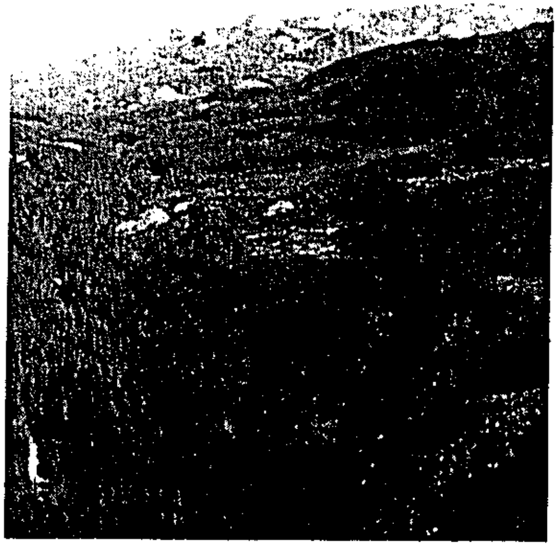
Collawash/Hot Springs

WATERSHED ANALYSIS



Final Report
September 1995

Collawash/Hot Springs
WATERSHED ANALYSIS

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Mt. Hood National Forest
2955 NW Division
Gresham, Oregon 97030

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INTRODUCTION

The Collawash/ Hot Springs Fork Watershed Analysis was prepared as one step in the application of the Northwest Forest Plan. Its purpose is to develop and document a scientifically-based understanding of the natural and cultural ecology of the area, and to provide management recommendations. Watershed Analysis is the landscape scale link between the broad policy direction of existing top-down decisions, and the smaller scale, detailed projects that are normally done within an environmental assessment framework.

This Analysis Report does not represent a decision to take any particular action on the land. It does help provide a context and framework for how to best carry out present policy direction. Watershed analysis is an iterative process that allows for new information and ideas to be developed and incorporated at any future point.

This analysis was done in a somewhat adventurous, experimental fashion in comparison with other analyses on the Mount Hood National Forest, or within the region for that matter. The innovations we have tried to bring forward are as follows:

• A highly graphic format, maximizing the use of professionally drawn maps and minimizing text length, to facilitate easy use and understanding.

• A compressed period of 12 weeks in order to focus the effort and efficiently use limited resources.

• Freedom given to the team leader in selecting and organizing the team, and in running the project.

• Full professional trust, meaning, the team accepted each others opinions about interpretations of particular resources or conditions within each specialty and blended all the resources to provide a collective view of the information for this watershed.

• A strong emphasis on the final product and the bottom line as opposed to a rigid process. All along, our idea has been that clear suggestions for the management of landscape patterns and human infrastructure would provide the context for restoration of habitat, production of economic resources, and the experiential setting. Consequently, we merged the Forest Landscape Analysis and Design Process (Diaz and Apostol, 1992) with the Watershed Analysis Guide.

• We took the admonition to "rely on existing data" literally, meaning we did not spend weeks or months upgrading incomplete data bases. This meant relying on aerial photos or field notes if the Geographic Information Systems (GIS) layers were not in readily usable form.

The results of this "experiment" are presented here before you, gentle reader. Our hope is that we have a report that meets the objectives of utility and credibility.

PARTICIPANTS

The following are those whose time and effort made this report possible:

***District Ranger*:** John Berry

***Team Leader*:** Dean Apostol (Landscape Architect)

***Stewards*:** Leo Yanez, Don Davison, Robert Penson, Robert Alvarado

***Core Team Members*:** Sharon Selvaggio (Wildlife Biologist), Todd Reinwald (Soil Scientist), Tom Horning (Fisheries Biologist), Cindy Froyd (Ecologist), Larry Bryant (Hydrologist)

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There are also some other groups that deserve mention for their input and ideas:

***Mt. Hood National Forest Water Board*:** Mike Ash, Tom Ortman, Laura Ceperley, Mike Redmond, Dick Hardman

***Members of the Public*:** These are the people who took the time to attend meetings and provide ideas and information about the Collawash area. Their names are listed in the Public Comments section of this report. Two Portland residents, Dave Corkran and Norman Goetz, got further involved by sending letters and making phone calls to team members, providing further insight.

***Friends of Bagby*:** A local group of concerned citizens who have an agreement with the Forest Service to provide supervision, upkeep and a physical presence at Bagby Hot Springs. We consulted with their board of directors concerning issues in that area.

EXECUTIVE SUMMARY

This analysis of the Collawash/ Hot Springs Fork watershed represents an attempt to merge the Landscape Analysis and Design Process with the Watershed Analysis Guide published by Region 6 in 1994. Doing this places much of the emphasis of the analysis on developing recommendations for management of landscape pattern and structure, and human infrastructure that best fit with natural character and processes, given present top-down direction (Northwest Forest Plan and Mt. Hood Forest Plan). It is important to stress here that these recommendations are intended to fall within this existing direction. They can be used to help guide development of site specific projects, including: Timber sales, restoration, recreation development, and biodiversity enhancement.

By focusing on landscape and infrastructure management, we have developed a reasonably clear image of how this watershed will change over time, assuming our recommendations are followed. This in turn allows some assessment of sustainability. The following provides a summary of issues, findings, consequences, and recommendations that follow from our analysis. The body of the report contains explanatory text, tables, maps, and other information. We have enclosed the entire report in a three-ring binder format to allow for additional or replacement information to be added to this analysis over time.

Four main topics were examined in the Collawash/ Hot Springs watershed. They encompass the areas of most concern and drive the analysis process. To address the issues listed under each topic we established objectives that we hope will lead us to the desired landscape. In our process we would develop issues and list findings. After sitting back and admiring them, we asked, "So what?" The answer to that question suggested a recommended course of action. Throughout we tried to focus on how a land manager would use this report in developing a management plan.

I. MANAGEMENT OF VEGETATION PATTERN AND STRUCTURE

Issue: **Harvest of Timber and Other Materials**

Finding: Past harvest activities created a highly fragmented pattern that contributed to increased windthrow, loss of habitat, increased sedimentation, and loss of aesthetic quality.

So what? Maintaining sustainable outputs will require strategies for altering landscape pattern and structure.

Objective: Maintain sustainable economic outputs (presently expected to be 4 MMBf per year for the first two decades, 1995-2015), while also sustaining biodiversity and aesthetic condition.

Recommendations: Look for initial harvest opportunities in windthrow areas, thinnings, and in creation of perforated structure. Actively manage existing "edges."

Issue: **Habitat and Populations of Late Seral Associated Species**

Finding: Late seral habitat is available in this watershed in larger and less fragmented blocks than elsewhere in the subbasin. Connectivity of late seral habitats is poor to moderate at the stand scale, moderate to good at the watershed scale and moderate at the Clackamas River Subbasin scale. Most of the Matrix spotted owls are close to take.

So What? The watershed contains a Late Successional Reserve (LSR) and wilderness area and will be relied upon as a "source" area for healthy populations of late seral associated species. Flows across the landscape need to be considered.

Objective: Restore and retain habitat for late seral associated species in LSRs, Riparian Reserves and key connectivity areas important to flows across the landscape.

Recommendations: Retain late seral habitat in key connectivity areas connecting to other watersheds. Promote development of late seral stand structure in Riparian Reserves and LSR's. Create and maintain snags and down logs in early and mid seral plantations. Where present, leave additional standing snags within 50 feet of early and mid seral plantations. Delay degradation of larger connected patches (Terrestrial Large Mosaic Late (TLML) patch types 1 and 2) in Matrix land.

***Issue:* Habitat and Populations of Unique, Rare and Valued Species**

Finding: The watershed supports populations of species that are declining or at moderate risk for viability. Game species are also present in moderate numbers. The watershed supports some of the Forest's highest densities of rock and talus habitat as well as many small wetlands.

So What? The high density of special habitats makes this watershed a significant resource for rare and sensitive species.

Objective: Protect habitats for unique, rare and valued species.

Recommendations: Limit disturbance near special habitats. Create small forage openings adjacent to cover. Maintain dispersal links across isolated special habitats.

***Issue:* Landscape Pattern and Range of Natural Variability**

Finding: Much of the watershed (primarily in the wilderness) is unfragmented mature forest. Outside of the wilderness the landscape is fragmented with regularly shaped, uniform open patches dispersed within the closed canopy matrix. Range of Natural Variability (RNV) for early seral stages is exceeded in all forest series.

So what? There is a risk that biological diversity and ecological function may not be maintained when systems are "pushed" outside the range of natural variability. In portions of the watershed the terrestrial species component has shifted toward early seral and edge-reliant species. In addition, there is a loss of aesthetic value and economic opportunities.

Objective: Devise management plans, to the extent possible, to restore forest structure to within historic RNV's.

Recommendations: See forest pattern strategy for long term and short term recovery. Focus restoration and silviculture projects in LSR and Riparian Reserve early and mid seral stages. Accelerate natural succession in some areas. Encourage greater amounts of mid and late seral forest development than exists now.

***Issue:* Riparian Reserves**

Finding: Intensively managed subwatersheds have high proportions of Riparian Reserve in mid and early seral stage.

So what? The intent of the Record of Decision (ROD) was for Riparian Reserves to contribute to the Aquatic Conservation Strategy (ACS) and fulfill dispersal needs for late seral organisms. The current condition of the Riparian Reserves is detrimental to these goals, and windthrow susceptibility is quite high in areas.

Objective: Design a Riparian Reserve network that best fits this landscape while meeting the ACS/ROD intent.

Recommendations: Focus restoration silvicultural projects in Riparian Reserve early seral stages. Maintain adequate buffer areas in riparian reserves. Retain interim reserve widths until existing early seral stands reach mid seral stage. Include active ancient landslides with a very high risk of mass wasting in the Riparian Reserve network.

II. DESIGN AND MAINTENANCE OF HUMAN INFRASTRUCTURE

***Issue:* Infrastructure Design**

Findings: Human use is closely tied to landscape structure and vegetative pattern. The demand for recreation and forest products is increasing, while future funding will probably be diminished. Present funding is only adequate for maintaining less than 50% of the forest road system.

So what? Reduced funding means reduced services that can be provided. Increased demand and use put a strain on the resources. Road dependent uses will be constricted. Semi-primitive recreation use potential will increase.

Objective: Design the appropriate amount and type of infrastructure given funding limits, present and past human use patterns, future growth, habitat objectives, and economic uses.

Recommendations: Maintain access to recreation sites. Continue to provide access to miscellaneous and small products (i.e., mushrooms, berries, firewood, etc.) where possible. Get developed sites into a market based fee structure and under management by private operators. Support development of partnerships for road and trail maintenance.

Issue: **Social Problems**

Finding: Bagby is the area of highest concentrated use in the watershed. Trailheads, particularly at Bagby, and other recreation sites are frequent targets for vandalism and car clouting, and other social problems.

So what? Social problems create an undesirable setting for visitors. High use near Bagby results in localized water pollution. High human presence reduces habitat effectiveness for some species. There is a lower coarse woody debris (CWD) component due to past high use of firewood.

Objective: Reduce the social problems throughout the watershed, particularly in high-use areas such as Bagby Hot Springs.

Recommendations: Put Bagby under concessionaire management and charge user fees if the fees can be kept for site maintenance. Improve camping near trailhead area. Change LSR boundary around Bagby to give the Forest Service more management flexibility. Consider adding to LSR in Elk Lake area. Consider development of increased overnight use in cabins at Bagby as a way to reduce antisocial behavior. Develop entry gate/ cabin at trailhead to reduce car clouting. Keep developed area small to avoid further loss of habitat.

III. PROTECTION OF AQUATIC CONDITION

Issue: **Stream Temperatures**

Finding: Removal of forest canopy along streams can raise stream temperatures. It can also result in cumulative impacts downstream in the watershed, depending on the extent of canopy removal. Some streams of this watershed are inherently warmer even without forest canopy removal such as the upper Hot Springs Fork which has never had timber harvest.

So what? Increased stream temperatures affect water quality and aquatic habitat, affecting the ability of certain fish species to thrive in the watershed.

Objective: Restore riparian forest cover/ shade and reduce possible increased stream temperatures caused by timber harvest.

Recommendations: Plant for shade along stretches of stream with insufficient canopy cover. Thin riparian stands to improve canopy development.

Issue: **Management to Improve Riparian Condition**

Finding: There has been a loss of recruitment of CWD. In harvested riparian areas, increased solar radiation input has raised stream temperatures (see previous Issue). Several road culverts restrict access of fish to historic spawning and rearing grounds.

So what? The above contributes to a lowering of aquatic and riparian habitat quality and connectivity.

Objective: Identify restoration priorities and coordinate restoration/ protection with design of landscape patterns and infrastructure.

Recommendations: Initiate restoration projects to restore or maintain aquatic habitat to meet Land Management Plan (LMP) and Policy

Implementation Guidelines (PIG) standards. See Restoration Projects.

IV. RESPONSE TO KEY NATURAL PROCESSES

***Issue:* "Flashy" Streamflow Regime Influenced by Management**

Finding: The streamflow regime of the Collawash River is quite "flashy", with streamflows responding quickly and profoundly to precipitation and snowmelt events. Generally steeper landform slopes and steep channel gradients (9%) and the relatively small extent of area of floodplains and broad alluvial valley bottoms (which would promote detention storage and groundwater recharge) contribute to an inherently flashier streamflow regime. Created openings (roads and clearcut harvest areas) have increased the amount of water available for runoff during storm events. Roads and ditches intercept precipitation and subsurface flows, essentially functioning as extensions of intermittent streams, increasing overall drainage densities and transporting water more rapidly than natural processes.

So what? Higher peakflows can substantially increase sediment transport, stream downcutting, instability of adjacent landforms, and alteration of aquatic and riparian habitats. Management activities, particularly roads and clearcut timber harvesting, appear to have increased the magnitude of peakflows in several subwatersheds as evidenced by degraded channel conditions generally associated with increased peakflows.

Objective: Reduce the road contribution to flashy streamflows. Defer activities which may delay hydrologic recovery in certain high risk subwatersheds. Conduct management activities elsewhere within guidelines prescribed to reduce flashiness and magnitude of peakflows.

