N	-	-	RB
Spring	IV	EB	N	-	-	-
Streams on Non-Federal Land						
Bunker	II	UNK	N	-	-	-
Lapham	III	UNK	N	-	-	-
Pine	III	UNK	N	-	-	-
Rock	I	UNK	N	-	-	-

CT = Cutthroat Trout, RB = Eastern Brook, UNK = Unknown
* From Washington State Historical Fish and Game Records (it is uncertain if "natural" means the species which originally inhabited the stream, or if successful reproduction of this species is occurring.)

No threatened, endangered, or sensitive fish species have been found in the watershed with the exception of bull trout being caught in Drano lake in 1988. A search for bull trout was conducted in the streams most likely to support a resident population of this species. On September 14, 1995, the USFWS and the Forest Service jointly conducted a snorkel survey to detect the presence of bull trout in the mainstem Little White Salmon River and Moss Creek. They surveyed one mainstem mile between the Willard Fish Hatchery and the town of Willard, and the lower mile of Moss Creek. No bull trout were detected on this survey.

Resident Fish In Lakes

Table 20 displays fishbearing lakes in the watershed, the number of acres of each lake, whether or not it is within Indian Heaven Wilderness, fish species present, current stocking practices, earliest recorded date and species of first stocking, fishing pressure, and the maximum and average water depth. All of the lakes of adequate size and depth have been stocked, and many have been stocked since the 1920s. Most of the larger lakes are deep enough for the fish populations to overwinter.

A brown trout fish hatchery was built on Goose Lake in 1929 and many of these fish were packed into the Indian Heaven Wilderness lakes. This hatchery was washed out by a flood in 1993. Since then the Washington Department of Fish and Wildlife assumed stocking of the Indian Heaven lakes.

Table 20. Fishbearing Lakes in the Little White Salmon Watershed.

Lake	Acres	Wilderness	Fish Species Present	Presently stocked	Date First Stocking*	First Species Stocked	Fishing Pressure	Max. Depth (feet)	Ave. Depth (feet)
Blue	12.7	Yes	CT	Yes	1926 1940	EB RB	Medium	46.0	UNK
Forlorn #1	12.7	No	BN, RB	Yes	1926	EB	High	21.0	8.9
Forlorn #2	14.5	No	EB	Yes	1926	EB	High	9.0	2.8
Forlorn #3	6.7	No	RB	Yes	1926	EB	High	4.0	1.9
Forlorn #4	3.6	No	None	No	UNK	UNK	High	7.8	3.5
Forlorn #5	7.0	No	EB	No	UNK	UNK	High	-	-
Goose	63.1	No	EB, RB, BN	Yes	1920 1929 1935 1939 1940	"Mixed" BN EB RB MB,KO	High	-	-
South Prairie	10.0	No	EB	Yes	1953	EB	High	-	-
Sahalee Tyee	5.1	Yes	CT, RB	Yes	1926	RB	Medium	74.0	35.0
					1928	EB			
Sebago	1.6	Yes	None	No	1926 1953	RB EB	Low	-	-
Toke Tie	3.1	Yes	EB	Yes	UNK	UNK	Low	-	-
Tombstone	1.7	Yes	EB	Yes	1928	RB	Low	-	-

CT = Cutthrout Trout, RB = Rainbow, EB = Eastern Brook, BN = Brown, MB = Montana Black Spotted (cutthroat), KO = Kokanee
* First Fish and Game record of fish stocked in lake.

Fish Habitat In Streams

Stream survey data describing current fish habitat conditions is lacking in this watershed. Only 3 streams in the watershed have been surveyed for fish habitat and include the Little White Salmon River, Lost Creek (north), and Goose Lake Creek. Results of these surveys as compared to the REAP and PIG criteria are displayed in Tables 17 and 18. All streams are lacking large woody debris, and the reach of the Little White Salmon River above Moss Creek and below Berry Creek (5.4 miles) has not met state standards for stream temperature. This is not surprising as the average width to depth ratio in the river is 23:1, the average number of pieces of large woody debris per mile is 7.2, and much of the riparian vegetation along the river is in an early-successional condition. Excessive scouring and deposition of the river bed is also occurring in this same reach degrading spawning habitat. Pfankuck Channel Stability surveys have been done for several streams in the watershed, and severe scouring and deposition of the channel bottom was noted in several stream reaches. These areas are displayed on Map O, along with other poor fish habitat reaches. Aside from these areas, spawning habitat seems to be adequate in most streams in the watershed. Rainbow trout appear to be reproducing successfully as fry are easily visible in most tributaries of the Little White Salmon River in the spring. Fish population surveys have shown all age classes to be present in the three streams which have been surveyed.

Fish Habitat In Lakes

Twelve lakes exist in the watershed and ten of these are fishbearing. Seven of the fishbearing lakes in the watershed have been surveyed for water quality, fish habitat, fish populations, and food availability. The surveyed lakes include: Forlorn Lake #1,#2,#3, and #4, Goose Lake, Blue Lake, and Lake Sahalee Tyee. All of these lakes have adequate water quality, productivity, nutrients, and rearing habitat (see Lake Survey Reports, 1991-1995 at Mt. Adams Ranger District). Spawning habitat is not adequate for successful fish reproduction in any of the surveyed lakes, therefore they would not naturally contain fish unless they were continually stocked. The only lake with known successful spawning occurring in it's tributaries is Goose Lake.

Migration Barriers

Several migration barriers are present in the watershed (see Map P). Two fish barrier dams exist in the watershed, one on Lost Creek (north) adjacent to the diversion intake, and one at the Little White Salmon Fish Hatchery at Drano Lake. An inventory of other fish migration barriers, such as falls or debris jams has not been adequately conducted in this watershed. Known waterfall barriers include a 38 foot falls located at river mile 2.0 on the Little White Salmon River (which historically blocked upstream fish migration from the Columbia River), one 20 foot and one 35 foot falls in the upper reach of the Little White Salmon River, one 18 foot fall on East Fork Goose Lake Creek, one 50 foot fall and one 35 foot fall on Goose Lake Creek, and one 8 foot fall on Spring Creek. An inventory of culvert barriers was conducted in most of the fishbearing streams in the watershed in July, 1995. Fifteen of the 26 culverts inventoried in the basin were determined barriers to fish. In addition, a comprehensive inventory of roads and culvert problems in the Key portion of the watershed was recently conducted by the Forest Service engineers, and their data will aid in determining additional potential fish barriers (see Map N and Appendix B). These culverts will need to be field checked by a fish biologist to determine the exact problem and make recommendations for passage improvement..

Diversions

Several water diversions are present in the watershed (see Table 12). The only diversion with known impacts to fisheries is the one on Lost Creek (north), a class II fishbearing stream. It is located approximately 3.3 miles upstream from where the stream disappears near the Big Lava Bed (see Map P). The diversion consists of a wood and concrete impassable dam, an adjustable screened control valve, and 1.5 miles of constructed ditch. The ditch crosses the watershed boundary and connects to Coyote Creek in the Trout Lake Creek Watershed. Coyote Creek is an intermittent stream which would normally be dry during the summer if there was no input from the diversion ditch. The diversion ditch is usually open from June through September. A Certificate of Water Right issued in 1937 allows withdrawal of a maximum of 5 cfs from Lost Creek for cattle watering. Up to a third of the water flow in the stream is diverted into the ditch during the low flow summer months. Low flow in summer often establishes an upper limit on the quality and quantity of fish habitat. The present diversion practices may have negative effects on fish populations present in the 3.3 miles of stream below the diversion site.

Low Flow Effects

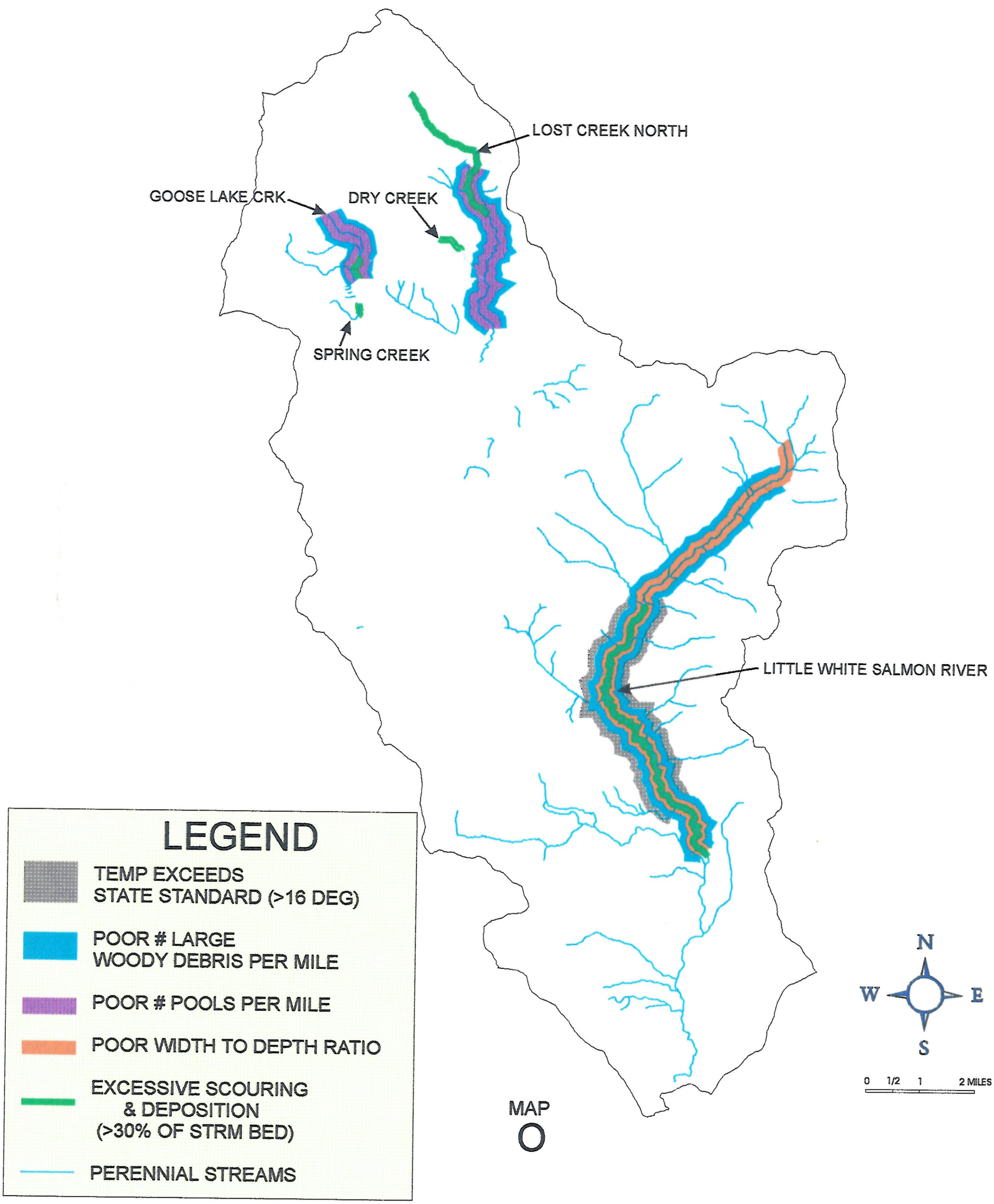
Little data exists on low flow quantities in the watershed (see Basin Hydrology Issue) or their affect on fish resources.