Recommendations: Reduce stream network expansion and created openings associated with the road system by decommisioning roads through closure, obliteration, and/or other appropriate rehabilitation techniques. See Road Restoration Opportunities. Reduce amount of early seral habitat overall. See Recommendations For Managing Long Term Landscape Patterns.

***Issue:* Erosion/Sedimentation and Human Actions**

Finding: Existing management related sediment production and delivery in the watershed comes primarily from the road system; some sites are chronic producers. Pathways for sediment transport and delivery have been expanded by road related drainage.

So what? Potential loss of aquatic habitat, with effects manifested downstream of this watershed.

Objective: Reduce human causes of erosion/sedimentation, related to timber harvest and roads.

Recommendations: Fix chronic sediment production sites as budget allows. Decommission roads not needed. See Road Restoration Opportunities.

***Issue:* Earthflows and Landslides**

Finding: This watershed has the most unstable geology on the Forest.

So what? Past management practices have contributed to mass wasting occurrence through landslide events.

Objective: Manage landscape patterns to reduce risk (human induced) to low levels.

Recommendations: Follow Mt. Hood LMP standards on earthflows. Include active earthflows in the Riparian Reserve system. Remove roads on unstable topography. See Road Restoration Opportunities. Develop a more perforated pattern of small openings in Matrix land to reduce the risk of mass wasting.

***Issue:* Forest Windthrow**

Finding: High windthrow hazard relates strongly to past harvest patterns.

So what? Potential impact to Riparian Reserves and LSR edges with increased risk of insect attack.

Objective: Adjust management of vegetation pattern structure to account for windthrow risk.

Recommendations: Move toward a perforated forest pattern of small (2-5 acre) openings in the Matrix to lessen occurrence of windthrow.

***Issue:* Insects**

Finding: High amounts of windthrow increase the risk of large beetle outbreaks. Windthrow occurrence is increased by fragmented forest pattern.

So what? Large beetle populations can move out of dead, down trees and attack surrounding live timber increasing mortality.

Objective: Maintain beetle activity in a "socially acceptable" range within RNV.

Recommendations: Design a perforated pattern specifically to respond to windthrow problems. Return to an active salvage program to remove heavy amounts of windthrown and damaged trees, but retain adequate snag numbers.

***Issue:* Role of Fire**

Finding: Fire created patterns differ from current harvest created patterns primarily in the size, shape, and distribution of patches. Fire suppression has reduced fire's role in the ecosystem in this century. American Indians used fire to maintain natural openings, particularly huckleberry fields.

So what? Substituting harvest created patterns for fire created patterns changes species distribution and movements. Absence of fire has caused loss of some huckleberry fields.

Objective: Restore fire to a role in the ecosystem.

Recommendations: Use managed "natural" fire in Bull of the Woods to reintroduce its role in influencing landscape pattern, structure, and succession on ridgetops. Recommend not to mimic natural fire patterns in the Matrix, due to windthrow risk and unstable soils.

***Issue:* Ecologic Dispersal and Flows**

Finding: Flows are those aspects of landscape ecology that move through the watershed. Vegetation patterns and seral stages affect flows of wind, water, people, and late seral species. The flows that most influenced landscape pattern design in this watershed were wind, mass wasting, and late seral species.

So what? The overall greatest benefits to desired ecological flows seem to be achieved in late seral types. See Landscape Ecologic Flows to see the relationships of flow to vegetative structure.

Objective: Maintain or restore natural flows.

Recommendations: Manage landscape pattern and structure to facilitate flows. Removing some road infrastructure helps naturalize hydrologic and aquatic flows.

KEY QUESTIONS

I. VEGETATION PATTERN AND STRUCTURE

How can the watershed vegetation pattern and structure best be managed to meet the Northwest Forest Plan (NWFP, also known as the President's Forest Plan, PFP), the Mt. Hood Forest Plan (FP), and other more local objectives?

• Can timber and other material outputs be sustainably harvested in this watershed over a 10 and 50 year period?

• How can upland vegetation pattern and structure be managed to retain or restore habitat for key species of concern?

- Where should connectivity of late seral habitat be retained or restored?
- Where should fragmentation of forest conditions be avoided or deliberately created?
- How can habitat for unique sensitive species be sustained or improved?
- How can we provide or restore healthy forest conditions?
- How can we best manage natural and prescribed fire to improve habitat?
- How can we restore scenic quality in the watershed?

• How do we provide a Riparian Reserve vegetation management strategy in existing cutover areas while retaining biodiversity over the longest period?

• How can riparian condition best be managed to maintain/improve aquatic habitat?

II. HUMAN INFRASTRUCTURE

How can the watershed's human infrastructure best be managed to meet the NWFP, FP, and other more local objectives?

• How can recreation and other experiential needs be met?

• What role does infrastructure play in biodiversity maintenance?

• How can we manage infrastructure to have a positive influence on human social patterns?

III. AQUATIC CONDITION

How can the watershed's aquatic condition best be managed to meet the NWFP, FP, and other more local objectives?

• How does management influence the relationship of watershed condition to existing and future fish habitat?

• How does management influence the relationship of watershed condition to existing and future water quality (sediment/water clarity, temperature, pathogenic organisms) and to the productivity of aquatic species?

IV. KEY NATURAL PROCESSES

What are the appropriate management strategies to deal with key natural processes?

• How is erosion/sediment influenced by human activity and how is human activity influenced by erosion/sediment?

• What influences the occurrences of mass wasting?

• How is stream hydrology influenced by human activity and how is human activity influenced by stream hydrology?

• How is forest windthrow influenced by human activity?

• How has fire historically influenced landscape pattern and how has human activity affected this?

• What are the successional trends within the watershed and what effect does this have on landscape pattern?

• How are ecological dispersal/flows influenced by human activity and how is human activity influenced by ecological dispersal/flows?

SETTING

The Collawash and Hot Springs Fork Watershed lies in the southern extreme of the Mount Hood National Forest, about 40 miles south of the Columbia River (See Map 1). It is on the west slope of the Cascade Mountain Range, between the snow-capped volcanic peaks of Mount Hood and Mt. Jefferson. Most of the 97,000-acre watershed is within Clackamas County, the remainder in Marion County. The Collawash flows north from its headwaters near Maryanne Spring. The Hot Springs Fork also runs north from the Bull of the Woods Wilderness, then turns abruptly to the east past Bagby Hot Springs. It joins the Collawash near Alder Swamp, from which point the larger river flows northward for about three miles until joining the Clackamas River.

Typical of other west slope Cascade watersheds, this one has steep rugged topography, ranging from 1480 to 5710 feet above sea level. Rhododendron Ridge, a broad 16 mile long landform, shapes the eastern boundary. To the south is a steep, rocky ridgeline that connects Collawash and Whetstone mountains, separating this area from the more famous Opal Creek area on the Willamette National Forest. To the west is another, less prominent ridgeline that roughly forms the western boundary of the Mt Hood Forest. To the north, Thunder Mountain, Baty Butte, and East Mountain form the divide with Fish and Sandstone Creeks, which also flow into the Clackamas. The climate is temperate, with high rain and snowfall in the winter months (70-130" average annual).

Features that especially characterize the Collawash/ Hot Springs Watershed include:

- Bagby Hot Springs, one of the most popular and controversial recreation areas on the Forest.

- A high density of special and unique habitats, including meadows, brushfields, wetlands, and rock cliffs.

- Bull of the Woods Wilderness Area (26,350 acres), a quite rugged, rocky complex of old growth forest and small lakes crowned by the Bull of the Woods fire lookout.

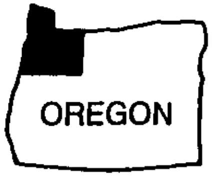
- Steep, boulder strewn streams of high gradient and flashy character.

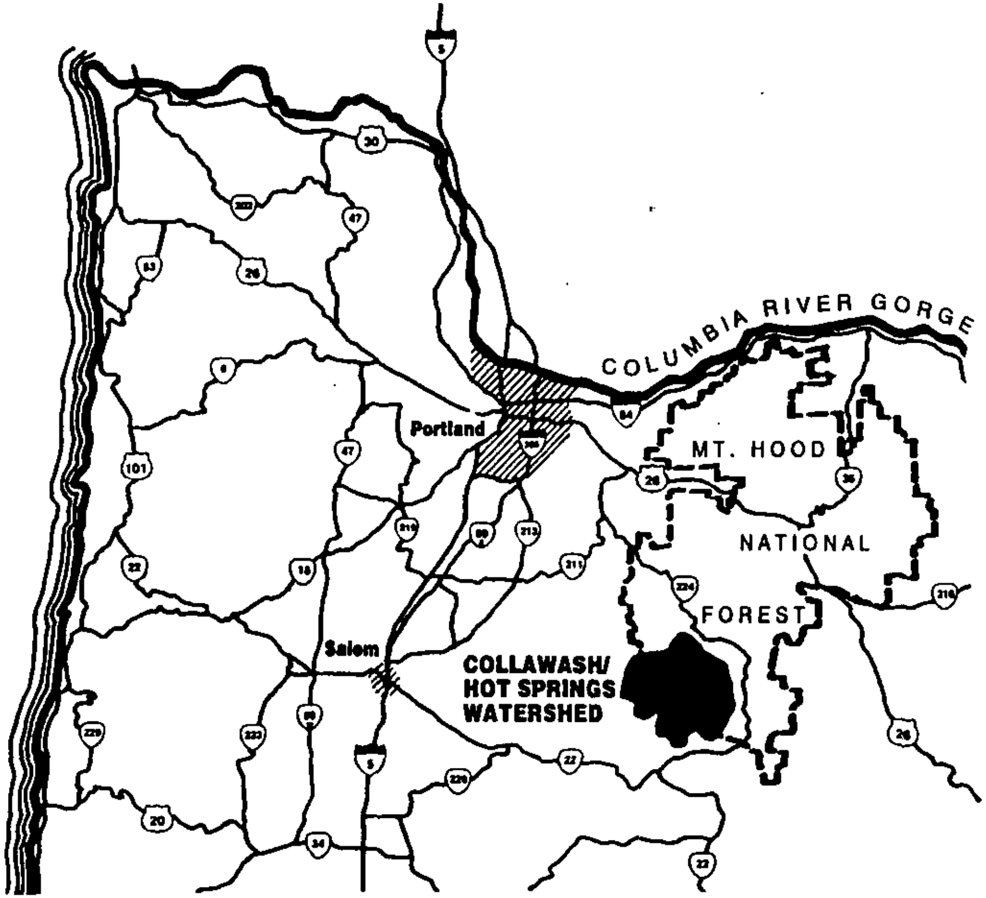
- A high amount of potentially unstable land, including saturated earthflows and weak resistant rock.

- A major Bonneville Power Administration (BPA) Powerline corridor that parallels the Hot Springs Fork on its north side.

- The Sugar Pine Botanical Area on Rhododendron Ridge, which is the northernmost grove of this species.

- Important wintering grounds for deer and elk.





Vicinity map

LAND ALLOCATIONS

Map 2 shows the distribution of land allocations in the Collawash/ Hot Springs Watershed, including the Northwest Forest Plan and the Mount Hood Forest Plan. It shows the dominant allocation, but not overlapping ones. Both plans provide top-down direction for specific management activities, including habitat protection for biodiversity, aesthetic, recreational, and economic goals, among others. Some allocations, such as Late Successional Reserves (LSRs), provide very specific objectives for managing landscape pattern and structure. Others are a bit vague, providing clues and some flexibility. Top-down direction does not always reflect an area's specific conditions, such as the existing seral stage distribution, reforestation, operations, rare or unique habitats, windthrow hazard, and other issues. Nevertheless, the existing top-down direction does provide an important framework for this analysis and recommendations. Below is a summary of existing direction for landscape pattern and structure management.

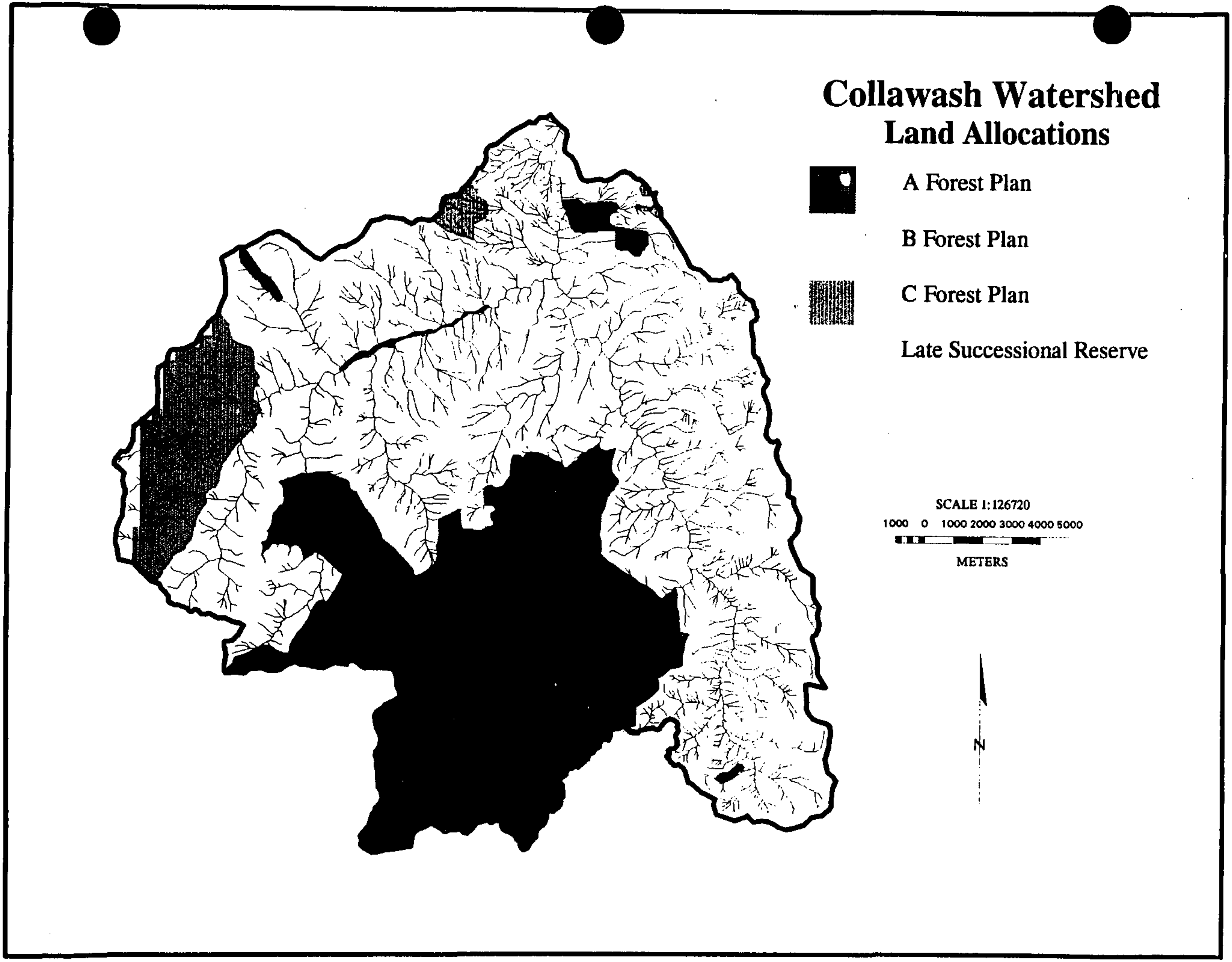
LSR and Congressionally Withdrawn Land: This includes Bull of the Woods Wilderness, a large area that lies between the Collawash River and the Wilderness, and an area to the west of the Wilderness. Overall it comprises about 50% of the entire watershed. LSRs are intended to serve as habitat for late successional related species, with natural processes allowed to function to the extent possible. The landscape pattern and structure should be unfragmented mature forest, except where natural openings exist, or where conditions preclude the development of mature forest structure. Pre-commercial and commercial thinnings inside the LSR in stands younger than 80 years old are allowed outside the Wilderness and Research Natural Area (RNA) for the benefit of an improvement of late seral habitat. Salvage of dead trees is limited to stand-replacing disturbance events exceeding 10 acres.

Riparian Reserves: These are buffers for streams, wetlands, and unstable terrain. Their purpose is to protect the aquatic system and to provide dispersal habitat for late successional species. Generally, the landscape pattern and structure goal is also to retain or grow mature forest structure, though with an emphasis on species that enhance aquatic conditions.

Unmapped LSR's: These include 100 acre cores around spotted owl activity centers, unmapped protection buffers around natural openings and nest sites for the great gray owl, and potentially other protection buffers around certain rare plants and fungi. The intent is to retain small patches of late seral forest structure around known occupied sites in the Matrix..

Administratively Withdrawn: These are "A" allocations in the Mt Hood Forest Plan, including A3 (RNA), A4 (Bagby Special Interest Area), A6 (Semi-primitive Roaded), and A7 (Special Old Growth) in this watershed. The landscape structure objective in these areas is mature forest structure.

Matrix: This is the land area where regulated timber harvest occurs. The intent is to retain some late seral habitat components (minimum 15%) to facilitate species flow. In this watershed, the Matrix area includes the following Mount Hood Plan allocations: C1 (Timber Emphasis), B2 (Scenic Viewshed), B6 (Special Emphasis Watershed), and B8 (Earthflow). The Mt. Hood LMP is not very precise about landscape pattern design for these allocations. Generally, there are various restrictions on size of openings and the amount of early seral forest allowed, but forest structure can be uneven aged, "perforated" (small openings scattered about), or fragmented. As stated in the ROD (page B-1), forests in the Matrix also function as connectivity between LSR's and provide habitat for a variety of organisms associated with both late successional and younger forests. This definition of Matrix differs from the landscape ecology definition of matrix, which is found in the Glossary.


Collawash Watershed
Land Allocations
A Forest Plan
B Forest Plan
C Forest Plan
Late Successional Reserve
SCALE 1:126720
1000 0 1000 2000 3000 4000 5000
METERS
N

PART II

Landscape History and Background Conditions

HISTORIC LAND USE

Map 3 represents the pattern and occurrence of historic land use, including: Camping, ranger stations, lookouts, grazing, and travel corridors. It includes American Indian and early Forest Service use. As is the case for most of the watersheds on what is now the Mount Hood National Forest, we have relatively little archeological data to help reconstruct early Native American use. Nevertheless enough exists in historical documents, ethnographies, and site relics to help paint a faint outline on what would otherwise be a blank canvas.

As illustrated on the map, the level banks above the Collawash and Hot Springs Fork were occupied by fishing camps seasonally. Favored sites were wide flats or alluvial terraces just below barrier falls or rapids. In places where canyon walls are steep, and narrow channels concentrated anadromous fish, it was relatively easy for a good supply to be hauled in. Drying and food storage took place in the camps. River corridors and long, broad ridgelines were natural travel routes for native people. These corridors linked the Collawash area with the Willamette Valley to the west, to Olallie Lakes and beyond to the east, and to the Columbia River.

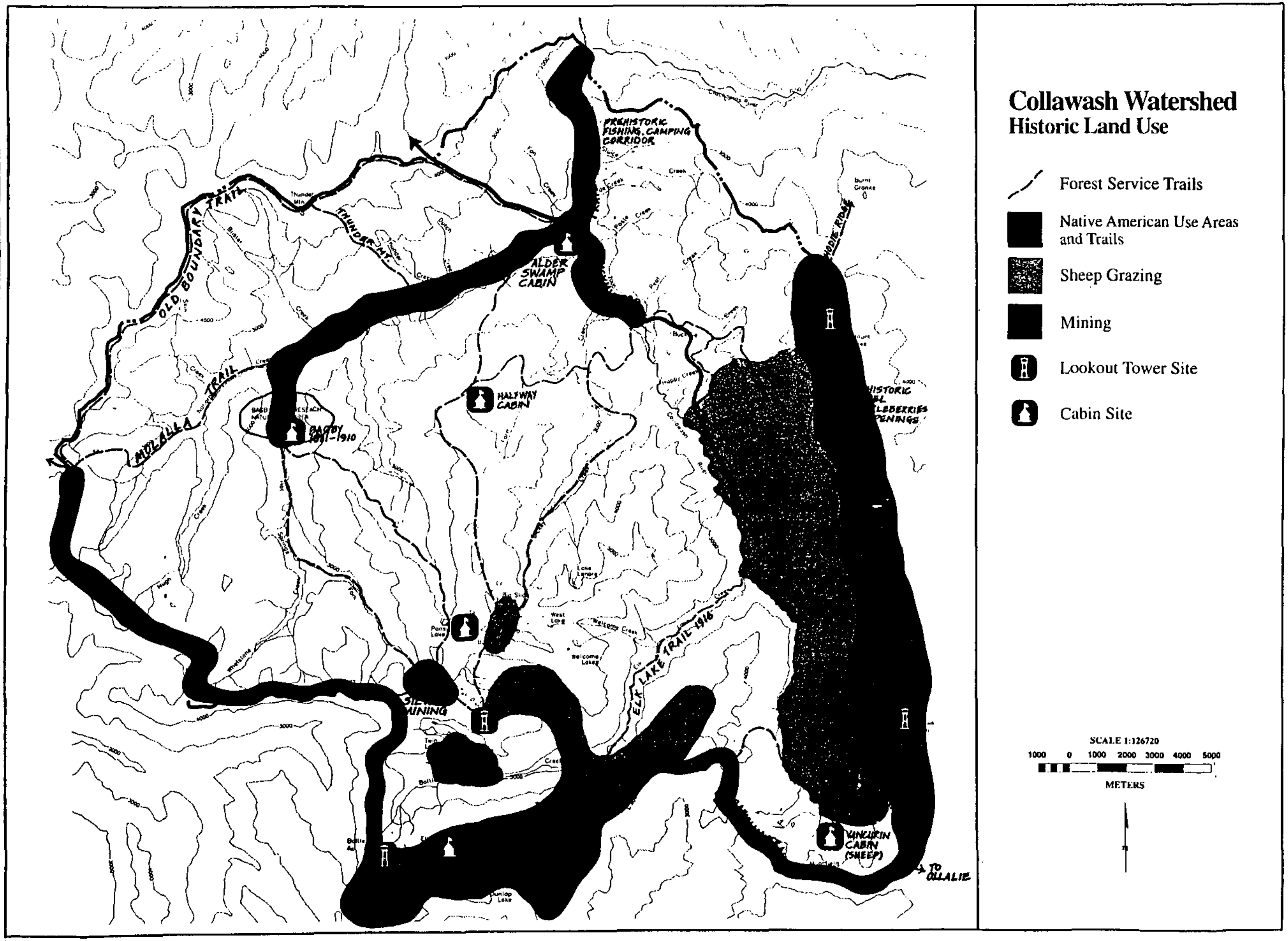
Once fish were caught and prepared for storage, attention turned to upland resources, including game, berries, and medicinal plants from high meadows. Bull of the Woods Wilderness and Rhododendron Ridge are two areas believed to have been used for these purposes.

The dispersed nature of upland resources required greater mobility and thus smaller encampments than were created along the rivers. Typically, upland camps would be on ridgelines, or on the edges of dry meadows and lakes. Dating of sites in the Collawash suggests use as far back as 5000-8000 years ago. Some fishing camps were still in use in the late 1800's, but American Indian populations were heavily decimated by that time. Seasonal use in the Collawash area appears to have been quite heavy compared with other watersheds on the Mount Hood National Forest. Further information awaits discovery.

Anthropologists and ecologists continue to hotly debate the role American Indians may have played in shaping the landscape pattern and structure with fire. While huckleberry fields and dry meadows along south facing slopes were deliberately burned to maintain openings, it is less clear whether native people burned the forest itself, as they are known to have done in other parts of the country (ponderosa pine stands for example). There is no direct evidence that this was the case in the Collawash/Hot Springs Watershed.

Euro-American use dates from the late 1800's. The same river corridors were used for hunting and fishing, but the use was more recreational than subsistence in nature. The travel routes often were the same ones used by American Indians. Silver was discovered in the upper Molalla watershed in the 1860's and gold and silver were being mined in the Battle Ax district in the 1870's. Hunters, trappers, and prospectors roamed east into Collawash country. By the 1880's copper was being mined in the Pansy Creek Basin but was quite limited in scope and left few landscape scars. Bagby Hot Springs was used as a base camp. The Molalla Trail provided a connection to the Willamette Valley and remained the primary access route until the 1950's. Sheep grazing took place along Rhododendron Ridge and within what is now Bull of the Woods Wilderness in the early 1900's.

In 1893 the Clackamas and Collawash watersheds were incorporated into the Cascade Forest Reserve that covered the entire length of the Oregon Cascades. The Forest Service began active administrative use in the early 1900's. In 1908 the present day Mt. Hood National Forest was established and called the Oregon National Forest. The name was changed to Mt. Hood in 1923. An extensive network of trails, lookouts, and seasonal cabins was developed, including the still existing Bagby Guard Station, built in 1913. Rangers and their families stationed in the various cabins would gather around their primitive phones in the summer evenings, playing guitars and singing songs. Recreational use at Bagby was already quite extensive, even though it was several days walk or ride from the Valley. The last remaining lookout in the Collawash is Bull of the Woods, which is considered eligible for listing in the National Register of Historic Places. A cabin also remains on Hawk Mountain. Early Forest



Collawash Watershed
Historic Land Use
Forest Service Trails
Native American Use Areas and Trails
Sheep Grazing
Mining
Lookout Tower Site
Cabin Site
SCALE 1:126720
1000 0 1000 2000 3000 4000 5000
METERS
OLD BOUNDARY TRAIL
THUNDER MT.
MULALLA TRAIL
PREHISTORIC FISHING, CAMPING CORRIDOR
ALDER SWAMP CABIN
HALFWAY CABIN
BAGBY 1881-1910
ELK LAKE TRAIL 1916
CABIN (SHEEP)
TO OLLALIE

Service management was custodial and protective in its intent and effect. Forest structure was allowed to develop, fires were extinguished where and when they could be reached in time, and human caused fires were discouraged. One result appears to be forest encroachment on ancient huckleberry fields along Rho Ridge and in Bull of the Woods.

RECENT HISTORY

World War II spurred the opening of the Upper Clackamas basin to timber harvest. Portland General Electric had built a railroad up the river in the 1920's to access several hydroelectric projects they had developed. The line was removed and converted to a road in the 1930's. It reached the Three Lynx area. During the war it was pushed further up the river and by the 1950's the Collawash area was accessible by vehicle. In the postwar era, many main trails were abandoned or turned into roads as industrial logging worked its way up the watershed. While change has been substantial, it is interesting to note that the same travel corridors continue to be used, as well as the same general encampment areas along the main rivers and near upland lakes and ridges.

The earliest road construction in the watershed was road 63 in 1953 with the first section of road 70 following in 1955. Most of the collectors and the rest of road 70 were constructed in the late 50's and early 60's. These roads were primarily of an aggregate surface type. Road 63 was reconstructed to asphalt in 1963 and a major program of reconstruction to paved surfaces took place in the 70's. In all, 87 miles of road were built in the 50's, 144 miles in the 60's, 79 miles in the 70's, 49 miles in the 80's, and 2.5 miles in the 90's up to 1994.

View of Bull of the Woods looking south to Mt. Jefferson

The first timber harvest occurred on 42 acres in 1950. In the 50's, 1688 acres were harvested. This number grew to 5228 in the 60's, 6594 in the 70's, and 7146 in the 80's. Through 1994, 5722 acres have experienced some type of timber harvest in the 90's.

In 1952 the Clackamas Planning Unit was split into three districts, Estacada, Lakes, and Collawash. The Collawash district basically covered the watershed. Along with timber harvest and the establishment of a road system, recreational use also increased dramatically. In 1969 the three districts reorganized into two- the Clackamas and Estacada districts. All watershed lands east of the Collawash became part of the Clackamas district and everything west of the river was included in Estacada. Currently the Mt. Hood is reorganizing again and the two districts are being combined. More detailed information can be gained from the Heritage Resource Staff at the Mount Hood National Forest Supervisor's Office.