Projects Likely To Affect Future Condition

The following projects are likely to affect fish habitat and fish populations in the future:

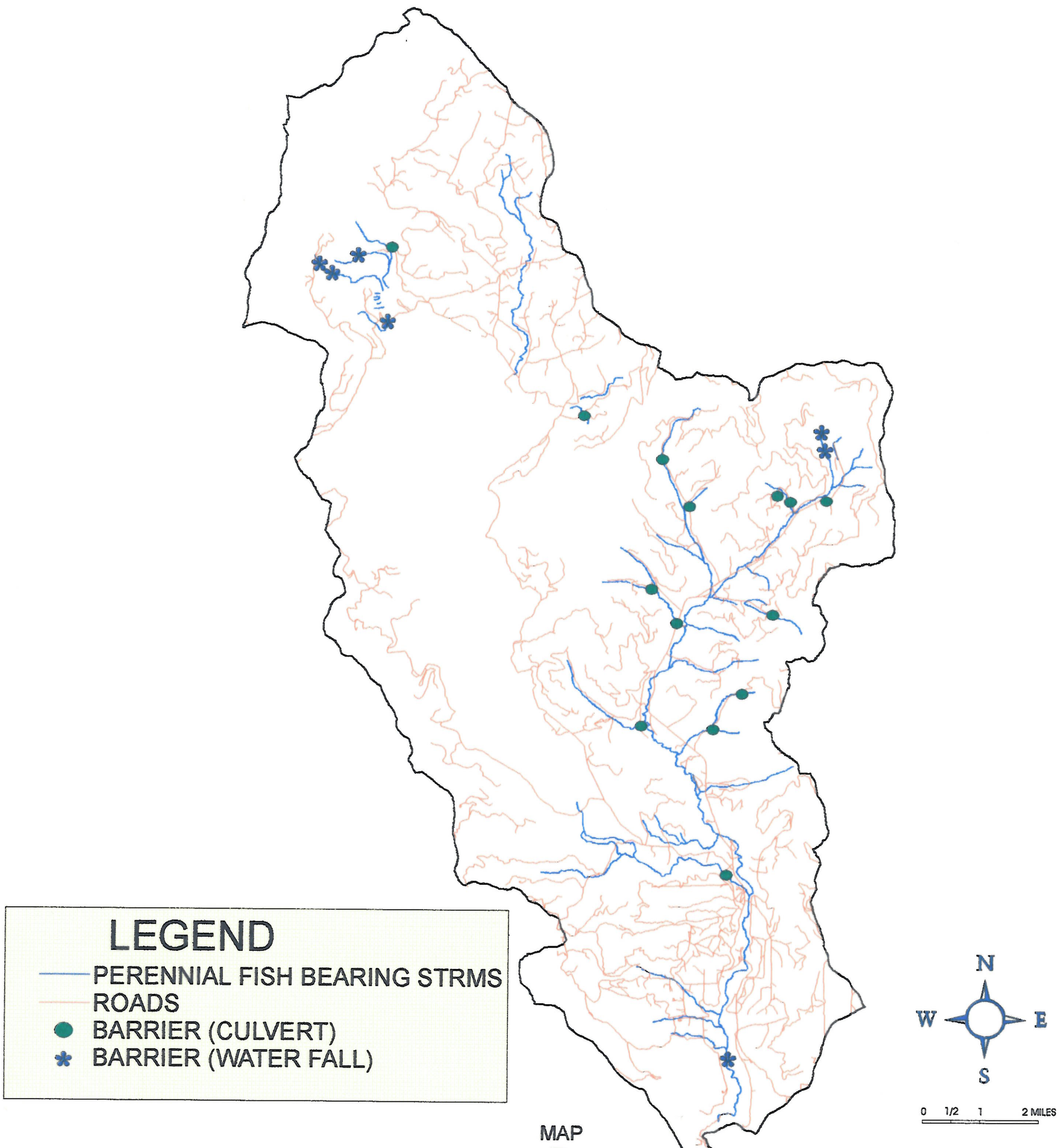
- Timber harvest.
- Road construction.
- Road decommission, maintenance, or improvement.
- Additional water extraction through diversions.
- Riparian restoration projects.
- Timber harvest, road construction, and development in riparian areas on non-federal land.
- Upstream timber harvest in subwatersheds with potential for increased peak streamflows and C channel types.
- Increased grazing in riparian areas.
- Mining activity
- Restoration of recreation sites.

FISH HABITAT CONDITION



MAP O

BARRIERS TO FISH MIGRATION



MAP
P

Future Condition

Given the current management direction under the Forest Plan and ROD, the following trends and future condition may occur:

- Fish stocking is likely to continue in currently stocked areas since no data on resident fish genetics exists to support discontinuing stocking.
- Establishment of riparian reserves will improve stream conditions in the future. As previously impacted riparian areas recover they will provide the streams with large woody debris, provide shade and cover, lower water temperatures, increase pool habitat, decrease width:depth ratios, and decrease sediment input leading to cleaner water and spawning gravel.
- Migration barriers and sediment loads may decrease as roads are decommissioned.
- Sediment levels may increase if roads are not maintained due to lack of funds.

Data Gaps

- Resident historic fish distribution so comparisons cannot be made with current fish distribution.
- Current fish distribution in Beetle, Berry (currently being surveyed), Cabbage, Goose Lake, Homes, Lava, Lost (north), Lost (south), Lusk, Moss, and Spring Creeks on Forest Service land, and Bunker, Lapham, Pine, and Rock Creeks on non-forest land.
- Genetic sampling to determine if any wild rainbow trout are present in the watershed. This information has implications in determining if fish should continue to be stocked in the watershed, and if barriers should be removed to allow for upstream migration which may impact any existing wild stocks.
- Historic stream survey conditions so comparisons cannot be made to determine changes in fish habitat. Some aerial photo analysis was done to determine changes in some stream reaches from 1957 to the present (see Riparian/Channel Condition Issue for channels with significant change).
- Current stream survey conditions. Of the 71 miles of fishbearing streams only 17 miles have been surveyed (76% of streams have not be surveyed for fisheries habitat). Streams on Forest Service land lacking data include Beetle, Berry, Cabbage, Homes, Lava, Lost (south), Lusk, Moss, and Spring Creeks.
- Local desired future condition for stream habitat conditions more specific to the analysis area streams than the general criteria presented in the Columbia River Anadromous Fish Policy Implementation Guide.
- Effects of low flows on fish populations (due to diversions or natural conditions).
- Lake habitat conditions in South Prairie, Toke Tie, and Tomestone lakes.

Issue: Cultural Resources

The Little White Salmon Watershed has been used by people over a several thousand year period for a variety of uses. In the distant past this use probably centered around the hunting of large game animals and the collection of tool stone, and in the more recent past (the last 2000 years) 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 the larger portions were used for the exploitation of the timber resources, as well as to provide forage for sheep and cattle. Other uses include recreational gold mining, other rock use (i.e. Lava Beds), hunting, general recreation, and the collection of miscellaneous products such as beargrass, mushrooms, young conifers, and assorted other shrubs. The primary resource that either directly or indirectly influenced human use of this area was the vegetation, in the form of food, timber, or forage for animals (game and domestic). The primary process that affected the vegetative structure in the past was fire, while in more recent times this has shifted to fire exclusion and timber harvest.

Indian people continue to collect traditional resources from the watershed. These include, but are not limited to, huckleberries, beargrass, cedar bark, 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. Timber harvest and road building activities could potentially impact the availability of cedar for traditional use.

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

Key Processes

The key natural processes affecting vegetation used by Native Americans 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. Beargrass follows a similar successional path.

Historically, the main disturbance event was fire, ignited by either lightning or Indians. Plummer (1900) in an early report for the U. S. Geological Survey discussed the various causes of forest fires, including several fires within the watershed which burned sometime between 1880 and 1897. These fires were located along the slopes of the Little and Big Huckleberry Mountains, as well as at the southern end of what is now the Indian Heaven Wilderness. All three of these areas were noted as huckleberry fields at the turn of the century. Plummer wrote that "Indians also start fires for the purpose of promoting the growth of huckleberries, blackberries, and also to drive game." French (1957) reports that a "common technique for increasing the probability that a fire would indeed occur was to leave the log burning that had served as the reflector during the course of heat drying the huckleberries." 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 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.

With the advent of aggressive fire suppression, timber harvesting has largely substituted the role that fire has played in the huckleberry ecosystem, though it is spatially disparate. Fire suppression has been nearly equally effective throughout the whole watershed, both high and low elevations. Timber harvesting; however, has focused at the accessible lower elevations. Consequently, succession has proceeded in the historical huckleberry fields on Big and Little Huckleberry Mountain and Indian Heaven. At lower elevations, timber harvesting has created early seral conditions favorable for both huckleberry and beargrass.

Historical Condition

Prehistoric

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 the 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 montane uplands with human population distributions most likely shifting along with them.

Several prehistoric archeological 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 sites located on lake shores, at stream confluence's along the Little White Salmon River, on ridge saddles, and another on a peak. 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 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 in itself is 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 Klickitat and related bands located primarily east of the Cascades and along the Columbia River as far west as the present community of White Salmon, as well as the Chinookan-speaking Wishram, Wasco, White Salmon and Cascade Indians. 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 AD 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. Huckleberries are notable in that they 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 literature to huckleberry collection and processing in the Indian Heaven area as well as in the area around Big and Little Huckleberry Mountains. Berries which were not suitable for drying were consumed at once, while the several varieties of huckleberries were dried and stored for winter use (Gibbs 1877).

The extent and productivity of historical huckleberry fields may be inferred from historic references to intensity of use. Internal Forest Service records and articles from local newspapers from the turn-of-the-century indicate that the use of Indian Race Track near Red Mountain was at a peak in the period between 1890 and 1910. Reports cite anywhere from 1000 to 1500 Indians camping in the vicinity during the height of the huckleberry season

(Unknown 1894; Shephard 1936, Hansen 1977). Numerous activities, not all associated with huckleberries collection, took place at these camps.

We have identified the remains of ten huckleberry processing camps within the watershed boundary. Some of these sites correspond to references in ethnographic literature and all fall within areas known to be huckleberry fields within the last 150 years.

Peeled Cedar

The association of peeled cedar sites with former huckleberry fields and camps has been documented on Little Huckleberry Mountain, as well as in the Red Mountain area and the Sawtooth Berry Fields. Peeling dates from these peeled cedar sites correspond to the dates of use of these particular huckleberry fields. It is possible that peeled cedar sites without obvious associations are located near former huckleberry fields which have since reforested.

Within the watershed boundary a total of 386 peeled cedar trees have been documented, in 29 clusters or sites. Peeling dates have been determined through tree ring counts in five of these sites, and the thirty peeling dates ranged from AD 1786 to AD 1943. The peeled trees appear to cluster along at least three major travel corridors, one being the main stem of the Little White Salmon River, the second being the route of the old Lava Beds Trail leading to Big Huckleberry Mountain, and the third being the route referred to today as McClellan's Trail, which crosses the Cascades near Red Mountain and follows the general route of Forest Road 60. The journals of the McClellan party also provide evidence for the use of the bark of the cedar. George Gibbs (1855), in discussing the "household goods" of the Klickitats, makes the observation that "the pails and baskets, constructed from bark of cedars.. are their principal articles of domestic manufacture."

Other species of peeled trees have been documented within the watershed boundary, but we have far less information on their use. Several peeled silver fir trees have been documented in the vicinity of an historic Indian berry picking camp, and the bark from these trees was probably used as a covering for the sweat lodge. Examples of peeled white pine and single peeled mountain hemlock have been documented in the northern portion of the watershed. White pine bark is known to have medicinal uses, and hemlock bark was used for food.

Trails

A number of historic travel routes exist within the watershed boundary, several of which have already been discussed in the previous section. 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 and Little Huckleberry Mountain and those near Red Mountain. These include trails that later came to be known as the Lava Beds Trail, the Cedar Creek Trail, the Little Wind River Trail, the Little Huckleberry Trail, Cougar Way Trail, the Pacific Crest National Scenic Trail, the Lost Creek Trail, the East Crater Trail, and an unnamed route which appears to follow the Little White Salmon Valley to its headwaters. These trails primarily follow drainages and/or ridge lines from points on the Columbia north to the mountains. These travel routes persisted through time, in most cases being adapted later as Forest Service trails and roads.

Other Cultural Sites

Other types of sites which have been documented within the watershed boundary include talus pit features and rock cairns. Three sites containing talus pit features have been recorded. All three are located in close proximity to known Indian huckleberry camps. The function of these features is not known; although, there are suggestions the pits 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. Rock cairns may possibly represent human burials. Three such sites have been located near high places.

The petroglyph site at Goose Lake, representing human hand and footprints, is a rather unique site. Before the lake was dammed, the prints were exposed on the shoreline during the summer months. These prints, along with Goose Lake itself, are the source of several legends.

Current Condition

Berry Picking

The historic berry fields on Big and Little Huckleberry Mountains and Indian Heaven Wilderness are in a state of decline. Succession has moved these areas to a middle seral stage comprised of pole and small saw sized trees. Early seral forest elsewhere in the watershed do have a thriving huckleberry component. These are largely clearcut and shelterwood forests north of the Big Lava Bed and within the silver fir ecoclass.

Based on analysis of a large number of peeling dates from peeled cedar in the Red Mountain area, it appears that the average duration of use for a huckleberry field in that area was between approximately 80-100 years. Around 1930-1940, Indian huckleberry use shifted away from traditional huckleberry fields in the vicinity of Red Mountain to areas which were more accessible to automobiles and perhaps more productive, such as Sawtooth Berry Fields and Potato Hill. Sawtooth Berry Fields, just north of the watershed boundary, is now the principal Indian gathering site on the Mt. Adams Ranger District

There are limited historical records on huckleberry collection and even poorer current records. Last year, the Forest Service once again required permits for both personal and commercial collection of huckleberries. These records are listed below in Table 21.

Table 21. Huckleberry Permits and Gallons Picked, Mt. Adams Ranger District

Year	1931	1932	1933	1934	1935	1936	1937	1938		1994
Non-Indian	5101	5549	4546	600	5500	5777	7862	9901		6203
Indian	1204	830	865	200	500	1034	910	1195		-
Gals. Picked	59000	52467	59056	3370	20336	31067	24977	46467		-

Because the data presented in Table 21 is for the entire District, our interpretation is limited of huckleberry availability and use solely from the Little White Salmon Watershed. This is further complicated by the fact that huckleberry picking by both Indians and non-Indians shifted north to the Sawtooth Berry Fields in the 1930's. The Sawtooth Berry Fields are still heavily used today. These numbers do indicate the comparative use by Indians versus non-Indians.

Peeled Cedars

Peeled cedar trees continue to be found in the watershed. To date, 386 peeled cedar trees have been found. Many more peeled cedar trees are known to occur, but were logged. At present, only four peeled cedar trees have been recorded in the vicinity of Big Huckleberry Mountain, and none have been recorded in the Lusk Creek drainage, although a number of surveys have been conducted there. One explanation for the low numbers of peeled cedars in the Little White Salmon Valley is the fact that logging began at a fairly early date there, particularly at the low elevations. Much of the early shake-bolt cutting also would have selectively removed cedar from the stands. An early reference to peeled cedar trees in the Little White, written as part of a series on the history of Skamania County, corroborates that logging had an impact on the current distribution of peeled cedar trees:

> On the trail to Big Huckleberry you can still see many cedar trees that have had one side stripped for use in basket making. While cutting timber on Lusk Creek, below Little Huckleberry, I counted the growth rings on a tree the Indians had stripped for bark. It indicated being stripped just about the year 1810, and we could still see the hack marks from the old stone axes used to cut the bark (Nielsen 1958).

Today, a portion of the peeled cedars not selected for preservation continue to be cut for timber. As a mitigation measure, a percentage of the trees are high stumped so that the year of peeling can be determined.

Trails

Many of the Indian trails have been incorporated into Forest Service trails and roads. This would include the Lava Beds Trail, the Cedar Creek Trail, the Little Wind River Trail, the Little Huckleberry Trail, Cougar Way Trail, the Pacific Crest National Scenic Trail, the Lost Creek Trail, and the East Crater Trail. The utilization of Indian trails as Forest Service trails began as early as 1910 (Stabler 1910).

Other Cultural Sites

Undoubtedly, other prehistoric sites occur within the watershed with significance to Indian culture and history. Of the 11 known sites, none have been excavated. They remain in a protected status pending future actions. Aside from berry fields, peeled cedars, and trails, there have been 16 historical sites discovered in the watershed. This includes berry field camps, talus pits and rock cairns.

Projects Likely To Affect Future Condition

Timber harvest has the potential affect forest succession, both forwards and backwards. This has implication on early seral plants (huckleberries and beargrass) and other plants used be Native Americans.

Fire suppression permits forest succession to advance, barring other disturbances.

Both timber harvest, road construction, and other soil disturbing activities have the potential to disturb prehistoric and historic cultural sites. In addition roads provide access to those who might vandalize historic sites. Such disturbance, besides from preventing interpretation, steals from Indian culture. Roads also facilitate the collection of huckleberries, beargrass, and other forest products.

The offering of miscellaneous forest products to non-Indians increases competition for these resources, though we have no indication as of yet that the availability of these resources has become limiting.

Future Condition

Berry Picking

The historic berry fields on Big Huckleberry Mountain and near Red Mountain are currently located within reserves (Late Successional Reserve RW-152 and Indian Heaven Wilderness, respectively). Reversal toward early seral conditions in these areas would be made possible only by fire or catastrophic wind. While prescribed fire is a possibility in Late-Successional Reserves, the best avenue for creating early seral conditions in both areas is through managing natural fire ignitions (lightning). Currently, there is no specific fire management regime for LSR RW-152. The Indian Heaven Wilderness fire management plan does allow letting confined fires burns under limited conditions.

Little Huckleberry Mountain remains in the Matrix. Current tree sizes would not drive timber harvest in the near future; however, an aggressive prescribed fire regime to create some early seral patches may be possible.

Elsewhere in the watershed, promotion of huckleberry and beargrass will likely occur as a result of timber harvest. Past clearcut and shelterwood harvests provided early seral conditions favorable to huckleberries and beargrass. This trend is likely to continue. Roads associated with timber harvest would also facilitate the collection of berries and beargrass by both Indians and non-Indians. Picking huckleberries remains a popular pastime with non-Indians, and it is likely that their pressure on the huckleberry resource will continue.

ROD designated Riparian Reserves place true riparian habitat and the adjacent upland forest stands where western redcedar occur into a "no harvest" allocation. This would include all of the western redcedar ecoclass zone. Consequently, this allocation will aid in the preservation of a portion of the remaining peeled cedar trees and other mature western redcedar which are large enough to peel. Restoration projects which favor western redcedar in riparian zones and upland plantations will also promote the species in the long term. There remain a number of peeled cedars which are located in upland stands within the Matrix allocation. These trees may be subject to timber harvest.

Peeled Cedars

The continued upward trend of recreational use of the National Forests suggest existing trails are likely to be used and maintained. Consequently, portions of the historic Indian trails that have been incorporated into the Forest Service network will remain recognizable.

Trails

Cultural resource surveys, which are required prior to site disturbing projects, will likely unveil more pre-historic and historic cultural sites in the watershed. Continued consultation with the Yakama Indian Nation would be required in managing and protecting these and currently known sites.

Other Cultural Sites

Data Gaps

- Productivity potential of huckleberry and beargrass in partial cut timber harvest regimes.
- Location of cultural sites still as yet undiscovered.
- Sacred places/tradition use sites held confidential to the Yakama Indian Nation.

CHAPTER IV RECOMMENDATIONS

This chapter consists of four parts:

1. Recommendations for Special or Unique Areas
2. Recommendations for Previouly Proposed Projects
3. Recommendations for Restoration Projects
4. Recommendations for Monitoring

Recommendations for Special or Unique Areas

Maintain and improve riparian late-successional linkage between the 100 acres Owl Cores and the larger reserves (LSR, MLSA). This may be accomplished through precommercial thinning to speed or maintain stand development, managing the placement of commercial timber harvest units so as to maintain old growth stands contiguous with old-growth stands in reserves, and through the selection of roads to be obliterated or decommissioned.

Late-Successional Reserves (LSR, MLSA, 100 acre Owl Cores)

Aggressive fire suppression and lack of other management activities, increases the odds of a catastrophic fire event, especially within Fire Group 3. This would apply to LSR RW-148 (Big Huckleberry) and the 100 acre Owl Cores within the Key portion of the watershed. Prescribed fire (underburns, management of natural starts) could reduce the risk or impact of a catastrophic, stand replacing fire. Thinning young plantations within the LSR may speed the development of late-successional conditions and may also reduce long term fire hazard.

Fire is less of a concern within the MLSA. Management of the western white pine within plantations in MLSA poses a question. Many of the planted western white pine is infected with blister rust. In order to maintain the white pine, which is native to these stands, management options include pruning the lower branches and or thinning the stand and underplanting with disease resistant western white pine.

Manage the perimeter of the 100 acre Owl Cores to increase interior conditions and reduce the potential impact from fire and wind. This may influence cutting prescriptions on adjacent stands, management of adjacent plantations, and closing roads

Grassy Knoll

Grassy Knoll is a located in LSR RW-148 (see recommendations for Late-Successional Reserves). Through fire and thin soils, Grassy Knoll is maintained in an early successional condition, providing unique botanical qualities. These unique qualities and ecological processes need to be recognized within the overall management for late-successional attributes.

Berry Fields

Managed fire on Big Huckleberry (now within the LSR) and Little Huckleberry ridges may help accentuate the huckleberry resource. Both sites are historic berry fields. Continued consultation with the Yakama Indian Nation is required regarding all projects affecting traditional uses.

Pale Blue-Eyed Grass and Branching Montia

We need to complete the conservation strategy for pale blue-eyed grass and write the draft conservation strategy for branching montia.

Oak and Chinquapin Areas

Oregon white oak and golden chinquapin are located on the thin soil ridgetops mainly within the Key portion of the watershed. These species may be adversely impacted by fire suppression, sheep grazing, or overtopping by conifers. The widespread early seral conditions following fire, which probably facilitated these species distribution, is not the current condition nor the desired managed condition. Consequently, maintenance of these species is dependent on some kind of disturbance, such as prescribed fire. Golden chinquapin requires disturbance to regenerate by seed or vegetative sprouting.

Golden hairstreak butterfly, a sensitive species, is exclusively associated with chinquapin. Recommend addition surveys to obtain basic information (e.g. population size) on known sites. The conservation management strategy that is currently underway for golden chinquapin and the golden hairstreak should be completed and executed. In the interim any action affecting golden chinquapin need address golden hairstreak. Furthermore, applications of herbicides or pesticides, particularly BTK, should be avoided in the vicinity of golden chinquapin populations. Also consider a limited operating season for heavy traffic, such as log haul, for the lower two miles of Road 6605 and for Road 8600.130 to protect larvae, adults, and nectar resources from June through September.

Big Lava Bed

Recommend that a management plan for the Big Lava Bed be written to clarify and incorporate Forest Plan direction. There is lack of clear understanding regarding management direction and lava rock extraction. The current scale and intensity of mining operations does not appear to be causing a significant problem.

Proposed projects need consider impact to Larch Mountain Salamander, bats and sensitive plants. Another specific area of concern is petroleum fuel contamination of the water table below the Big Lava Bed, given the significance Lost and Lava Creeks have in maintaining the quality of water in the Little White Salmon River and low capacity of basalts to filter petroleum products.

Big Lava Beds has been a destination of explorers, lichenologists, mushroom hunters and botanists; interpreting the area would be worthwhile.

Lava Tube and Caves

An extensive network of lava tubes and caves parallel Road 60 near the junction of Road 66. We need to implement the management plan for caves which have them. For the majority of caves which do not have management plans, the following protective measures should be implemented:

- Physical protection of shallow running lava tubes from machinery on the surface.
- Prevention of the dumping of trash and spillage of petroleum products into cave entrances.
- Management of vegetation near cave entrance to maintain cave microenvironment (i.e. humidity)
- 250 foot buffering of cave entrance from timber harvest (ROD S&G) pending survey for sensitive bat species.