FIRE CREATED LANDSCAPE PATTERN

RECONSTRUCTED HISTORIC LANDSCAPE — EARLY 1900's

Fire, historically, was the dominant landscape pattern-forming disturbance in this portion of the Cascades. The last major fire events in the Collawash/ Hot Springs Fork watershed occurred around the turn of the century. Map 4 is a reconstruction of the Collawash/ Hot Springs Fork landscape in the early 1900's. It shows the amount of early seral vegetation that was present at the time, along with the younger mid seral stands. Some of the areas, especially those in Bull of the Woods, were probably in an early seral condition for quite some time, due to slow regeneration and stand growth.

The landscape pattern was reconstructed using 1946 aerial photographs, current age class information, and panoramic photographs taken from lookouts in the early 1930's. It is acknowledged that this is only a single point in time, and that to get a true picture of "natural" conditions, many other points in time would need to be examined. This is a conservative estimate of the total amount of early seral in the watershed. Only stand replacement fires were mapped, and some smaller fires were probably missed.

FIRE REGIMES

The Mt. Hood National Forest has been divided into eleven fire ecology groups based on vegetation, fire frequency and behavior (Evers, 1994). The Collawash/ Hot Springs Fork watershed contains three of these groups. Fire Group 8, the "warm, moist western hemlock, Pacific silver fir" group has an average stand replacement fire frequency of 50-300+ years.

Fire Group 6, the "cool moist lower subalpine" fire group, is found in the higher elevations of the watershed, in Bull of the Woods, and along Rho Ridge. It has an average stand replacement fire frequency of 170-430 years characterized by crown fires, torching, spotting, and lethal underburning.

Fire Group 9, the "dry western hemlock, westside Douglas-fir" group, has a fire frequency of 25-150 years with primarily underburning, and some crown fire. This group is found on south and west aspects, on steep slopes in the Collawash and Hot Springs Fork canyons, and in some areas with rock outcrops and talus slopes. These areas are assumed to have reburned frequently with below canopy ground fires. These stands have a different fire regime due to their steepness, wide spacing of trees, thin soils, and the high percentage of exposed rock.

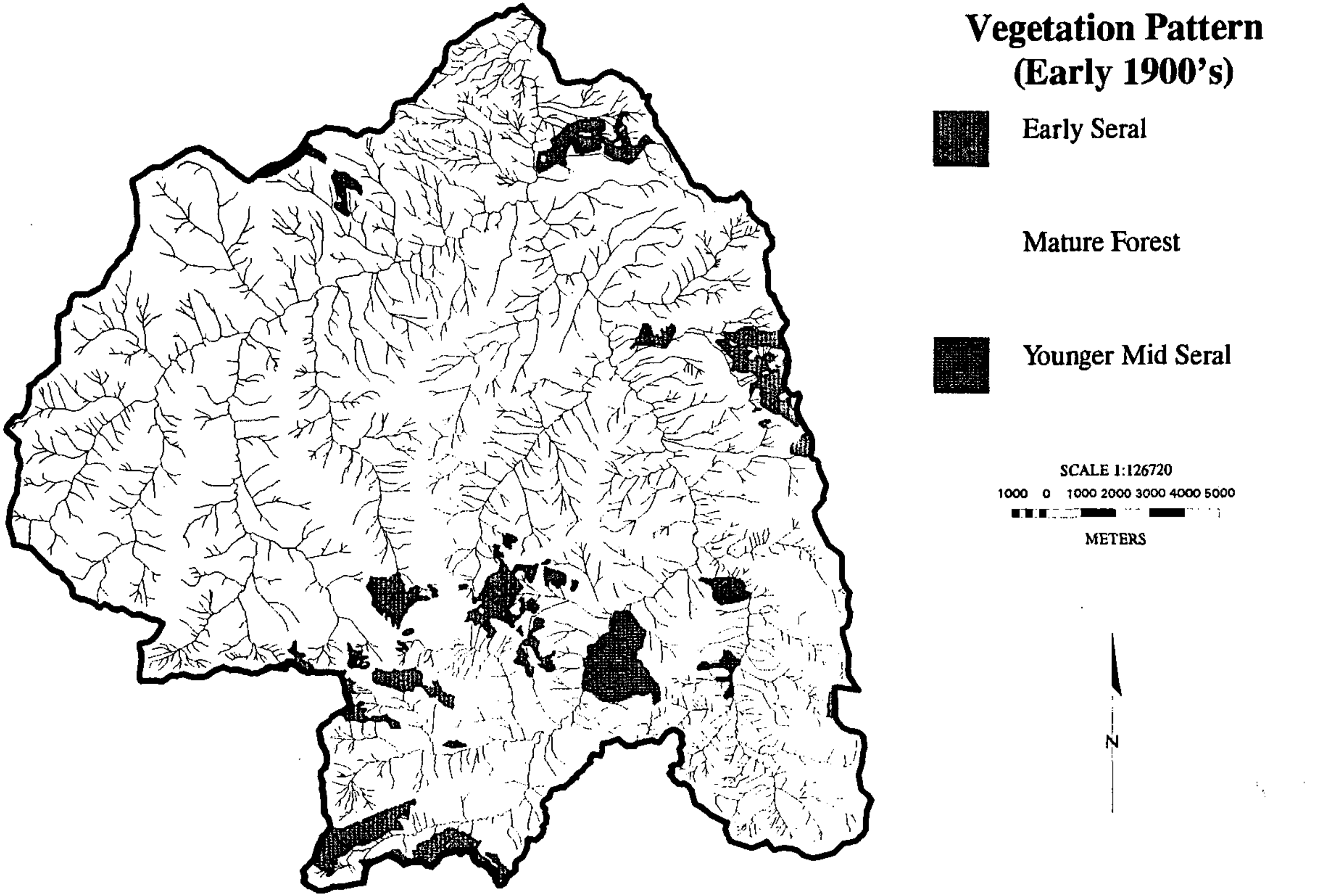
PATTERN

Fire created patterns differ from current harvest created patterns primarily in the size, shape, and distribution of patches. Fire created openings tend to be large, irregularly shaped, and infrequently distributed (both spatially and temporally) across the landscape. Fire created openings also contained more remnant live trees and snags.

This watershed currently contains much more unfragmented, closed canopy forest than many of the surrounding watersheds in the Clackamas subbasin. Outside of the wilderness the landscape pattern is primarily fragmented (30-40% of the area is in early seral openings). Early seral openings have been created mostly by clearcut harvesting. Open patches are uniform in size, regularly shaped, and evenly dispersed within the closed canopy matrix. The fragmented pattern that currently exists outside of the wilderness area has more edge habitat and less connectivity of mature forest than the pattern created by the natural disturbance regime.

Certain species and processes are favored by the current pattern. Contrast (edge) species such as elk, great horned owl, and possibly the great gray owl have benefited because the juxtaposition of late and early seral types provides ideal foraging conditions near the shelter, resting, and breeding sites they need. Species that avoid edges and openings such as pine marten and fisher are disadvantaged by the current pattern. The brown-headed cowbird, a non-native parasitic bird, seriously threatens native bird populations nationwide. It is known to be present on the Forest and is generally favored in fragmented landscapes. It could be encroaching upon this watershed; more monitoring is needed.

Collawash Watershed
Vegetation Pattern
(Early 1900's)



INSECTS/ DISEASE

This section provides information about past and present insect infestations in the watershed. To date, no known studies have been conducted to determine the extent of insects or disease in Bull of the Woods. All known data come from past field observations on managed lands and experience with the idiosyncrasies of each organism. Though very little (if any) data has been gathered within the wilderness, projections can be made as to existing conditions and what can be expected given specific parameters.

Insects are part of the ecosystem and will be in the future. Normal insect populations fluctuate up and down depending on various factors such as weather, predators, etc. However, specific events occasionally allow a particular species to increase populations dramatically. This is the case with the Douglas fir bark beetle and the spruce budworm.

Douglas Fir Bark Beetle: This beetle usually attacks freshly downed Douglas fir trees. The down tree may have fallen by any number of methods (e.g., wind, chainsaw, etc.). Normally, beetles go through their cycle(s) and then move elsewhere. This process goes unnoticed by the casual observer. However, when a major event takes place, populations increase dramatically. If there are sufficient numbers and a lack of dead wood for the population size, they can move into stressed live trees in the surrounding area.

Once beetles have gone through their cycle and the young leave the brood tree, they can travel up to two miles in search of more down or recently dead trees. If a large outbreak occurs, it typically lasts about 3-5 years after which the population decreases to its normal level unless another catastrophic event occurs.

The only previously known outbreak of beetles occurred in the Hot Springs Fork canyon in the 1970's in three different areas (see Map 5). From what is known about this event it was not widespread. It is suspected that the event was stimulated by a major windstorm and subsequent blowdown. It is suspected that blowdown occurred and that the infestation set in soon after the storm. In the '89-90 blowdown event, large areas of down trees existed. The beetle populations soared. After the initial infestation, the young beetles left the brood trees and moved into surrounding weaker trees. This was evidenced by the many trees that died and turned red several months after the storm event. Most beetle killed standing trees were in and around areas with intensive past harvesting (where the blowdown was most extensive). Some blowdown did occur in the wilderness, the Bagby RNA, and the Hot Springs Fork canyon. As a result, the beetles attacked stressed trees in these areas, too.

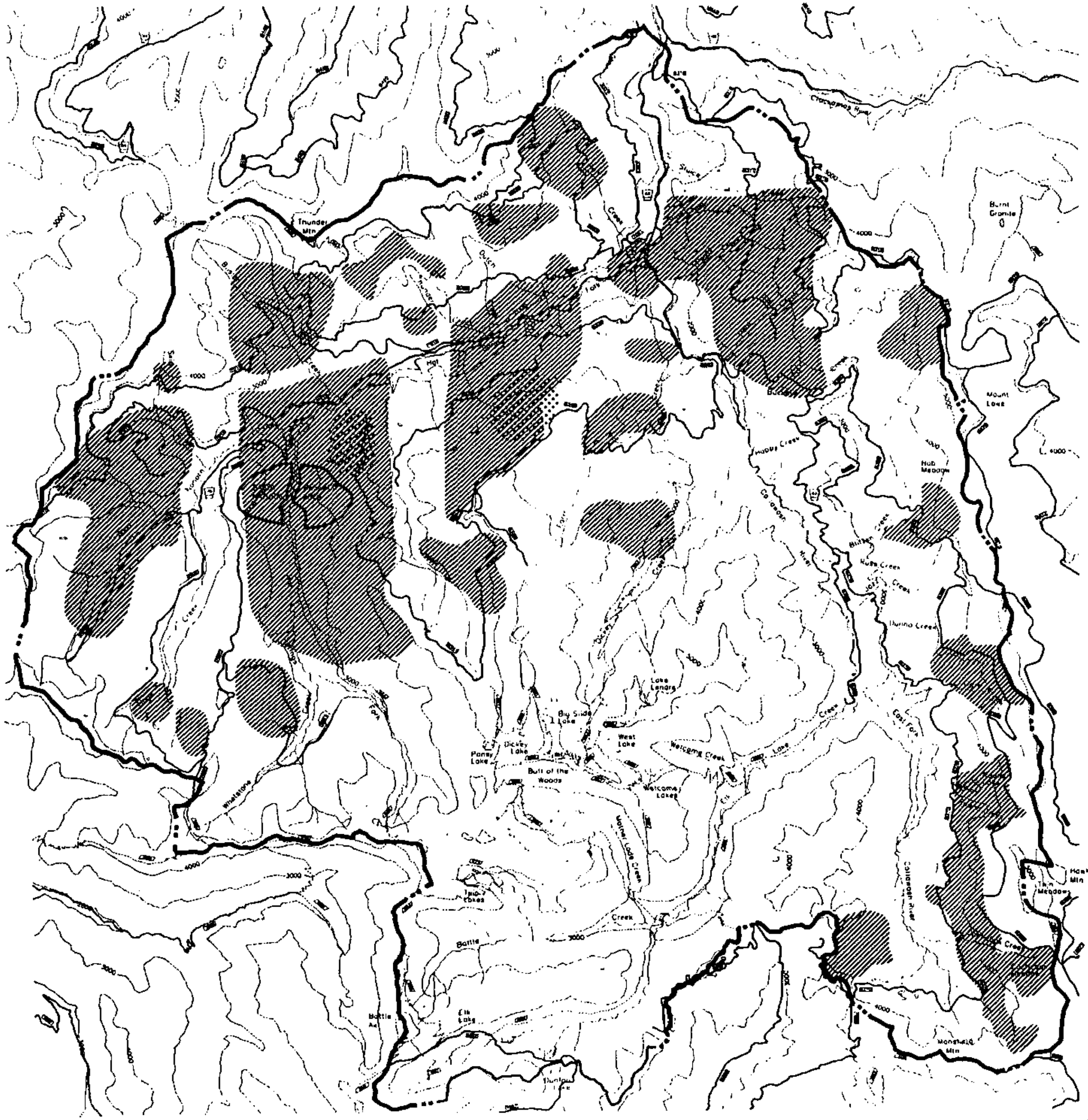
Spruce Budworm: This insect has defoliated thousands of acres of trees on the eastside and around Government Camp. To date, there have been no outbreaks or pockets of activity on the Estacada or Clackamas districts in the Collawash area. These insects prefer weakened and stressed trees. The weakening agent on the east side and around Government Camp was the drought period that lasted several years in the late 80's and early 90's.

Silver Fir Bark Beetle: These insects attack the "true fir" species when these trees come under some sort of stress. There are no known outbreaks in the Collawash watershed. However, there are large populations in the Olallie Lakes area.

Although there are pockets of disease (such as *Phellinus weirii*, mistletoe, blister rust, and *Armillaria*), there appears to be no outbreaks or areas of infection in the Collawash area that would raise an immediate concern. It can be expected that existing disease pockets will grow in size, however, this growth will be slow.