Talus

Recognize that talus slopes are a unique habitat for many species including Larch Mountain salamander which is a sensitive species.

South Prairie

The unique nature of South Prairie is reflected in its allocation as both Geological and Botanical Special Interest Area. Its attributes include sensitive plants (pale blue-eyed grass), bogs, early successional opening for wildlife, open space, the lake, cultural significance, and a hydrologic recharge area for Big Lava Bed. Road 66 fragments the wetland, creating a lake apart from the meadow. Cattle graze the meadow throughout the summer and were present decades ago along with horses and sheep. Lodgepole pine is currently encroaching the perimeter of the meadow. These conditions suggest some kind of action may be warranted; however, this analysis does not provide the level of detail necessary to understand site specific ecology of South Prairie. It would be prudent to first develop a management plan for South Prairie, including the adjacent forest stands and bogs.

Western Redcedar and Pacific Yew

Western redcedar was a prevalent species in the lower watershed. Shingle Mountain was so named for the western redcedar which was logged off at the turn of the century. This species is now under-represented in planted stands. Western redcedar is also a desirable species in riparian zones, and culturally important to Native Americans. Consequently, this species should be enhanced where currently and formally present.

Pacific yew fills a similar niche as western redcedar. It is a uncommon species. It also is used by Native Americans and of recent value for the production of Taxol, a cancer fighting drug. Pacific yew was cut or burned during past logging. This species should also be enhanced where currently and formerly present.

Old-Growth Forest

Late-successional and old-growth forest currently comprises 34% (29,342 acres) of watershed's area. It is distributed throughout the watershed and in all forest ecoclasses. Area off limits to timber harvest protect half of the watershed's late-successional and old growth forest (14,634 acres), but it is in a fragmented condition. Interior old-growth forest is limited. When old-growth forest is proposed for harvest within Matrix lands, consider the spatial distribution and size of existing stands. Where possible, maintain old-growth forest in large blocks and adjacent to old-growth in reserves, in order to maintain interior old-growth conditions until younger stands within the reserves develop.

Buck Creek (White Salmon Municipal Watershed)	Because of eastward tilting bedrock, sub-surface waterflow in Subwatershed LE, has the potential to affect water quality in Buck Creek, which is east of this watershed. Possible pollutants to groundwater include spilled petroleum, fertilizer, and fecal coliform. Currently, there are no timber sale or timber stand improvement projects proposed in this area. This area is located within the Twin Buttes Goat and Sheep Allotment. This allotment has been inactive for the last four years, but may be re-activated. The Oklahoma Trail, which is open to livestock, also crosses this subwatershed. This land is currently being offered to the Washington Department of Natural Resources in exchange for land already acquired by the Forest Service in the CRGNSA.
Moss Creek	Moss Creek probably drains the Big Lava Bed. It currently provides a constant flow of very cold water. Along with Lava Creek, these streams are integral to resultant quality of water reaching the downstream federal hatcheries and Columbia River, particularly during the summer low flows. The quantity and quality of this water needs to be maintained.
Riparian Reserves	The network of Riparian Reserves in this watershed do protect a substantial amount of the current late-successional and old-growth forest and should provide adequate connectivity for dependent wildlife in the future. In the interim, however, they require focused action to meet their intended function. Stream crossings by roads should be reduced by road obliteration or decommission, particularly within subwatersheds with a high number of crossings (Subwatersheds K, LE, V, and W), and small culverts replaced to meet 100 year flood events (ROD S&G p. C-33 RF-4). As stated previously under the old-growth recommendations, old-growth on General Forest (Matrix) should be retained where possible adjacent to old-growth in reserves. Also, underburning and prescribed fire should be considered within the Riparian Reserves on intermittent and small perennial streams in Fire Group 3 (grand-fir zone in the Key portion of the watershed). This would reduce fuels and reduce the impact of a large stand replacing fire within an area that has had a fire return interval of 100 years and has not had a large fire since the 1820s.
Riparian Hardwood Areas	Large riparian hardwood stands occur along the mainstem of the Little White Salmon River and Lava Creek (southern). Smaller hardwood strips occur along the alluviated reaches of numerous other streams (i.e. Lusk Creek). While the hardwoods are a desirable component, these same reaches are deficient in large woody debris. Large diameter conifers best meet this need. We need to review these areas and identify reaches where we can restore and/or enhance conifers. Such projects may include under-planting western redcedar or releasing existing western redcedar from hardwood competition..
Lakes	The current trend to move users away from the edge of lakes in the Forlorn area and Indian Heaven Wilderness needs to continue. Monitoring of the riparian condition and water quality should continue. Place nesting structures in the vicinity of wetlands, meadows, and recreation sites. Snags have been selectively removed from the landscape and species like osprey *(Pandion haliaetus*), bats, and large cavity users could benefit. Nest structure to include tree-top platforms, tree-trunk excavations, boxes, and or artificial "trees" for holding nest structures.
Amphibian Predation	Reconsider stocking of all the lakes, particularly within Indian Heaven Wilderness. Some introduced fish stocks maybe predators to some natural amphibians. Study and compare amphibian populations in stocked and un-stocked lakes.
Springs	Springs are of value both to water quality/quantity and to wildlife (i.e. amphibians). Consider protective measures for low elevation springs, which may be most susceptible to impact from sheep grazing should the Twin Buttes Allotment be re-activated.

Wetlands are a unique and limited habitat throughout the watershed. Management activities to maintain this habitat may be prescribed on a site specific basis.

Wetlands

Recommendations for Previously Proposed Projects

Monte Cristo Research Natural Area Proposal

This proposed RNA would preserve a high diversity area. The ridgeline area is mix of early-successional forest, rock outcrops, and talus, which is already designated a Biological Special Interest Area in the Forest Plan. The lower slopes are late-successional and old-growth forest in the grand fir ecoclass. These forest are optimal thermal cover for deer and elk, and also nesting habitat for a nearby spotted owl. A short fire return interval may be contributing to the diverse conditions along the ridgeline. Prescribed burning should be considered in the management plan.

Recreational use of the Monte Carlo Trail (#52) conflict with maintaining botanical values. Lithosol on ridges are subject to damage from bikes and horses. Signs interpreting the Botanical Special Interest Area may be erected on Monte Carlo, to help protect and share this resource. Uses appropriate for the Monte Carlo Trail should be reviewed.

Much of productive forest land lying within the proposed RNA boundary is potentially unstable ground which has been incorporated into the Riparian Reserves. Thus, establishment of the RNA would have little to no effect on the Forest's potential sale quantity (PSQ) and would contribute toward the aquatic conservation objectives.

Oklahoma Loop Trail

Proposed routes generally follow the ridges of the Monte Cristo Range. Some lower elevation roads have been proposed to be converted into trail. As streams are avoided, the project would have little aquatic impact. Trail construction/use may conflict with the biodiversity found along the ridgetops.

Forlorn Lakes Recreation Projects

We continue to move camp sites away from the lakes' edges, provide vault toilets, and control vehicle access. This trend reduces riparian impacts and compaction/erosion. Future projects include the construction of loop trails and viewing/fishing platforms. To the extent this minimizes use and the proliferation of user created trail, the riparian zone would benefit. Trail constructed around lakes need consider water flow to and from lakes and effects to amphibians.

Noxious Weed Control

An existing Memorandum of Understanding between the Gifford Pinchot National Forest and Skamania County, will result in a list of noxious weed projects prioritized across the county, and including some within the Little White Salmon Watershed. The projects will be determined late in 1995 and will be implemented as soon as funds are available. This approach is expected to reduce introductions of weeds from other watersheds, as well as treat populations within this watershed. These projects must be done in conjunction with weed preventative measures and eradication activities within a planning area.

Timber Stand Improvement Projects

Timber stand improvement projects consist of pruning , thinning , inter-planting and/or fertilization of plantations. These plantations occur in various allocations (riparian reserves, matrix, winter range, LSR). Recommendations are as follows:

- Continue to tailor prescriptions (e.g. leave tree spacing and species) to meet allocation objective.
- For precommercial thinning, favor healthy naturally occurring trees over the planted trees particularly when planted trees make up the vast majority of the stocking. This will

ensure that natural regeneration is maintained as an important component of the stand. In addition retain rare species (Pacific yew, western redcedar, golden chinquapin)

- Prune western white pine to reduce the incidence of blister rust. Use genetically resistant stock for artificial regeneration in initial plantings and underplantings.
- Consider precommercial thinning stands in subwatersheds with low Aggregate Recovery Percentage (ARP)(Subwatersheds C, DS, K, LE, Q, V, and W). Short-term effects of marginally opening the canopy need to assessed with long-term benefits of stand development and attainment of "recovered" hydrologic condition.
- Target riparian thinning in subwatersheds with a high percentage of early seral riparian conditions (Subwatersheds C, DS, G, LW, V, and W). Riparian thinning should result in a community over time that approximates the reference conditions. Vary prescription by stream class; consider underplanting.
- Consider thermal cover, hiding cover, or forage needs within deer and elk winter range.
- Consider and meet LSR or MLSA objectives for late-successional attributes.
- Create half acre gaps in plantations, taking advantage of areas with low stocking.

Little White DEMO (LW Timber Sale)

The following concerns with DEMO were noted:

- High total road density, high open road density (Subwatershed G)
- Peak Flows
- ARP's at threshold (Subwatershed G)
- Moderate diversity (Subwatershed G)
- Lava owl pair below habitat threshold at 1.8 mile radius, incidental take situation
- Berry Creek has sensitive channel types that have shown past widening (Subwatershed LW)
- Mass wasting potential
- Riparian reserves have a high percentage of early seral conditions.
- Removes interior habitat

The following recommendations for DEMO were made:

- Helicopter log units so as to avoid new road construction in Key watershed on potentially unstable soils in the vicinity of streams.
- Take advantage of opportunities to minimize impacts from helicopter logging in the placement of landing locations and fueling areas. Pick sites that cause the least disturbance and consider restoration opportunities. Avoid riparian areas, spotted owl home ranges, pair circles, Big Lava Bed.
- Do not expand Unit 3 beyond study grid boundary, because it will reduce habitat within 1.8 miles of the Lava pair.
- Monitor the effects of DEMO on the Lava pair to determine if "take" occurs. Assess effect of habitat reduction and helicopter logging.
- Protect riparian reserves where possible in placement of aggregate leave areas; avoid riparian reserves in the placement of aggregate patch cuts within the parameters of the study.
- Subwatershed LW drains into Berry Creek. The health of Berry Creek requires further investigation as aquatic indicators conflict with one another.
- There is a monitoring opportunity to validate aquatic predictors
- Use purchaser and KV funds for road maintenance and/or road decommission.
- Use K-V funds to thin nearby plantations within riparian reserves.

Other Commercial Timber Sales (Jammin)

One product the District Ranger desired from this analysis was to identify an additional timber sale opportunity which would be consistent with Aquatic Conservation Objectives. This sale was tentatively named the Jammin Timber Sale for the purpose of tracking. Using the Aquatic and Terrestrial Synthesis Table (Appendix A), the watershed analysis team identified the aquatic subwatersheds where timber harvest would be appropriate given current conditions. Subwatersheds A, B, DW, H, J, LW, M, and RE were identified as being within most threshold levels. As the Little White DEMO had already been proposed in Subwatershed LW, this subwatershed was not considered further. The remaining subwatersheds were assessed on the potential volume (PSQ) they could yield and grouped by proximity where yields were low. Subwatersheds B and LW had low potential volumes, and were not considered further as there were no adjacent subwatersheds which could have been added to raise the total volume of the project. Because of commercial thinning opportunities in Subwatershed RW, it was lumped with M and RE. Consequently, four possible areas were identified for Little Timber Sale:

1. Subwatersheds A, DW: High elevation, low volume stands. Concerns not addressed in the synthesis table include scenery and proximity to Indian Heaven Wilderness.
2. Subwatershed H: Lusk Creek
3. Subwatershed J: Little White Salmon River headwaters
4. Subwatersheds M, RE, RW: Well roaded. Primarily commercial thinning opportunities.

The following recommendations were made for the timber management program throughout the watershed:

- Conserve off-site genetic material be continuing to manage the Mid-Columbia Tree Improvement Coop Evaluation Plantations, the Coyote Seed Orchard, and sample seed lots from select trees stored at Dorena Tree Improvement Center.
- Use combinations of natural regeneration and genetically adapted artificial regeneration in timber sales to enhance genetic variability.
- As opportunities arise, install "mass selection" plantations for ponderosa pine in the grand fir ecoclass and western larch in the Pacific silver fir ecoclass. Mass selection plantations serve as less-intensively managed seed orchard, and help to preserve genetic diversity by providing additional off-site pools of genetic material.
- Consider genetic testing as opportunities arise in harvest units with high mature tree retention levels.
- Where feasible, retain representative large, remnant tree which have survived previous stand-replacing fires.
- Leave trees in timber sales (all harvest prescriptions) should include representatives of the least abundant species in the area as prescribed on a site-specific basis.
- Consider thinning high density, even aged stands to increase species richness and reduce the possibility of large-scale insect outbreaks. Also consider creating stand gaps or openings and underplanting as prescribed on a site-specific basis. Thinning prescriptions should address the possibility of future competing and unwanted vegetation, such as vine maple, at the time that the stand will be regenerated.
- Retain overstory seed trees in existing shelterwoods for frost protection of regeneration, structural diversity, plus future large snags and down wood. This may exceed the 15% green tree retention minimum specified in the ROD.
- Protect or enhance the remnant old-growth western white pine near Road 6020 in the vicinity between the junction of Road 6030 and 6020.040.

Twin Buttes Sheep and Goat Allotment

Several resource areas would be sensitive to sheep grazing. Concerns includes fecal coliform input to streams, impact to riparian vegetation, increase in bank cutting, changes to plant communities possibly accentuating noxious weed populations, and general soil compaction. The District and this watershed has a long history of sheep grazing since the turn of century. While historic head levels were quite large (100,000 head), sheep grazing in recent decades have been much lower (1100 head). There has been no grazing within the last three years. This provides an opportunity to gather pre-grazing measurements prior to the potential re-activation of this allotment.

- Measure coliform levels in perennial stream below the Road 1831.020 (Berry Creek) rock pit. This rock pit was traditionally used to pen sheep early in the season while they acclimated to the vegetation. Sheep were watered in this stream. Compare coliform levels to nearby ungrazed streams (i.e. Road 1800.080 tributary). Riparian condition could be assessed as well.

- Assess vegetative changes in plantations grazed in 1989. These plantations were intensively grazed for several months in an attempt to control vegetation (mainly shrubs) competing with conifers. These plantations may also be evaluated for soil compaction.

- Assess macroinvertebrate/large insect populations along selected streams. These species area sensitive to change in riparian/water conditions and are indicators of ecosystem health.

- Use recently initiated range condition survey to assess forage availability, and current forb/shrub composition.

- Identify and protect sensitive habitats and species (i.e. sensitive plants, wetlands, low elevation springs likely to be grazed).

If the RNA is established, grazing would be in conflict with management policy for RNA's

A rest rotation grazing scheme has been suggested for future implementation. This would have the Key portion of the watershed grazed for three months every other year (sheep would graze the Twin Buttes area in the intervening years). The watershed analysis team recommends the least intensive system, with impacts constantly dispersed, rather than incurred periodically. Natural ungulate grazing is constant year to year, and not subject to roving herds as in ecosystems where the rest-rotation grazing scheme was devised.

The conditions in several subwatershed suggest sensitivity to grazing:

- High percent early seral in riparian reserves : C, DS, G, LW, V, and W.
- Sensitive channel types: H, RE, RW, S, W, and LE
- Sensitive channel types with stream widening: I, K, W, P, and Q

Recommendations for Restoration

HEALTH ELEMENT: **AQUATIC CONDITION**

Large Woody Debris Placement in the LWSR

Project Name: **Large Woody Debris Placement in the Little White Salmon River**
Location: River Mile 6.3 - 11.7.
Health Measure: Little White Salmon River exceeds State temperature standards of federal land. Sediment a concern for downstream federal fish hatcheries. Maintain or improve fish habitat/populations
Objective: Add habitat complexity, trap spawning gravels, provide bank stability, store sediment, decrease water temperature and increase fish populations, on a degraded segment of the Little White Salmon River (see Map 0 - Fish Habitat Condition).
Description: Place large woody debris in Little White Salmon River. No site specifics have been determined.

Large Woody Debris Placement in Lusk Creek

Project Name: **Large Woody Debris Placement in Lusk Creek**
Location: River mile 0 - 1.0.
Health Measure: Little White Salmon River exceeds State temperature standards on federal land. Sediment a concern for downstream federal fish hatcheries. Maintain or improve fish habitat/populations
Objective: Add habitat complexity, trap spawning gravels, provide bank stability, store sediment, decrease water temperature and increase fish populations. This reach of the Lusk Creek is lacking large woody debris, has water temperatures approaching the State maximum (16°C), and of Rosgen channel type C.
Description: Place large wood debris in Lusk Creek, between river mile 0 - 1.0 (Specific sites have been determined).

Large Woody Debris Placement in Lost Creek (North)

Project Name: **Large Woody Debris Placement in Lost Creek (North)**
Location: Above stream mile 3.3 (above diversion)
Health Measure: Meet State temperature standards. Maintain or improve fish habitat/populations
Objective: Add habitat complexity, trap spawning gravels, provide bank stability, store sediment, decrease water temperature and increase fish populations. This reach of the Lost Creek (north) is lacking large woody debris, has water temperatures approaching the State maximum (16°C), and of Rosgen channel type C.
Description: Place large woody debris in stream. No site specifics have been determined. Some in-stream structures were placed in this area of the stream in 1988.

Lost Creek (North) Stream Diversion Modification

Project Name: **Lost Creek (North) Stream Diversion Modification**
Location: From the diversion intake to below the 24 - 041 road.
Health Measure: Meet State temperature standards. Maintain or improve fish habitat/populations
Objective: To lessen the amount of stream flow diverted during the summer critical low flow period. This will help to lower stream temperatures, increase available fish habitat area, and increase deep pool fish habitat.
Description: Options include piping the water to the desired site in the ditch, or construction of ponds or troughs suitable for cattle watering. The ponds or troughs could be filled with the ditch water, and then the diversion intake could be closed for the rest of the season.

There is the potential to involve outside partners in this project. Potential partners include the Washington Department of Fish and Wildlife (who have shown much interest in this project), local fishing clubs and wildlife partners (i.e. Rocky Mt. Elk Foundation) as the watering sites would also benefit wildlife.

Lost Creek (North) Diversion Dam Modification

Project Name: **Lost Creek (North) Diversion Dam Modification**
Location: At diversion intake.
Health Measure: Maintain or improve fish habitat/populations.
Objective: Provide upstream fish passage through the currently impassable dam. This diversion dam is the only migration barrier on Lost Creek.
Description: Remove the west side of the dam to allow for fish passage.

Reintroduction of Steelhead into the LWSR

Project Name: **Reintroduction of Steelhead into the Lowest Reach of the Little White Salmon River**
Location: Little White Salmon Hatchery
Health Measure: Maintain or improve fish habitat/populations in the Little White Salmon Watershed. Anadromous fisheries currently limited to Drano Lake.
Objective: The objective is reintroduce naturally produced steelhead into a portion of the Little White Salmon River that may have had steelhead in the past, from the hatchery dam to the natural migration barrier at river mile 2.0. This would slightly increase the natural production of Columbia River steelhead in the lower Columbia Basin.
Description: Steelhead are currently stopped by the Little White Salmon Hatchery dam. Steelhead that do maneuver up the existing fish ladder would be placed upstream of the dam. Implementation of this project is pending genetic testing of steelhead to determine if they are hatchery or native stocks. If these steelhead are hatchery produced, passing them upstream would give no genetic advantage to naturally-produced Columbia River steelhead population. This project is proposed and would be implemented by the USFWS.

HEALTH ELEMENT: **RIPARIAN CONDITION**

Decoy #5 Riparian Conifer Release

Project Name: **Decoy #5 Riparian Conifer Release**
Location: Decoy #5 (Subwatershed H) (Inventory of other possible sites has not been completed).
Health Measure: Little White Salmon River exceeds State temperature standards. Sediment a concern for downstream federal fish hatcheries. Maintain or improve fish habitat/populations.
Objective: Maintain the conifer component within a 10 acres riparian zone previously harvested and planted about 10 years ago. The purpose of the project is to improve future down woody debris recruitment in this resident fish-bearing tributary of Lusk Creek.
Description: Cut red alder and other hardwood species to release existing conifer seedlings and saplings. This actions may be combined with other thinning projects in the vicinity.

Indian Heaven Wilderness Lakeshore Campsite Rehabilitation

Project Name: **-Indian Heaven Wilderness Lakeshore Campsite Rehabilitation**
Location: Lakes in Indian Heaven Wilderness (e.g. Blue, Tombstone, Sahalee, and Tyee).
Health Measure: Sedimentation. Maintain or improve fish habitat/populations.
Objective: Restore riparian vegetation and soil condition to improve water quality and riparian wildlife.
Description: Aerate soil, inbed rocks, transplant vegetation, and prohibit camping in specified areas along lakeshores.

Project Name: **-Goose and Forlorn Lakes Campsite Rehabilitation**
Location: Dispersed campsites in the riparian zone of Goose and Forlorn Lakes.
Health Measure: Sedimentation. Maintain or improve fish habitat/populations.
Objective: Restore riparian vegetation and soil condition to improve water quality and riparian wildlife.
Description: Aerate soil, inbed rocks, transplant vegetation, and prohibit camping in specified areas along lakeshores.

Goose and Forlorn Lakes Campsite Rehabilitation

Project Name: **Lost Creek \ Road 60 Bridge Campsite Rehabilitation**
Location: Road #60 bridge
Health Measure: Sedimentation. Maintain or improve fish habitat/populations
Objective: Decrease sediment input into the stream, decrease soil compaction
Description: Revegetate areas currently being used as dispersed campsites above and below the bridge. Place structures to deter use of the sites adjacent to the stream.

Lost Creek \ Road 60 Bridge Campsite Rehabilitation

Project Name: **Road Obliteration, Decommission, Maintenance, and Road-to Trail Conversion**
Location: Watershed-wide, but initially within the Key portion of the watershed.
Health Measure: Sediment is a concern for downstream federal fish hatcheries. Maintain or improve fish habitat/populations. Reduced the road erosion and the high number of stream crossing.
Objective: The objective is to reduce road crossings and overall sedimentation caused by roads to the benefit of water quality and fisheries. Effective road closure also reduce open road density to the benefit of wildlife.
Description: Road restoration prescriptions priorities have been tentatively developed based on four sources of information:

Road Obliteration, Decommission, Maintenance, and Road-to Trail Conversion

1. The desired future condition (DFC) for each road as determined through the Mt. Adams Access and Travel Management Plan (phase 1).
2. Road condition surveys (A&TM phase 2) for all system roads in the Key watershed (non-Key road surveys are in progress).
3. Subwatershed aquatic conditions as listed in the Watershed Analysis Synthesis Table.
4. Potential for land exchange to Washington Department of Natural Resources (DNR).

Based on the road condition surveys, roads exhibiting erosion, mass failure, plugged culverts, and culverts preventing fish passage were identified. Based on the Watershed Analysis Synthesis Table, Subwatershed I, K, LE, LW, P, Q, S, V and W were determined to be exceeding multiple aquatic thresholds.