NATURAL CONTROLS

Insectiverous forest birds, bats, and fires exert natural control over forest insects and diseases. Bark beetles are preyed upon by birds that employ a chipping or excavating foraging method in and under the bark of trees (woodpeckers). The populations of these birds are not known with any precision; population numbers are currently inferred by the density and distribution of large snags in the landscape. Budworm is eaten by a variety of foliage gleaners (especially chickadees). The populations of these birds is also uncertain.



Collawash Watershed

Areas of Concentrated Insect Activity (1970-present)

1990 Douglas-fir Bark Beetle

1970 Douglas-fir Bark Beetle

SCALE 1:126720

1000 0 1000 2000 3000 4000 5000

METERS

WINDTHROW

Within the Collawash/ Hot Springs Fork watershed catastrophic windthrow was not historically common, excluding large events such as the 1962 Columbus Day Storm. Anecdotal observation indicates that, generally, normal blowdown only involves a single tree or small group of trees scattered over a wide area. These trees provide for such things as nutrient cycling and large wood in streams. However, the intensity and occurrence of windthrow have increased during windstorms since the 1970's. This is mainly due to the increase of harvest-related openings and associated cutting line/edges that are not windfirm, allowing the winds to drop down and hit a residual stand full-force. Unmanaged forests often have high stand densities and tall trees that are shallowly rooted. In dense stands, individual trees depend on mutual support during a wind storm. When neighboring trees are removed, in combination with certain terrain, soil, and exposure conditions, the potential for windthrow is increased.

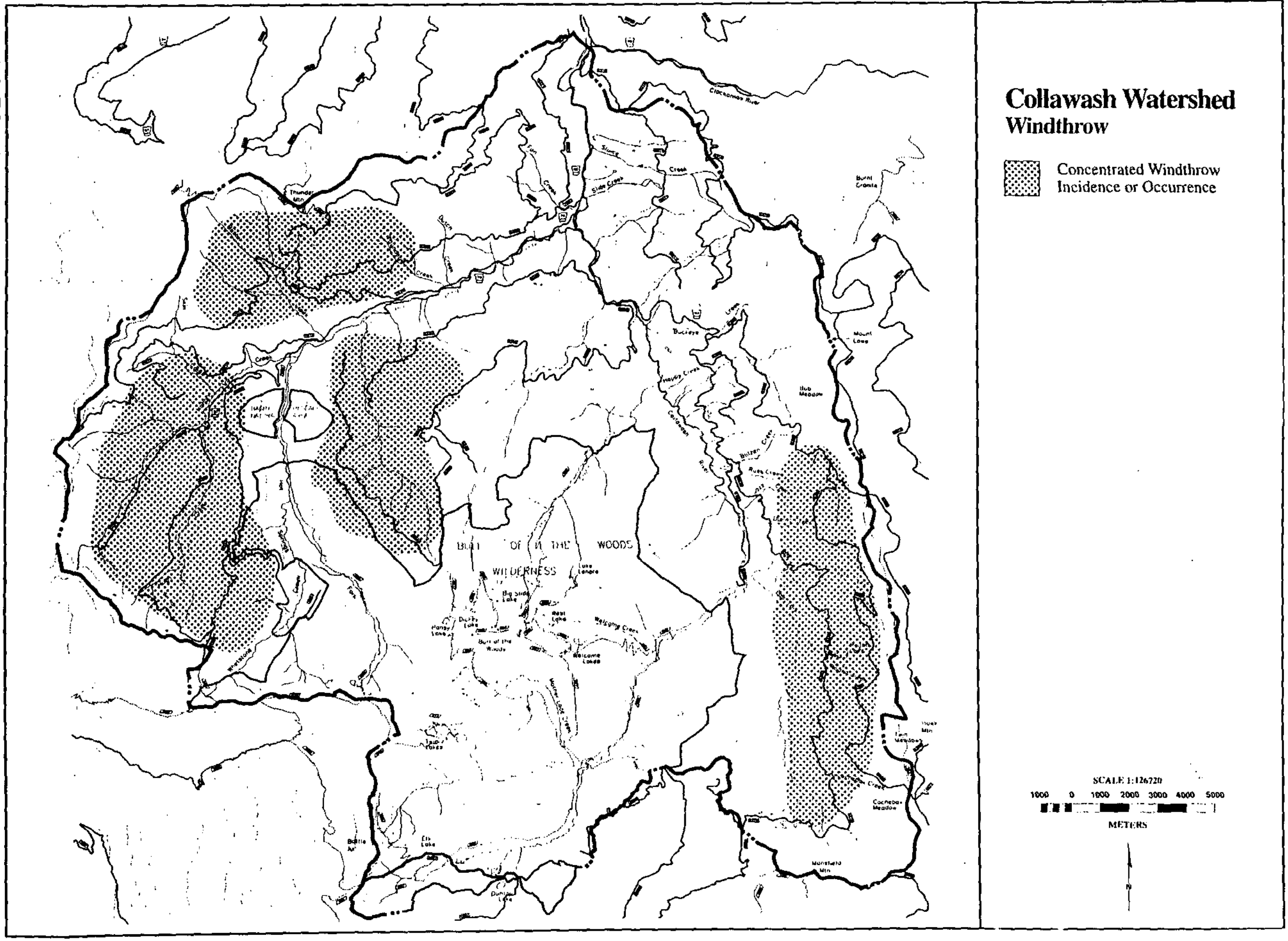
A windthrow interpretation based on the Mt. Hood National Forest Soil Resource Inventory (SRI) identifies a moderate or high windthrow hazard over a large portion of the watershed (Map 6). This is based on SRI interpretations regarding rooting depth. For high hazard sites, the SRI indicates rooting depths are expected to be generally less than 18 inches.

A slope class map generated with digital elevations shows a large portion of the watershed has slopes of less than 50 percent. According to the literature, winds generally can follow slopes of less than 70 percent. Gentler slopes result in a greater potential for windthrow if other stand, soil, and exposure conditions all coincide.

During catastrophic wind events windthrow can occur in unharvested stands, such as Bull of the Woods Wilderness, although not to the extent as in the portions of the watershed that have been heavily harvested. As in a managed stand, if an opening in the wilderness occurs through natural events (i.e., fire, insects, wet areas, etc.), windthrow can be expected on susceptible sites. For example, a fire occurred in the upper Hot Springs Fork area near Shower and Spray Creeks in the late 1970's. It was approximately two acres in size. In the 1989-90 windstorm the trees to the north of this "hole" blew over. The blowdown area is about 1-2 acres in size, however, it is expected that now that it has started, more blowdown will periodically occur.

In the storm of 1989-90 the Estacada District portion of the watershed had about 16MMBf of timber blow over. This involved about 320 acres. To date, a portion has been salvaged, however, approximately 200 acres have not. The Clackamas District portion of the watershed experienced similar blowdown east of the Collawash River.

Collawash Watershed
Windthrow



SOIL SENSITIVITY AND SOIL QUALITY

DESCRIPTION

Map 7 depicts certain soil characteristics in the watershed pertinent to forest management. The intent of the portrayal is to show the distribution and extent of soil types that are sensitive to forest management practices. They are sensitive because their inherent properties (physical, biological, and chemical characteristics) make them susceptible to detrimental soil impacts such as compaction, landslides, and accelerated erosion. These disturbances have the potential to decrease forest productivity. Only sensitive soil types are shown so as to alert managers where to exercise additional caution when implementing management activities on them.

Soil types have been divided into two categories, sensitive and non-sensitive. Sensitive soil types have been further divided into seven subsets (Table 1). Each subset has been rated for certain capabilities: soil sensitivity, inherent soil productivity (as measured by site class), and soil resilience. An assessment was conducted to qualify effects of previous management practices on these soil types, and the amount of recovery from those effects. Then the soil capabilities were coupled with the effects of previous harvest to come up with an existing condition termed soil quality.

The utility of these ratings is to provide information for management planning that could help prevent detrimental soil impacts, thereby helping to maintain forest productivity and minimize indirect effects to off-site resources such as water quality.

CAPABILITY DESCRIPTIONS

Soil sensitivity is an appraisal of a soil's susceptibility to detrimental impacts from harvest and road related activities. Soil properties such as texture, depth, infiltration, organic material, nutrient level, etc., are used to determine sensitivity.

Inherent soil productivity is measured by site class. Site class reflects productivity, thus vegetative expression is representative of soil productivity.

- *High Soil Productivity:* site class I or II
- *Moderate Soil Productivity:* site class III or IV
- *Low Soil Productivity:* site class V or less

Soil resilience is the capability for a soil type to recover from detrimental impacts or resist them.

High Soil Resilience: These soils have a good capability to recover from detrimental impacts, impact recovery is not considered long-term, or these soils have a strong ability to resist detrimental impacts.

Moderate Soil Resilience: Soils with recovery capabilities and detrimental impact susceptability somewhere between low and high resilience. These soils don't possess low or high resilience characteristics.

Low Soil Resilience: Recovery capability is poor, impact recovery is considered long-term. These soils have properties that make them very susceptible to detrimental impacts.

ASSESSMENT OF EFFECTS FROM PAST MANAGEMENT

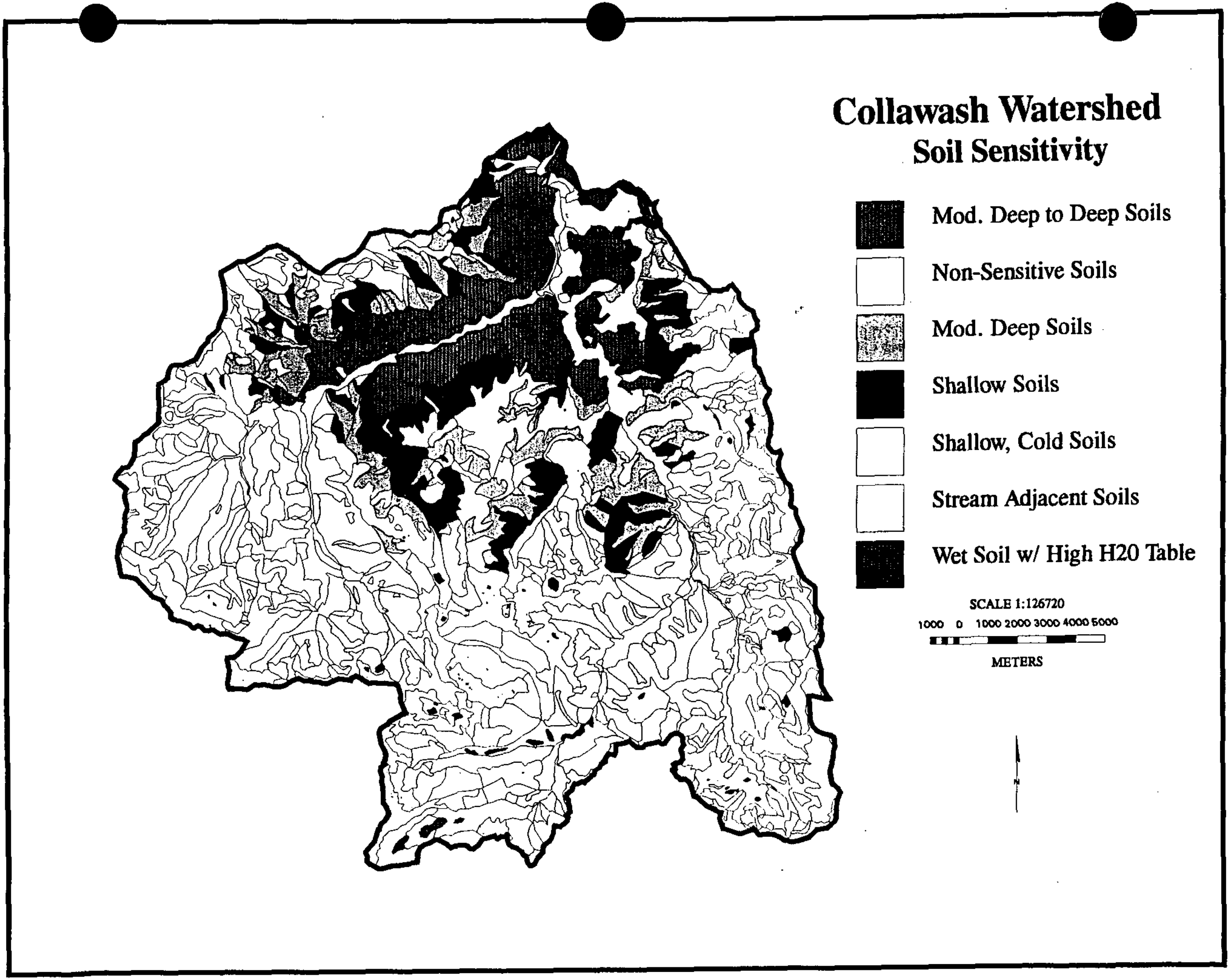
Extent of previous harvest is the amount of area harvested within a soil group. Assuming that most of the past management regimes included clearcut harvesting and broadcast burn site preparation, it was hypothesized that the greater the amount of area harvested within a soil type, the greater the degree of detrimental soil impacts that could have occurred.

- *High extent of Previous Harvest:* soil groups with > 50% of acres ever harvested.

- *Moderate Extent of Previous Harvest:* groups with 25-50% of acres ever harvested.

- *Low Extent of Previous Harvest:* soil groups with <25% of acres ever harvested.