Road Obliteration or Decommissions (not yet determined)

Priority 1 - DFC is decommission (code O), and road is exhibiting problems.

Road	Miles	Road	Miles
1800.101	0.8	1831.708	0.2
1800.121	1.0	8600.121	1.4
1800.772	0.1	8600.132	1.5
1831.081	0.8	8600.141	2.4
		Total miles	**8.2**

Priority 2 - DFC is decommission, and subwatershed is exhibiting problems.

Road	Miles	Road	Miles
1800.712	0.1	1831.701	0.1
1800.714	0.2	1831.702	0.3
1800.716	0.1	1840.100	0.6
1800.717	0.4	1840.702	0.5
1800.752	0.2	1840.710	0.3
1800.753	0.2	8600.080	0.5
1800.754	0.3	8600.752	0.1
1800.776	0.1	8600.756	0.1
1800.781	0.1	8600.757	0.3
1800.782	0.1	8600.758	0.3
1800.785	0.3	8600.779	0.3
		Total miles	**5. 5**

Priority 3 - DFC is decommission but neither road or subwatershed is exhibiting problems.

Road	Miles	Road	Miles
1800.779	0.3	6605.705	0.4
1800.791	0.5	8600.765	0.1
6605.704	0.3	**Total Miles**	**1.6**

Road Decommission or Maintenance (not yet determined)

Priority 1 - DFC is passive or active access closure (codes F or G), and road and subwatershed are exhibiting problems.

Road	Miles	Road	Miles
1800.000	5.0	1840.051	1.2
1800.130	0.9	1840.055	0.2
1800.181	1.7	1840.080	1.0
1800.186	0.4	1840.704	0.3
1800.201	0.2	6600.016	1.0
1800.733	0.6	6600.020	2.5
1800.772	0.1	6600.040	0.6
1831.020	2.5	6600.044	1.3
1831.031	2.8	6600.050	2.9
1831.040	1.8	8600.105	0.3
1831.051	0.5	8600.106	0.9
1840.041	0.3	8600.110	2.3
		Total miles	**31.3**

Priority 2 - DFC is passive or active access closure, and road is exhibiting problems.

Road	Miles	Road	Miles
1800.230	1.1	1840.071	0.7
1800.271	0.5	1840.221	0.7
1800.281	0.8	6800.580	2.2
		Total miles	**6.0**

Priority 3 - Identified for DNR land exchange, and road is exhibiting problems.

Road	Miles	Road	Miles
1800.050	2.1	1840.025	0.3
1840.021	0.7	1840.030	1.6
1840.023	0.3	**Total miles**	**5.0**

Road Maintenance (DFC is to keep road in system (code A, B, or E), and road is exhibiting problems)

Road	Miles	Road	Miles
1800.000	0.4	1840.020	3.0
1800.080	1.8	6600.000	16.2
1800.230	1.0	6605.000	9.2
1831.000	2.7	6800.000	5.6
1831.070	3.4	8600.000	8.8
1840.000	8.8	**Total miles**	**60.9**

Road-to-Trail Conversion

Priority 1 - DFC is road-to-trail conversion (code H), and road is exhibiting problems.

Road	Miles	Road	Miles
1800.201	1.2	8600.088	0.9
1800.766	0.5	8600.098	0.5
8600.085	1.0	8600.141	2.4
		Total miles	**6.5**

Priority 2 - DFC is road-to-trail conversion, and subwatershed is exhibiting problems.

Road	Miles	Road	Miles
1800.220	0.8	1840.717	0.2
1800.752	0.3	8600.130	
1800.763	0.5	8600.735	0.2
		Total miles	**3.7**

HEALTH ELEMENT: **UPSLOPE WATERSHED CONDITION**

Precommercial Thinning

Project Name: **Precommercial Thinning**
Location: Plantations with trees less than 8 inches in diameter (DBH). Specific units have not been identified.
Health Measure: Subwatershed hydrologic recover as measured by ARP and movement of stand development toward late-successional conditions.
Objective: Maintain stand growth and avoid stagnation within conifer plantations. This will provide incremental hydrologic recovery (ARP) within the watershed so as to moderate peak flows in streams. Precommercial thinning also meets timber supply and wildlife habitat objectives as well.
Description: Thin common conifer species so as to maintain growth of dominant trees and minor conifer species. Implement other recommendations for precommercial thinning as

listed in the previous section on Recommendations for Specific Management Activities and Projects.

Sub-Soiling Non-Obliterated Temporary Roads

Project Name: **Sub-Soiling Non-Obliterated Temporary Roads.**
Location: No specific locations have been identified.
Health Measure: Sedimentation. Subwatershed hydrologic recovery.
Objective: The objective is to correct compacted temporary roads in old plantations to reduce erosion and improve site productivity. Priority roads are temporary roads within or near riparian zones within subwatershed basins noted for high past compaction (Subwatersheds C, DE, DS, E, K, LE, P, S, and V).
Description: Mechanically sub-soil temporary roads. Sub-soiling is analogous to deep plowing with a winged ripper. Accomplish with Knutson-Vandenberg funds from nearby timber sales.

HEALTH ELEMENT: **WILDLIFE HABITAT CONDITION**

Homes Creek Wetland Enhancement

Project Name: **Homes Creek Wetland Enhancement**
Location: SW 1/4, NE 1/4, Section 2, T4N, R9E (WA state land)
Health Measure: Maintain or improve diversity.
Objective: The objective is to provide a herbaceous wetland (Hall et al. 1985) and increase wildlife diversity. This habitat is scarce on the landscape and highly used by wildlife. Two similar sites in the watershed were sampled for amphibians and yielded approximately 30 larval stage northwestern salamanders. Amphibians as a group are particularly unique in that they depend on both aquatic and upland habitats. As such, they can serve as indicators of community health.
Description: Schedule pond development during the late summer when water flows are minimal. Options include an earthen embankment approximately 20 feet upstream from the existing culvert, as well as using the Road 1840 prism itself as the embankment with below culvert excavation for pond depth. the latter option is considered to be the least impacting. Cavity structures could be installed. This is an interagency cooperative project with the WA Department of Fish and Wildlife.

End of Road 18 Wetland Restoration

Project Name: **End of Road 18 Wetland Restoration**
Location: Plantation at end of road 18 (SW 1/4 SE 1/4 Sec.18, T4N,R9E)
Health Measure: Maintain or improve diversity.
Objective: The objective is to restore the pond-type habitat. Historically, this area provided an important congregating and security area for elk. With the inclusion of surrounding harvest units and roads, which provide an overlook of the wetlands, big-game use here dropped with the increased exposure to predation. Amphibians also breed in the wetland.
Description: Schedule pond development during the late summer when water flows are minimal. Excavate a pond deep enough to hold water over time without filling in from sediment.

Pond Restoration off Road 1840

Project Name: **Pond Restoration off Road 1840**
Location: NW 1/4 SE 1/4 Sec. 17, T5N, R10E
Health Measure: Maintain or improve diversity.
Objective: The objective is to restore wetland ponds which were incorporated into a harvest unit. Amphibians have been located here.

Description: Schedule pond development during the late summer when water flows are minimal. Excavate a pond deep enough to hold water over time without filling in from sediment.

Project Name: **Underplanting Single-Story Forested Stands**
Location: Along Road 1840 (E 1/2 NW 1/4 Sec. 32, T5N, R9E and NW 1/4 NW 1/4 Sec.6, T4N, R10E)
Health Measure: Maintain or improve diversity.
Objective: Underplant single-story forested stands to improve elk and deer biological winter range habitat.
Description: Underplant stands with shade tolerant conifers.

Underplanting Single-Story Forested Stands

Project Name: **Noxious Weed Control**
Location: Key watershed
Health Measure: Maintain or improve diversity.
Objective: Reduce presence of noxious weeds through manual and biological means to improve forage for wildlife and livestock, improve native biodiversity, and reduce compaction and erosion.
Description: Implement noxious weed control projects developed and prioritized by Skamania County per Memorandum of Understanding with the Gifford Pinchot National Forest.

Noxious Weed Control

Project Name: **Road Signing on Existing CFR Seasonal Road Closures**
Location: Elk and Deer Biological Winter Range, Little White Salmon River
Health Measure: Maintain or improve diversity.
Objective: The project objective is to effectively reduce open road density in winter range and reduce wildlife harassment and mortality. We have attempted to restrict public access to a number of roads via a 1992 CFR order (R6-92-02). This restriction is not legally enforceable as the road closures have not been posted with signs as closed under CFR order. With this project we would install the signs.
Description: Post signs made of corrugated polypropylene with two grommets. This material is cheaper than aluminum ($188 versus $530 for 50 signs) and holds up well to bullets and shot. Existing CFR road closures are covered under order R6-92-02 and include the following roads: 6800-580 after Broughton road jct; 6600-020; 6600-030; 1831-070 (has post & guard rail); 1831-031; 1831-020; 1800-101; 1800-121 (has tank trap); 8600-130; 8600-121; 1800-181; 1800-201; 1800-251; 1840-025; 1840-100. Signs are sold by Shenango Screenprinting (208)-667-1406. If the road obliteration project is also selected, several of these roads will not need to be posted with signs.

Road Signing on Existing CFR Seasonal Road Closures

Project Name: **Winter Range Road Gates**
Location: Elk and Deer Biological Winter Range, Little White Salmon River
Health Measure: Maintain or improve diversity.
Objective: The project objective is to effectively reduce open road density in winter range and reduce wildlife harassment and mortality.
Description: Move existing gate on road 8600-132 to road 8600-130 by the Lusk Creek bridge (find most effective location). Install a new gate at 1800-101, west of the Broughton land exchange. These roads are covered under existing CFR seasonal road closure order R6-92-02. In association with the signing project, this project will reduce motorized traffic on several thousand acres of winter range surrounding roads 8600-130 &141 which interconnect with road 1800-101. If this project is not selected as a

Winter Range Road Gates

watershed restoration project, perhaps it can be included as a KV project under the Little Timber Sale.

Add Boulders to Existing Road Closures

Project name: **Add Boulders to Existing Road Closures in Biological Winter Range to Eliminate All Types of Motorized Vehicle Traffic**
Location: Elk and Deer Biological Winter Range, Little White Salmon River
Health Measure: Maintain or improve diversity.
Objective: The project objective is to effectively reduce open road density in winter range and reduce wildlife harassment and mortality This would be accomplished by adding boulders to existing road barricades (post & guard rails, gates, and tank traps) within biological winter range in order to reduce all types of motorized vehicle traffic including ATVs and snowmobiles.
Description: Boulders would be obtained from the Cabbage Creek rockpit and placed in such a manner as to eliminate the ability of people to transport their motorized vehicles behind the closed road barricades. Existing barricaded roads needing boulders include: 1800.708 (post & guard rail); 1831.070 (post & guard rail); 1840.020 (post & guard rail, thin-walled socket); 1840.041 (gate); 1840.041 (gate); 1840.071 (deep tank trap); 1840.080 (post & guard rail); 6600.080 (post & guard rail, autos can breach this barricade by driving around it); 8600.106 (post & guard rail)

Recommendations for Monitoring

Water Quality

Monitoring Item: Water Quality of the Little White Salmon River and Major Tributaries.
Purpose/Objective: Determine if Aquatic Conservation Strategy Objectives for maintaining or improving water quality is being met, and determine compliance with State water quality standards.
Parameters to Monitor: Temperature, pH, turbidity, conductivity, and coliform for the Little White Salmon River as it leaves the Forest boundary and for other major tributaries in the watershed. (Note. The Little White Salmon National Fish Hatchery will continue to monitor water quality at its location near the mouth of the Little White Salmon River.)
Location/Timing: For this watershed analysis, a water quality monitoring station on the Little White Salmon River near the Forest boundary was re-established. This monitoring station needs to be maintained long-term. Monitoring stations were also established on Berry and Lusk Creeks to develop baseline information. Due to limited equipment and funding, these latter two stations may be rotated to other major tributaries under investigation. **Theses monitoring stations do not assess coliform, which must be done by sampling. Potential re-activation of the Twin Butte Sheep and Goat Allotment further heightens the need for baseline data on fecal coliform.**

Peak and Low Flows

Monitoring Item: Peak Water Flow and Low Water Flow for the Little White Salmon River
Purpose/Objective: Determine if Aquatic Conservation Strategy Objectives for maintaining and restoring in-stream flows are being met. Peak flow data also helps to interpret turbidity data.
Parameters to Monitor: Peak water flow during storm events and summer low flows.
Location/Timing: Water quality monitoring stations (see previous monitoring recommendation also measure summer low flows. Peak flows may be monitored by re-establishing the USGS monitoring stations. In particular, a USGS station where the stream cross section has been calibrated and a measuring rod mounted offers the best

solution. It is unknown at this time if any of the USGS stations on the Little White have been calibrated in this fashion.