Recovery from previous harvest was assessed by evaluating stand and plantation ages. It is assumed that acres harvested more than ten



Collawash Watershed
Soil Sensitivity
Mod. Deep to Deep Soils
Non-Sensitive Soils
Mod. Deep Soils
Shallow Soils
Shallow, Cold Soils
Stream Adjacent Soils
Wet Soil w/ High H20 Table
SCALE 1:126720
1000 0 1000 2000 3000 4000 5000
METERS

Soil Type	Description	Sensitivity	Resource	Forest Productivity	Extent Prev. Harvest	Recovery Rate	Soil Quality
Wet Soils (high water table): 470 acres	These soils have perennially high water tables, they are generally wet meadows both forested and non-forested, distribution is widespread on many landforms.	Mod.	Low	Low	Mod.-High	Low	Low
Very Rocky Soils: 12,803 acres	Soils in this category are very thin and fragmental, exist on slopes generally greater than 30%, are often associated with talus slopes, are widespread, comprise the majority of soil types in the wilderness, with low to moderate forest cover.	Mod.	Very Low	Very Low	Low	Very Low	Low
Stream Adjacent Soils: 6,070 acres	These soils are often very erosive, unstable, sometimes lack topsoil and organic horizons. They are always associated with perennial streams and major drainageways; they are constantly subject to erosional forces despite heavy to moderate forest cover.	Mod.	Low	Low-Mod.	Mod.	Low	Low-Mod.
Moderately Deep to Deep Soils: 10,144 acres	Very erosive soil types with thick topsoil and organic horizons, often with fine textures. They have the highest clay content of any soil type in the watershed. They can store large amounts of water, may have high water tables, are usually unstable, associated with large ancient landslides both dormant and active (earthflows). They are distributed primarily in the lower reaches of the watershed, with heavy forest cover. W. Hemlock Zone.	Mod.	High	High	High	High	Mod.
Moderately Deep Soils: 7,593 acres	Highly erosive soils with slopes greater than 30%. They have high rock content, are unstable, associated with steep weak rock. They are variably distributed in the lower reaches of the watershed, with heavy forest cover. Pacific Silver Fir (PFS) Zone.	Mod.	Low-Mod.	Mod.	Mod.-High	Mod	Low-Mod.
Shallow soils, Pyroclastic parent material: 7,764 acres	Extremely erosive soil types, very shallow, with a low water holding capacity. They have high rock content, with slopes greater than 60%, associated with steep weak rock, generally distributed on lower sideslopes, with moderate forest cover. PSF Zone.	Mod.	Low	Low-Mod.	Mod.-High	Low	Low
Shallow cold soils, parent materials are Glacial deposits: 18,726 acres	These soils exist above 3,000' elevation, are very shallow, have a low water holding capacity, and a high rock content. They are very cold soils prone to frost, very widespread, associated with glaciated landforms, primarily distributed on upper sideslopes south of the Hot Springs Fork mouth, with moderate to heavy forest cover. PSF Zone.	High	Low	Low-Mod.	Mod.	Low	Low-Mod.

Key: Res-Resilience, FPr-Forest Productivity, EPH-Extent of Previous Harvest, RR-Recovery Rate, SQ-Soil Quality

Table 1 Sensitive Soils

years ago have undergone natural recovery from detrimental soil impacts such as compaction, accelerated erosion, landslides, excess removal of organic material, and extreme soil scorching. Impacts may have been eliminated or reduced; it's likely that effective ground cover has established and vegetation has formed some degree of protective cover over bare soil.

EXISTING CONDITION (SOIL QUALITY)

Soil quality is an overall assessment of existing soil resource conditions. The qualitative designations are a product of evaluating soil capabilities (inherent productivity, resilience, and sensitivity) in combination with past management effects and recovery from those effects. There are three soil quality designations: low, moderate, and high.

High Soil Quality: high productivity, site class I or II, high resilience, not susceptible to detrimental impacts, not sensitive, less than 25% of the area has been harvested in the past.

Moderate Soil Quality: moderate to high productivity, site class III or IV, low to high resilience, may or may not be susceptible to detrimental impacts, may be sensitive, 25% to 50% of acreage has been harvested in the past.

Low Soil Quality: low to high productivity, site class varies II to V, low resilience, very susceptible to detrimental impacts, sensitive soil, 25% to greater than 50% of acreage has been harvested in the past.

Most of the soil resource acres in the watershed are in a low to moderate soil quality condition.

- 33,637 acres of moderate to high soil quality
- 10,144 acres of moderate soil quality
- 32,389 acres of low to moderate soil quality
- 21,037 acres of low soil quality

Implications of the soil quality conditions in the watershed indicate that detrimental soil impacts from past management exists and that forest productivity has likely been affected, but not drastically. Much of the soil resource is in good condition. There are many acres of sensitive soils with low or moderate soil quality. These soil types may require careful strategies and consideration for managing natural resources on them.

SOIL TYPES

One-third (33,637 ac.) of the soils in the watershed are considered non-sensitive. They vary greatly in characteristics, distribution, and occurrence. However, they all are resistant to detrimental impacts.

- *Sensitivity:* low to moderate
- *Soil Productivity:* moderate
- *Recovery Rate:* moderate to high
- *Overall Soil Quality Rating:* moderate to high
- *Resilience:* high
- *Degree of Previous Harvest:* moderate

About two-thirds of the soils in the watershed are considered sensitive. They are particularly susceptible to detrimental impacts from management activities. They vary greatly in their characteristics, inherent productivity, and resilience. These sensitive soil types are divided into seven subsets, each subset differing in their capabilities and characteristics that make them sensitive. The subsets are listed and described in Table 1.

INFORMATION GENERATION

The soil map was produced by Geographic Information Systems (GIS). As a result of this watershed analysis, the Mt. Hood's SRI map was transferred into an electronic format in GIS. Aerial photo ('88 infra red, 1"/mi) interpretation was used to obtain ocular estimates of the percent area that has ever been harvested on each soil group. Soil Quality ratings were determined by inputting qualitative ratings for soil capabilities and effects of past management into a decision matrix that produced a soil quality designation. All factors were weighted equally. For more information contact the Soil Scientist on the Estacada Ranger District. Primary references used are listed in the Reference section.

REFERENCE/ BACKGROUND SEDIMENT REGIME

Map 8 depicts background, or natural, primary sediment production sources and delivery routes. It provides a backdrop to characterize natural sediment production and delivery through the watershed. The map shows where primary, chronic sediment production occurs naturally and where it is delivered to water courses. It illustrates the relative amount of background sediment production in the watershed and represents what conditions might be if there were no roads or timber harvest in the watershed.

The storage component of the sediment regime is not visually characterized on the map. Most fine sediment in the watershed is stored in the soil mantle, primarily on earthflows (ancient landslides), valley bottoms, and glacial cirques. Natural storage of fine sediment in these fluvial environs is relatively short-lived, the watershed is very "flashy." Winter storms and high water events tend to flush fine sediments through the system.

Major sediment sources are consistently associated with drainageways or steep, unstable slope conditions. The dominant processes influencing sediment production and delivery in the watershed are mass wasting and fluvial dynamics. In terms of slope stability, the Collawash watershed is more unstable than any other on the Mt. Hood NF. Sediment is produced and delivered directly into water courses by distinct mechanisms and events such as:

• Debris slides, debris flows, and translational failures (shallow landslides), primarily on steep drainageways, drainageway sideslopes, shallow soils, and steep, weak rock types;

• Streams and rivers that undercut the toes of ancient landslide landforms (often called earthflows), both active and dormant;

• Streams dissecting ancient landslide landforms, both active and dormant:
 - very erodible, unconsolidated materials, unstable streambanks;
 - rapid stream downcutting and bank undercutting, even on relatively low gradients;

• Slumps, earthflows, and soil creep where soil materials are under constant sheer stress, resulting in the slow, downhill movement of the soil mantle.

Other ecosystem processes and components are primary contributors to mechanisms that drive sediment production and delivery in the watershed. Sediment production and delivery mechanisms are strongly associated with the wet season, high precipitation, and rain-on-snow events. Unstable slopes, steepness (>60%), soil types, and rock materials greatly influence this sediment regime.

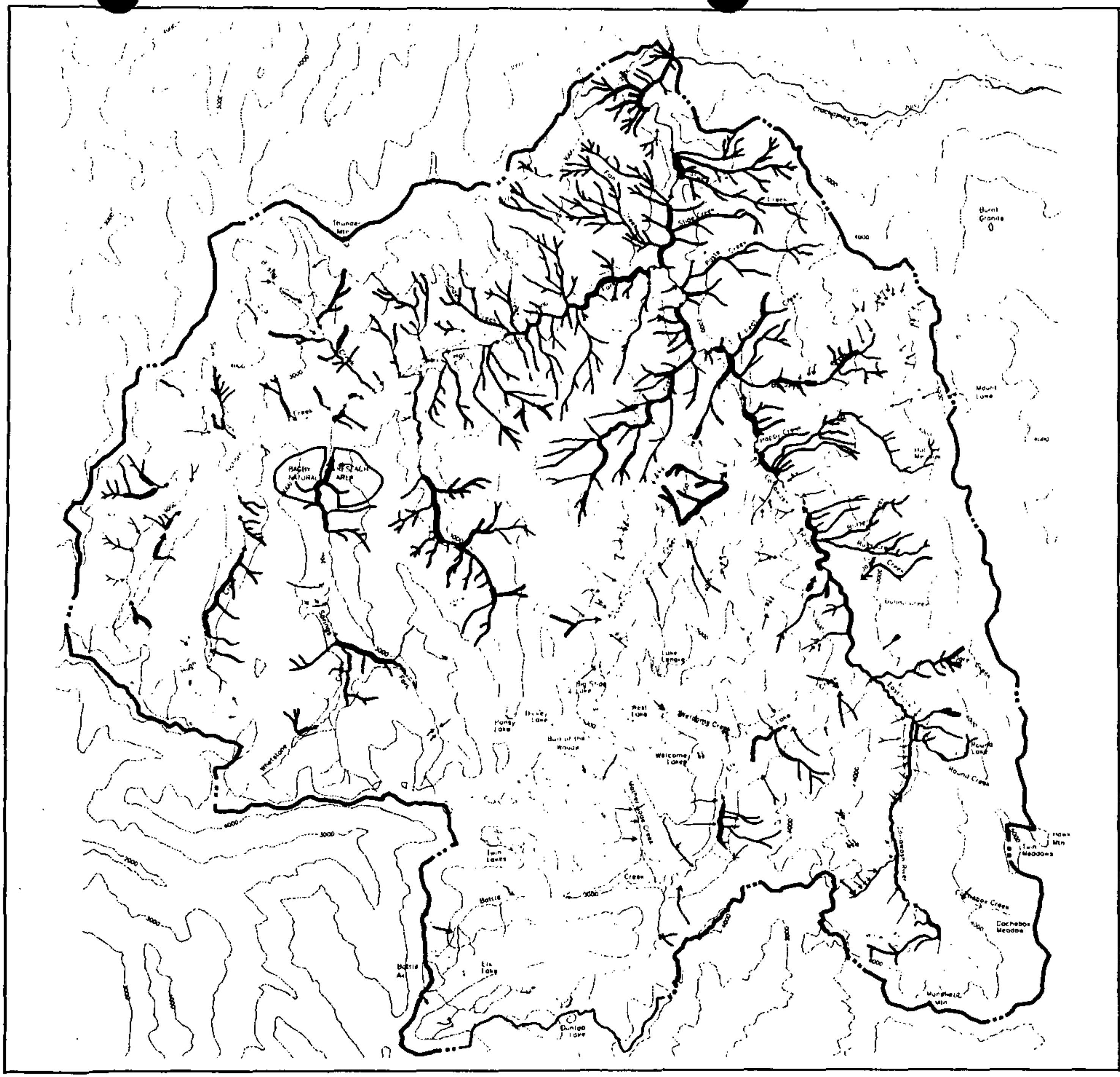
Sediment production and delivery mechanisms often function as sources for aquatic habitat components. Mass wasting events and streambank erosion are major source mechanisms for large woody debris and rock substrate inputs to streams.

Primary sediment sources in the watershed are the mid and lower reaches and tributaries to the Collawash and Hot Springs Fork rivers. The ancient landslide landforms (earthflows) are primary contributors of fine sediment to water courses. The wilderness area delivers a relatively smaller proportion of sediment to the watershed than areas outside its bounds, primarily in the form of slope failures on steep slopes.

INFORMATION GENERATION

The accompanying map was produced by overlaying a variety of maps to interpret which physical features and processes interact to generate the sediment regime in this watershed. Aerial photograph interpretation was also used to help validate assumptions and conclusions. Maps and GIS overlays used:

- Landform
- Streams
- Soils (SRI)
- Precipitation
- Vegetation
- 1"/mi. 1989 IR aerials
- Slope
- Mass wasting risk
- Geology



Collawash Watershed

Background Sediment Regime

- Estimated *primary* sources and delivery routes
- Natural regime at a snapshot in time, pre-roading condition
- Spatial and relative magnitude of sediment production and delivery

Sediment Delivery

Debris Slides, Debris Flows, Tranlational Failures on Steep Slopes and Minor Drainageways

Ancient Landslide (Active and Dormant) Toes and Streambanks, Unstable Drainageways, Rapid Stream Downcutting, Debris Slides and Flows in Major Drainageways, Soil Creep, Slope Undercutting.

Note: Line thickness denotes relative production rates. Thick lines suggest higher production than thin lines.

SCALE 1:126720

1000 0 1000 2000 3000 4000 5000

METERS

Certain assumptions were used to help formulate hypotheses on the sediment regime in this watershed.

- In forested watersheds with continuous effective ground cover, rain splash, overland flow, dry ravel, dust, and wind erosion are not primary factors contributing to the reference sediment regime (except after stand replacement fires).

- The natural range of sediment production in the watershed is quite large; low quantities are produced in the dry season, higher amounts during the wet season.

For more information contact the Soil Scientist on the Estacada Ranger District. Primary references used are listed in the References section.

GEOLOGIC LANDFORMS

Landforms were delineated based on their susceptibility to landsliding. Each landform type reflects a unique combination of geologic units, slope gradient, and drainage density. The dominant slope forming processes vary from landform type to landform type. Table 2 gives descriptions of the landform types.

INFORMATION GENERATION

The landform type map (Map 9) was constructed using existing bedrock and surficial geology mapping, slope angle, and drainage density. Hammond and others (1982) was the primary source for the bedrock and surficial geology. Inside Bull of the Woods Wilderness the bedrock geology mapping of Walker and others (1985) was used to modify the mapping of Hammond. Slope angles were obtained using the Mt. Hood's digital elevation model. The relative activity of ancient landslides was determined using past landslide mapping by geotech personnel, and by personal field experience with many landslides.

The key assumption and interpretation step in producing the landform map involves the grouping of particular geologic units into simplified units based on their susceptibility to mechanical and chemical processes.