Peak Flow Predictions

Monitoring Item: Peak Flows Predictions
Purpose/Objective: Validate peak flow predictive models (ARP, % Increase Two Year Flood)
Parameters to Monitor: Changes in peak flow following harvest.
Location/Timing: The Little White DEMO experiment and Little Timber Sale comprise an opportunity to monitor changes in peak flows in Subwatersheds H, G, and LW.

Water Diversions on Moss and Lava Creeks

Monitoring Item: Water Diversions on Moss and Lava Creeks
Purpose/Objective: Determine actual water diversion under existing water rights. Both streams provide significant cold water to the Little White Salmon River during period of low flow.
Parameters to Monitor: Water removed by diversion. Condition and efficiency of diversions.
Location/Timing: Moss and Lava Creeks during summer lows. The Washington Department of Ecology is now preparing a publication listing the current surface and subsurface rights and projected future water needs for the Little White Salmon River and Wind River Watersheds.

Fish Stocking of Lakes

Monitoring Item: Fish Stocking of Lakes
Purpose/Objective: Determine effects of artificial trout stocking of lakes to other than naturally occurring species.
Parameters to Monitor: Compare stocked and unstocked lakes. Determine if introduced trout act as predators to amphibian and macro-invertebrate populations.
Location/Timing: Stocked lakes in Goose Lake/Forlorn area to non-stocked lakes in Indian Heaven Wilderness.

Recreational Impact to Riparian Zones

Monitoring Item: Recreational Impact to Riparian Zones
Purpose/Objective: Determine effects of human use to riparian ecology.
Parameters to Monitor: Condition of soil and vegetation. Populations of macro-invertebrates and amphibians. Impacts to stream banks and riparian areas. Presence and or spread of noxious weeds
Location/Timing: Developed and dispersed sites throughout the watershed. Special emphasis near or around Forlorn Lakes and Oklahoma Campground

Road Condition Follow-up Surveys

Monitoring Item: Road Condition Follow-up Surveys
Purpose/Objective: Initial road condition surveys have identified road segments where there is a higher probability or risk of resource damage. For roads that will remain in the transportation system, monitoring these segments for maintenance needs will prevent damage and make the most efficient use of limited maintenance funds.
Parameters to Monitor: Road segments identified during road condition surveys. Monitor culverts, erosion, and signs of mass failure.
Location/Timing: Throughout watershed. Prior to onset of fall rains and during major storm events.

Grazing Impacts

Monitoring Item: Grazing Impacts
Purpose/Objective: Determine pre-grazing condition of the watershed pending re-activation of the Twin Buttes Sheep and Goat Allotment.

Parameters to Monitor: Forage condition. Condition of soil and vegetation in riparian areas. Noxious weeds. Presence of coliform in streams.
Location/Timing: Twin Buttes Allotment prior to and after use by permittee. (See recommendations for Twin Buttes Allotment in previous section).

Health of Big Game Populations

Monitoring Item: Health of Big Game Populations
Purpose/Objective: Determine if livestock are transmitting disease to the big game population.
Parameters to Monitor: Health of both the livestock population and big game populations of deer and elk for indications of infectious disease.
Location/Timing: Throughout the watershed in conjunction with both the Twin Buttes and Ice Caves Allotments.

Lava Bed Northern Spotted Owl Pair

Monitoring Item: Lava Bed Northern Spotted Owl Pair
Purpose/Objective: Determine the effects of Little White DEMO and other timber sales on Lava Bed Pair which is already in an incidental take situation based on habitat levels within its 1.8 mile home range. This project contingent on USFWS consultation with Little White DEMO.
Parameters to Monitor: Lava Bed Pair survival and activity during helicopter activities and following habitat reduction.
Location/Timing: Lava Bed Pair before and after management activities.

Oak and Chinquapin Areas

Monitoring Item: Oak and Chinquapin Areas:
Purpose/Objective: Determine condition of unique vegetation type and special habitat.
Parameters to Monitor: Condition, reproductive activity, gain or loss of acreage in type, use of habitat by sensitive butterfly populations. Effects of management activities.
Location/Timing:

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APPENDIX A - LITTLE WHITE SALMON WATERSHED SYNTHESIS TABLE

The following table summarizes data presented within the Little White Salmon Watershed Analysis, permitting a comprehensive look at individual subwaterseds or the watershed as a whole. At the subwatershed scale many of the processes that are otherwise masked at the watershed scale, become more readily apparent. In addition, processes which are related and interacting may also become apparent. The table is formatted as follows:

- Items which are shaded exceed the concern threshold listed at the bottom.
- The thresholds listed were derived specifically for this watershed analysis or represent the Range of Natural Conditions for the Hood-Wind Subbasin, Columbia River Anadromous Fish Policy Implementation Guide, or Forest Plan direction (see respective issues within watershed analysis report).
- Blank fields in the table indicate that data was not available or was not appropriate (such as stream survey data).

LITTLE WHITE SALMON WATERSHED ANALYSIS SYNTHESIS TABLE

TERRESTRIAL

		Biodiversity				T, E, or S Animals				
Subwatershed	Name	Eco Class	% Early-Successional	% Late-Successional/ Old-Growth	Diversity Index	Sp.Owl in Take (center #)	50-11-40 %	Large Blocks of Interior LS/OG	Winter Range Optimal Cover %	Open Road Density mi./sq.mi.
10A	Hdwtrs Goose Lk	MH	6	19	10	none	>50%	Yes	N/A	0.91
10B	Dry Cr.	**PSF/MH**	17 (>25 PSF)	26	11	3020, 318	>50%	No	N/A	1.44
10C	Lost Cr. (north)	**PSF**	44	34	9	3020	36%	No	N/A	2.39
10D east	NE Lava Bed Tribs	**PSF**	28	64	6	none	>50%	No	N/A	3.76
10D south	NW Lava Bed Tribs	**PSF**	39	56	5	none	>50%	No	N/A	4.62
10D west	Spring Cr/Goose Lk	PSF	9	52	7	none	>50%	Yes	N/A	2.66
10E	South Prairie	**PSF**	31	49	14	318	>50%	No	N/A	3.39
10F	Big Lava Bed	Rock	N/A	N/A	15	325	>50%	No	62	0.16
10G	Little Huckleberry	PSF	23	55	8	325	>50%	Yes	42	3.74
10H	W. Fk. Lusk Cr.	GF	14	73	14	none	>50%	Yes	68	0.73
10I	Lusk Cr.	GF	26	62	12	318	48%	Yes	54	2.59
10J	Hdwtrs LWS R.	GF	19	68	13	319	>50%	Yes	74	2.47
10K	Beetle Cr.	GF	28	55	9	none	>50%	No	51	3.09
10L east	Homes Cr.	GF	26	37	6	none	44%	No	40	2.32
10L west	Berry Cr.	GF	26	69	9	3227, 338	>50%	Yes	54	1.39
10M	Big Huckleberry	GF/PSF	21	60	15	325	>50%	No	N/A	2.09
10P	Middle LWS R.	GF	23	38	6	3227, 338	47%	No	23	2.37
10Q	Timber Head	GF	16	21	6	322	46%	Yes	8	2.47
10R east	Lava Cr.	GF	6	29	12	322, 325	>50%	No	15	2.39
10R west	Lost Cr. (south)	GF	17	46	10	325	>50%	Yes	15	3.16
10S	Moss Cr.	GF	18	9	11	322	46%	No	36	4.26
10V	Lapham Cr.	GF	33	24	5	none	46%	No	N/A	4.47
10W	Cabbage Cr.	GF	37	57	10	322, 325	>50%	No	54	2.05
10	LWS Watershed	ALL	24	41	N/A	7 centers	>50%	Yes	51	2.27
Concern Threshold		GF	>50%	<10%	>8	Any	<50%	Yes	<44%	>2.0
		PSF	>25%	<30%						
		MH	>45%	<5%						

LITTLE WHITE SALMON WATERSHED ANALYSIS SYNTHESIS TABLE

AQUATIC

		Basin Hydrology				Stream Channels					Water Quality / Fish Habitat					Erosion		
Subwatershed	Name	%ROS	ARP	%Incr. Peak Flow	Total Road Density	RD Crossing/ Sq. Mile	Chan Type	Channel Stability Rating	Chan Change	% Riparian Early Seral	Max Temp C	# Large Pools /Miles	Width / Depth Ratio	Average # LWD/ Mile	Scour and Depo.%	Surface Erosion	Mass Wasting Potential %	Compaction %
10A	Hdwtrs Goose Lk	7	95	6	1	1.5	C	Good/Fair		3		10	5:1	6		low-mod	0	1.2
10B	Dry Cr.	9	86	9	1.9	2.7	C	Good/Fair	None	26						low-mod	0	3.8
10C	Lost Cr. (north)	43	67	16	2.9	2.5	C	Fair	Wider	34		21	11:1	14	39	low-mod	0	9.2
10D east	NE Lava Bed Tribs	78	83	13	4.1	9.1	other			24						low-mod	0	5.6
10D south	NW Lava Bed Tribs	6	66	12	5.2	5.3	other			49						low-mod	0	8.2
10D west	Spring Cr/Goose Lk	29	92	3	2.9	5.8	C	Good/Fair		6						low-mod	0	1.8
10E	South Prairie	84	76	11	3.7	4.9	C			21						low-mod	0	6.4
10F	Big Lava Bed	88	100	0	0.2	0.1	other			2						low-mod	0	0.4
10G	Little Huckleberry	73	75	13	4.4	6.2	other			31						low-mod	24.1	3.4
10H	W. Fk. Lusk Cr.	78	87	7	1.1	1.3	C	Fair		23						low-mod	9.0	1.4
10I	Lusk Cr.	97	79	12	3.1	5.7	C	Good/Fair	Wider	25						low-mod	21.0	3.0
10J	Hdwtrs LWS R.	77	79	9	2.9	6.9	other			15						low-mod	48.2	3.8
10K	Beetle Cr.	97	66	15	4.1	14.7	C	Fair	Wider	29						low-mod	18.3	5.4
10L east	Homes Cr.	98	56	10	3.3	10.1	C	Good/Fair		28						low-mod	15.0	7.6
10L west	Berry Cr.	96	78	5	2.2	7.2	C	Good	Wider	38						low-mod	35.0	2.6
10M	Big Huckleberry	78	78	8	2.7	7.4	other			27						low-mod	2.1	2.6
10P	Middle LWS R.	98	75	14	3.5	9.9	C		Wider	23	18'C					low-mod	12.3	4.4
10Q	Timber Head	82	74	12	2.7	8.6	C		Wider	12						low-mod	0	2.6
10R east	Lava Cr.	91	92	8	2.6	3.1	C/E			3						low-mod	4.0	1.0
10R west	Lost Cr. (south)	100	87	7	3.2	6.1	E			14						low-mod	5.0	2.8
10S	Moss Cr.	50	79	16	4.4	6.1	C			13						low-mod	20.0	3.2
10V	Lapham Cr.	81	67	26	4.6	13.4	other			36						low-mod	0	5.0
10W	Cabbage Cr.	99	66	6	3.4	10.1	C	Fair	None	44						low-mod	50.1	3.6
	LWS River						A/B/C	Fair/Poor				44	23:1	17	66			
10	LWS Watershed	69	81	8	2.8	5.4				21						low-mod	10.7	3.9
Concern Threshold		none	<75	>10	>3.0	>10	C or E	Fair	Wider	>30%	>16'C	<40	>10:1	<80	>30%	High	>20%	>5%

*Blank fields indicate that data was not available or not appropriate (such as stream survey data).

APPENDIX B - ROADS WITH CONCERNS IN THE LITTLE WHITE SALMON KEY WATERSHED

Road erosion, blocked culverts, and fill failures were identified in the Little White Salmon Watershed Analysis as being a significant contributors to sediment in the Little White Salmon Watershed. The following table was generated in order to identify which roads were exhibiting these problems and list other information that would allow us to prioritize roads for obliteration, decommission, or maintenance (see Recommendations for Restoration). The basis for this table is the Mt. Adams Ranger District Access and Travel Management Plan (A&TM Plan). Phase 1 of the A&TM Plan was the determination of the Desired Future Condition (DFC) of all existing roads. Phase 2 of the A&TM Plan was road condition surveys in the field. These surveys were conducted for the Key portion of the watershed this summer (1995). This data was supplemented with fish habitat surveys, and subwatershed data from the Aquatic Synthesis Chart (Appendix A)

Roads were listed in this table if it had one or more of the following conditions:

- Culverts known to be barriers to fish migration (from fish habitat surveys).
- Culverts with a one foot drop on a live streams (these culverts are suspected to be fish migration barriers due to the jump height; future investigation would be warranted).
- Culverts that are 40% or more plugged (these culverts are likely to fully plug, re-directing water flow and eroding road fills or surfaces).
- Mass wasting indicators (roads with existing fill slope/cut bank failures or cracks).
- Actual erosion ruts deeper than six inches (no length of rut specified).

The DFC per the A&TM Plan was then identified for each of these roads. The codes are as follows:

CODE	DESCRIPTION
A	These roads are open to public use and are maintained for travel by a prudent driver in a standard passenger car. Safety and directional signing are consistent with the National Highway Safety Act. These roads may be closed seasonally (for a portion of the year).
B	These roads are open to public use and are maintained for travel or high clearance vehicles. Passenger cares are allowed to use these roads, but vehicle damage or safety problems may result from lack of clearance. These roads may also be closed seasonally.
E	These roads are closed year round to the public with a gate, guardrail, or other removable barricade. These roads are open to justifiable administrative use and are maintained for travel of high clearance vehicles.
F	These roads and their continued use are not causing resource damage. Brush will not be cut, and logs or rocks will not be removed unless resource damage is occurring. This lack of maintenance may eventually result in roads that are impassable to motor vehicles. These roads may have waterbars or other weatherization features. There would be no legal restriction on public use as long as no environmental damage occurs. This type of management is commonly referred to as "allow to close naturally" or maintenance level "2/1".
G	These roads and their continued use have resource concerns and will be closed to the public year-round. Active measures will be taken to mitigate the damage caused by the road prism itself. Access will be denied by closure devices, natural barricades, or removal of culverts. In some instances these roads may be scarified and seeded or planted, but will remain on the system for potential use in the future.

H These roads will be closed year round and will be converted to trails when funds become available. Roads needed for management activities within the next 20 years that do not have resource concerns will not be converted to trails.

O These roads have resource concerns, are in conflict with management guidelines, are not needed for management activities within the next 20 years, or are no longer discernible as a road. They will be decommissioned and removed from the system.

Thresholds for subwatershed criteria are the same as those listed in the Aquatic Synthesis Chart:

- High number of stream crossings per square mile - >10 road crossing per square mile.
- High percent riparian early-seral vegetation - >30%.
- High road density (all roads) - >3 miles per square mile.

Blanks in the table indicate that the condition does not occur (0 or No).

ROADS WITH CONCERNS IN THE LITTLE WHITE SALMON KEY WATERSHED

Road Number	**1800.000**	**1800.050**	**1800.080**	**1800.101**	**1800.121**	**1800.130**	**1800.181**	**1800.186**	**1800.201**	**1800.230**	**1800.271**
Road Miles	5.4	2.1	1.8	1.6	1	0.9	1.7	0.4	1.4	2.1	0.5
Remarks		DNR									
A&TM DFC Code	A,F	B	E	G,O	O	G	F	G	G,H	B,F	G
In subwtshd with high # of stream xings?	Yes						Yes	Yes	Yes	Yes	Yes
Stream xings (#)	21	12	8	7	4	5	6		2	7	
Stream xings/mi	3.9	5.7	4.4	4.4	4.0	5.6	3.5		1.4	3.3	
Culverts known to be fish barriors (#)	1	2			1				2		
Culverts with 1 ft drop on live stream (#)	4	1				2	2		1	3	
Culverts plugged 40% or more (#)	6	4	2		3		1	1	4	5	
Mass wasting potential (rd mi)	2								0.3		0.3
Mass wasting indicators (#)	1	2	1		1		1			1	
Actual erosion ruts deeper than 6 in. (#)	3	2		5		4		2	1		4
In subwtrshd with high % early seral riparian?											
Miles in riparian	3	1.5	1.5	1.3	0.9	0.3	0.4	0.1	0.8	1.5	
% road in riparian	56%	71%	83%	81%	90%	33%	24%	25%	57%	71%	
In subwtrshd with high road density (>3m/m2)?	Yes		Yes			Yes	Yes	Yes	Yes	Yes	Yes
In deer/elk winter range?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

*Blank fields indicate that the condition does not occur (0 or No).

ROADS WITH CONCERNS IN THE LITTLE WHITE SALMON KEY WATERSHED

Road Number	1800.281	1800.733	1800.766	1800.772	1831.000	1831.020	1831.031	1831.040	1831.051	1831.070	1831.081
Road Miles	0.8	0.6	0.5	0.1	2.7	2.5	2.8	1.8	0.5	3.4	0.8
Remarks							aka 310				
A&TM DFC Code	G	G	H	O	B	F	F	F	F	E	O
In subwtshd with high # of stream xings?	Yes		Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes
Stream xings (#)			1		7	8	8	4	1	13	2
Stream xings/mi			2.0		2.6	3.2	2.9	2.2	2.0	3.8	2.5
Culverts known to be fish barriors (#)											
Culverts with 1 ft drop on live stream (#)									1	3	
Culverts plugged 40% or more (#)					2	9	2			4	2
Mass wasting potential (rd mi)	0.3	0.1			0.5	0.3	0.2	0.5		0.3	
Mass wasting indicators (#)			1			1	1	4		4	
Actual erosion ruts deeper than 6 in. (#)	5	1		1		3	1		1		1
In subwtrshd with high % early seral riparian?					Yes			Yes	Yes	Yes	Yes
Miles in riparian			0.3	0.1	0.6	0.8	0.7	0.5	0.3	2	0.3
% road in riparian			60%	100%	22%	32%	25%	28%	60%	59%	38%
In subwtrshd with high road density (>3m/m2)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
In deer/elk winter range?		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

ROADS WITH CONCERNS IN THE LITTLE WHITE SALMON KEY WATERSHED

Road Number	**1831.708**	**1840.000**	**1840.020**	**1840.021**	**1840.023**	**1840.025**	**1840.030**	**1840.041**	**1840.051**	**1840.055**	**1840.071**
Road Miles	0.2	8.8	3	0.7	0.3	0.3	1.6	0.3	1.2	0.2	0.7
Remarks				DNR exch	DNR exch	DNR exch	DNR exch				
A&TM DFC Code	O	B	E	G	G	F	G	G	F	F	F
In subwtshd with high # of stream xings?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stream xings (#)	1	30	4	1	2	1	6		4		2
Stream xings/mi	5.0	3.4	1.3	1.4	6.7	3.3	3.8		3.3		2.9
Culverts known to be fish barriors (#)			1								
Culverts with 1 ft drop on live stream (#)		1	1		1						
Culverts plugged 40% or more (#)	1	18	5	1	2		2	1	2	1	1
Mass wasting potential (rd mi)		0.5	0.1			0.1					0.1
Mass wasting indicators (#)	4	7	4	1	1		14		2		1
Actual erosion ruts deeper than 6 in. (#)			1	1	2	6	4		2		1
In subwtrshd with high % early seral riparian?	Yes										
Miles in riparian	0.1	1.8	0.7	0.1	0.1	0.2	0.5		0.2		0.1
% road in riparian	50%	20%	23%	14%	33%	67%	31%		17%		14%
In subwtrshd with high road density (>3m/m2)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
In deer/elk winter range?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

ROADS WITH CONCERNS IN THE LITTLE WHITE SALMON KEY WATERSHED

Road Number	1840.080	1840.221	1840.705	6600.000	6600.016	6600.020	6600.040	6600.044	6600.050	6605.000	6800.000
Road Miles	1	0.7	0.3	16.2	1	2.5	0.6	1.3	2.9	10.4	5.6
Remarks											
A&TM DFC Code	G	F	G	A	F	F	F	F	F	B,F	B
In subwtshd with high # of stream xings?	Yes		Yes	Yes		Yes	Yes		Yes		
Stream xings (#)	5		1	21	5	8		2	2	36	17
Stream xings/mi	5.0		3.3	1.3	5.0	3.2		1.5	0.7	3.5	3.0
Culverts known to be fish barriors (#)											
Culverts with 1 ft drop on live stream (#)										2	
Culverts plugged 40% or more (#)	1			9		4	2	1	6	19	Yes
Mass wasting potential (rd mi)				1.6			0.3		1.4	0.5	
Mass wasting indicators (#)		1		3					4	3	Yes
Actual erosion ruts deeper than 6 in. (#)		1	1	5	1	2				1	Yes
In subwtrshd with high % early seral riparian?				Yes			Yes	Yes	Yes		
Miles in riparian	0.2	0.1	0.2	1.4	0.6	1	0.1	0.2	0.3	2.2	1.8
% road in riparian	20%	14%	67%	9%	60%	40%	17%	15%	10%	21%	32%
In subwtrshd with high road density (>3m/m2)?	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
In deer/elk winter range?	Yes	Yes	Yes	Yes	Yes	Yes		Yes			Yes

ROADS WITH CONCERNS IN THE LITTLE WHITE SALMON KEY WATERSHED

Road Number	**6800.580**	**8600.000**	**8600.085**	**8600.088**	**8600.098**	**8600.105**	**8600.106**	**8600.121**	**8600.132**	**8600.141**	
Road Miles	2.2	8.8	1	0.9	0.5	0.3	0.9	1.4	1.5	2.4	
Remarks											
A&TM DFC Code	F	B	H	H	H	G	F	O	P	H	
In subwtshd with high # of stream xings?		Yes									
Stream xings (#)	5	14					3	1	4	4	
Stream xings/mi	2.3	1.6					3.3	0.7	2.7	1.7	
Culverts known to be fish barriors (#)		2									
Culverts with 1 ft drop on live stream (#)		4									
Culverts plugged 40% or more (#)	Yes	21			1		2	1			
Mass wasting potential (rd mi)	0.1	2.2		0.7	0.5				0.1	0.5	
Mass wasting indicators (#)	Yes	11	2			1	2	1			
Actual erosion ruts deeper than 6 in. (#)	Yes	2		2	1		3		4		
In subwtrshd with high % early seral riparian?											
Miles in riparian	0.6	3.3					0.5	0.4	0.5	0.6	
% road in riparian	27%	38%					56%	29%	33%	25%	
In subwtrshd with high road density (>3m/m2)?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes		
In deer/elk winter range?	Yes	Yes	Yes				Yes	Yes	Yes	Yes	