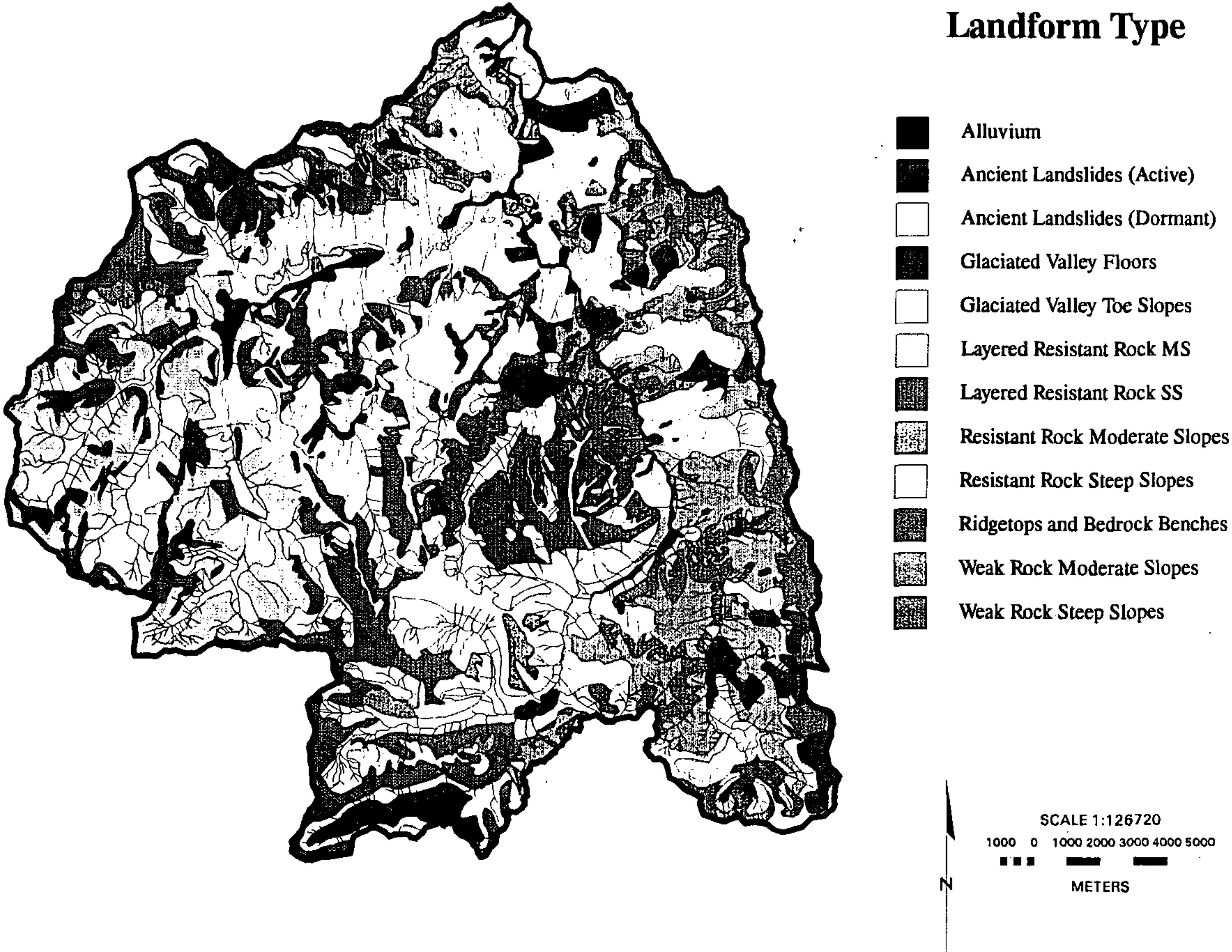
Another assumption involves assigning adjectives such as "Steep" or "Moderate" to a group of slope angles to highlight their propensity for landsliding. The breaks between slope classes are somewhat arbitrary, and there is no evidence to suggest that landslide frequency abruptly declines immediately upon moving from a higher to lower slope class.

For more information on the landform map, contact the Forest Geologist for the Mt. Hood NF. For information on the geology base maps, see the Reference section.

Ancient Landslides-Active (ALA)	Large ancient landslides or earthflows that have moved recently, evidenced by freshness of surface features as documented in the geotech project files. Most types of management activities are likely to reactivate or accelerate movement on these landforms.
Weak Rock- Steep Slopes (WRSS)	Generally horizontal-lying layers of easily-erodible pyroclastic materials with enough thin, resistant lava flows to hold up the steep (>50%) slopes. Changes in permeability at the contacts between the different layers often result in springs or shallow groundwater tables. Altering the groundwater conditions in these areas can trigger debris slides and debris flows. This landform unit is highly dissected.
Layered Resistant Rock- Steep Slopes (LRRSS)	Generally horizontal-lying layers of resistant lava flows separated by layers of weak pyroclastic materials. Permeability contrasts similar to that in the WRSS landform type increase the susceptibility to landsliding at those contacts. Slopes are greater than 50%.
Ancient Landslides-Dormant (ALD)	Large ancient landslides or earthflows that are not known to have moved recently. These features may have been initiated thousands of years ago by extremely large earthquakes. Portions of these features have probably moved since then because of other large earthquakes or extreme climatic events. The present risk is for reactivating portions of these ancient landslides.
Resistant Rock- Steep Slopes (RRSS)	Large igneous intrusions near Austin Point and Bull of the Woods Mountain underlie the steep (>50%) slopes in those areas. This landform type does not contain the layered bedrock common to much of the watershed so permeability contrasts are not as pronounced.
Weak Rock- Moderate Slopes (WRMS)	Similar to the WRSS landform type except for the lower slope angle (20-50%). Landslide susceptibility is also less.
Layered Resistant Rock- Moderate Slopes (LRRMS)	Similar to the LRRSS landform type except for the slope angle (20-50%). Landslide susceptibility is also less.
Glaciated Valley Toe Slopes (GVTS)	Lower sideslopes of glaciated valleys. Glacial till mantles these slopes, providing them with a smoother shape and less dissection than the steeper valley side-slopes directly above this landform type.
Resistant Rock- Moderate Slopes (RRMS)	Similar to the RRSS landform type except for the slope angle (20-50%). Landslide susceptibility is also less. Occurs only in a few small areas near Austin Point and Mother Lode Creek.
Talus (T)	Angular loose rock that has accumulated downslope from outcrops of generally resistant bedrock as a result of rockfall and small debris slides.
Glacial Valley Floors (GVF)	Low angle glacial till deposits that formed in the valley bottoms of the larger glaciated valleys or on the low angle plateaus along the eastern edge of the watershed.
Ridgetops and Bedrock Benches (RT)	Low angle ridgetops and midslope benches not underlain by glacial till. Very poorly dissected.
Alluvium (A)	Very flat, fluvial depositional landforms. Includes both glacial outwash and flood deposits.

Table 2
Descriptions of Landform Types

Collawash Watershed
Landform Type



MASS-WASTING HAZARDS

The mass-wasting risk map (Map 10) highlights those landform types that have an inherent risk of mass wasting. Management activities on these landforms increase the relative hazard for inducing landslides and mass wasting occurrence. This map divides the Ancient Landslide landform type of the landform map into active and dormant portions.

The relative hazard ratings (Table 3) are based on two major factors: the susceptibility of the landform type to mass-wasting events, and the likelihood of sediment from that event reaching a defined channel. No historical landslide inventory was attempted for this watershed due to time constraints. Information from historical landslide inventories completed on portions of two adjoining watersheds (Fish Creek and Upper Clackamas) with similar landform types was extrapolated into this watershed and used to assign the relative hazard rating. The Collawash/ Hot Springs Watershed is the most unstable within the Mt. Hood National Forest. Landslides can and do occur almost anywhere in this watershed.

A relative hazard rating of high for a landform type does not mean that the entire landform has an equally high probability of delivering mass-wasting produced sediment to a defined channel because of a management activity. It means there are more potentially unstable areas or a more efficient sediment delivery system or some greater combinations of these two factors within that landform type compared to others with lower hazard ratings. Within any landform type there will be some areas with a very low relative hazard for sediment-delivering landslides and some with an extremely high relative hazard. The high hazard areas will be identified during the planning phase of individual projects.

The relative hazard ratings for the landform types designated during this watershed analysis are different from the earthflow risk ratings (high, moderate, low) in the Forest Plan. The earthflow risk rating system incorporates other factors besides sediment delivery when assigning a rating to a particular earthflow, unlike this analysis' hazard rating system. Since earthflows are a type of landslide, the high, moderate, and low risk earthflows mapped for the Forest Plan are included within the Ancient Landslide landform mapped for this watershed analysis. Additional landslides that are probably not true earthflows are also part of the Ancient Landslide landform. The mapping completed during this watershed analysis does not replace the earthflow mapping that is part of the Forest Plan. The B8 standards and guidelines from the Forest Plan are not extended to any new areas because of mapping completed for the watershed analysis. Boundary discrepancies between the two mapping exercises should be resolved with field-based mapping.

The Ancient Landslide landform type (Table 2) is based primarily on the geologic mapping of Hammond and others (1982). Active portions were delineated based on past landslide mapping by geotech personnel, and by past field experience with many landslides. The accuracy of the mass wasting map reflects the accuracy of Hammond's map and the past landslide mapping of the geotech group.

For more information on the mass wasting map, contact the Forest Geologist of the Mt. Hood National Forest. For information on the geology base maps, see the Reference section.

This table lists the 13 landform types with their associated geologic units, the relative hazard rating, range of slope angles, and dominant mass- wasting processes.

Landform Type	Geologic Units	Hazard	Slope	Dominant Processes
Ancient Landslides - Active (ALA)	Qls	XH	10-70	Slumps, EF, DS, DF
Weak Rock - Steep Slopes (WRSS)	Tb, Tbc, Tr, Tvs	H	50+	DS, DF, Slumps
Layered Resistant Rock - Steep Slopes (LRSSS)	Tn, Qba, Tba	M-H	50+	DF, DS
Ancient Landslides - Dormant (ALD)	Qls	M-H	0-70	Slumps, EF, DS, DF
Resistant Rock - Steep Steep Slopes (RRSS)	Tipa, Tda	M	50+	DF, DS, Rockfall
Weak Rock - Moderate Slopes (WRMS)	Tb, Tbc, Tr, Tvs	M	20-50	DS, DF, Slumps, EF
Layered Resistant Rock - Moderate Slopes (LRRMS)	Tn, Qba	M	20-50	DS, DF
Glaciated Valley Toe Slopes (GVTS)	Qyt	M	20-40	Slumps, DS
Resistant Rock - Moderate Slopes (RRMS)	Tipa, Tda	L	20-50	DS, DF
Talus (T)	Qta	L	40-70	Rockfall, DS
Glacial Valley Floors (GVF)	Qyt	L	0-20	Slumps, DS
Flat Upland Surfaces (RT)	QTb, Tn, Tr	VL	0-20	Weathering
Alluvial Flood Plain (A)	Qal	VL	0-10	Streambank Failure

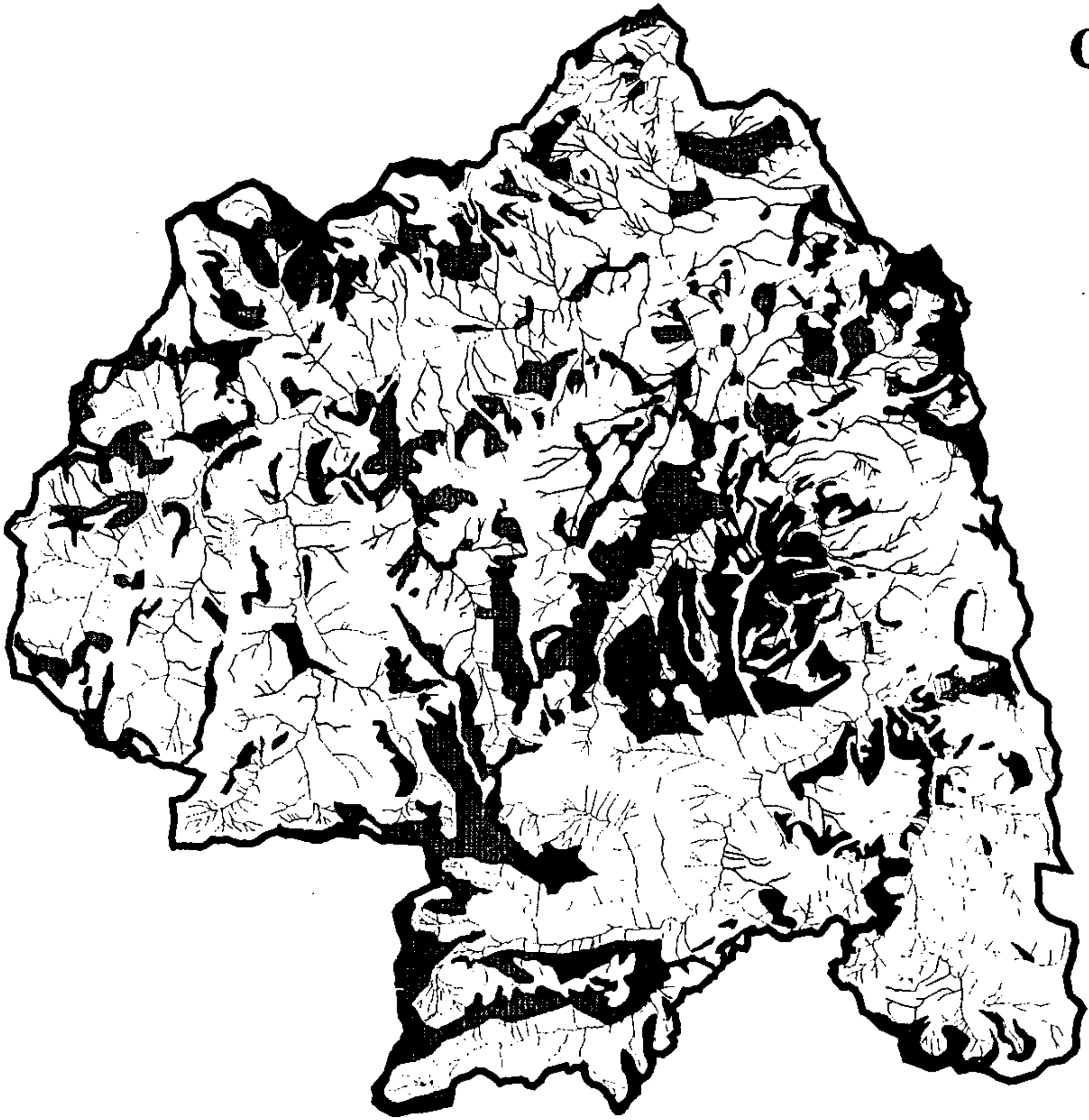
Abbreviations:

Dominant Processes
DS = debris slide
DF = debris flow
EF = earthflow

Hazard
XH = extremely high
H = high
M = moderate
L = low
VL = very low

Table 3
Relative Hazard Rating for Management Activities Triggering Sediment-Delivering Landslides

Collawash Watershed
Mass Wasting Risk



Very High Risk
(Ancient Landslide, Active)

High Risk
(Weak Rock, Steep Slopes)

Mod. to High Risk
(Layered, Resistent Rock, Steep Slopes)

Mod. to High Risk
(Ancient Landslide, Dormant)

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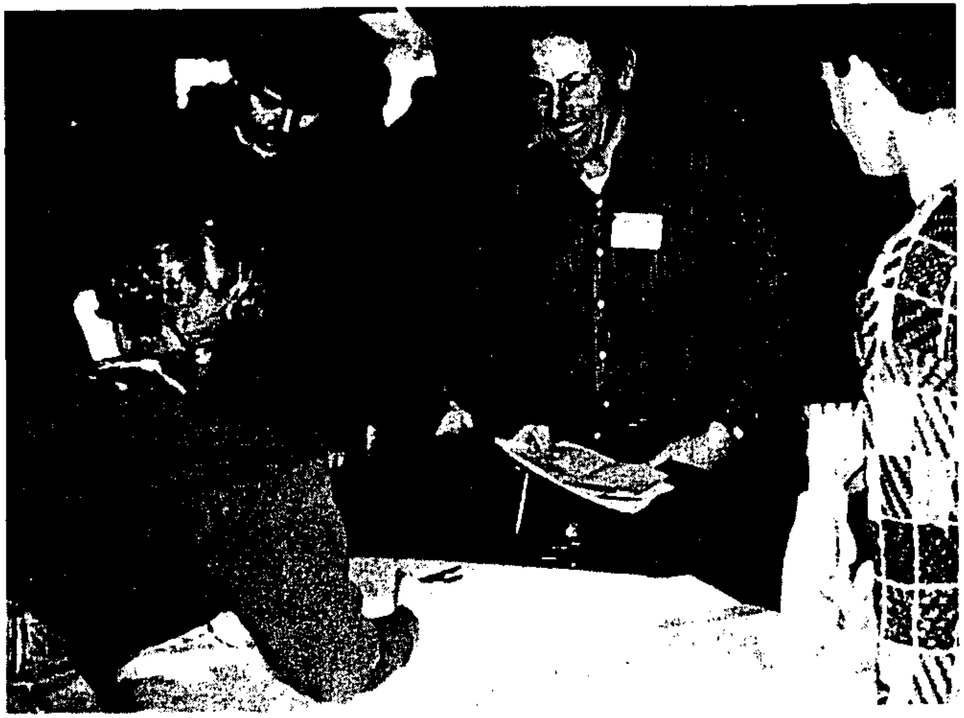
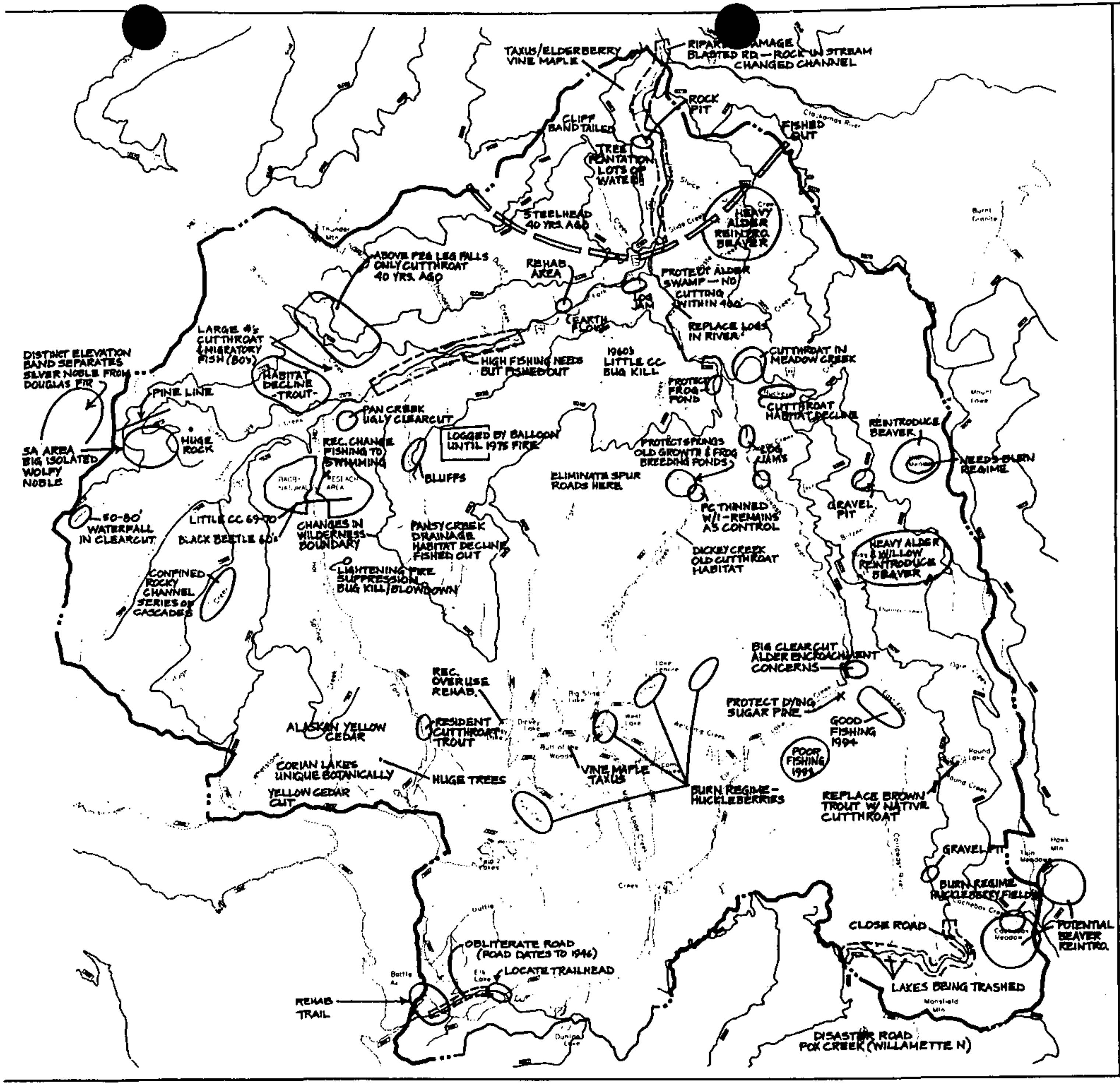
PUBLIC COMMENTS

Map 11 is based on comments and suggestions received at a Public Meeting held February 18, 1995 in Estacada. The topic of concern was the Collawash/ Hot Springs watershed analysis and the objective was to capture the questions and suggestions of those citizens present. Most are long time residents of the area who are quite familiar with the watershed. Some have been using it for years. They were asked to illustrate their comments by drawing or writing on maps of the watershed that were provided. Their concerns covered a wide range of topics but among the more popular were biodiversity, fisheries, recreation, and roads.



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

- Bud Beechwood, Tigard
- Guy Kennersman, Oregon City
- Ed Eaton, Portland
- Wayne Coultas, Oak Grove
- Cole Gardiner, Portland
- Jim Mastne, Corbett
- Rex Lebow, Estacada
- Chet Greene, Portland
- Noel Hamel, Estacada
- Steve Hinton, Portland
- Harry Coultas, Gaston
- Avis Rana, Oregon City
- Dave Corkran, Portland



Collawash Watershed
Public Workshop Comments

CONCERNS:

- Rehabilitate Cutthroat Areas
  - Long-term goals
  - Cedar logs to trap sediment
- Alder
  - Leave some on ground. Don't sell all.
- Color Code Stream Segments
  - Temperature
  - Pool, riffle
  - Morphology change
  - Subwatershed
- Fan Creek
  - Side channel restorations
  - Plan dispersed recreation for accessibility
  - Predation - needs cover
  - Rehab. island
- Earth Movement Areas (Geology and Amount of Roads)
  A - Road condition
  B - Culverts
- Grouse Hunting Off
  - 63 side roads

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PART III
Present Conditions

VEGETATIVE STRUCTURE

Map 12 is a vegetative structure map that displays the current condition of the Collawash/ Hot Springs Fork watershed. The structural elements of the Collawash/ Hot Springs Fork landscape are divided into six broad categories:

- *Matrix (landscape ecology definition)*
- *Immature forest patches*
- *Wetland patches*
- *Sitka alder shrub patches*
- *Aquatic patches*
- *Rock patches*

The matrix within the Collawash/ Hot Springs Fork watershed, based on the criteria of relative area, connectedness, and control over landscape dynamics (Forman and Godron, 1986, Diaz and Apostol, 1992), is defined as "mature forest," a combination of large and small sawtimber. The matrix is composed of three different structural classes: large conifer, closed small sawtimber, and open small sawtimber. Ages of large conifer stands in the watershed range from approximately 80 to 550 years old. Most of the large conifer stands in the Collawash/ Hot Springs Fork are between 200 and 350 years old. The small sawtimber stands are a combination of mid-successional stands originating from stand replacement fires and some late-successional stands on poorer, high elevation sites.

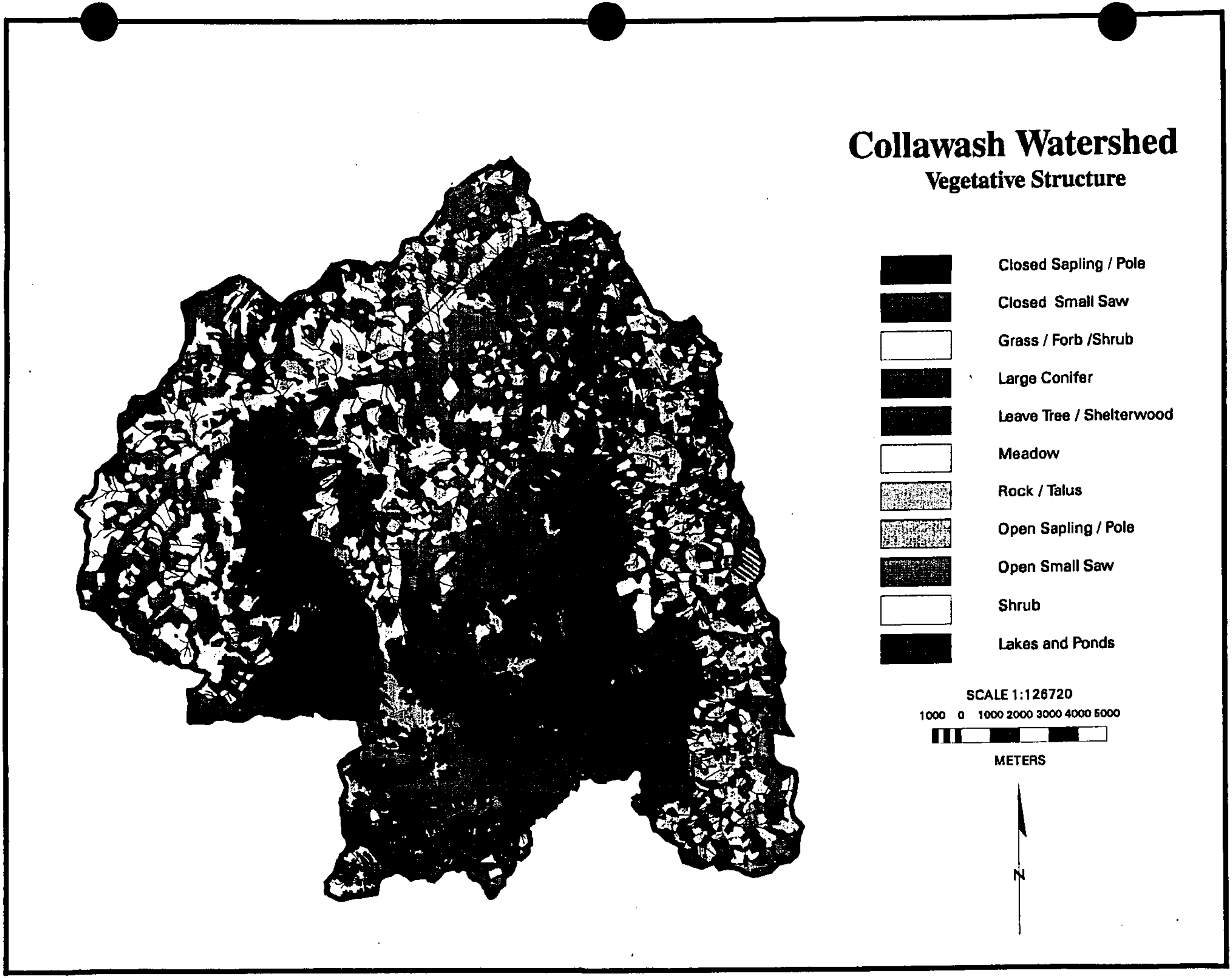
Immature forest patch structural classes include: Grass/forb/shrub, open sapling pole, closed sapling pole, and leave tree and shelterwood stands. Other landscape patch types identified within the watershed are: Sitka alder shrub patches; wetland patches (grass/forb dominated meadows, shrub wetlands, and red alder swamps); aquatic patches (lakes and ponds); and rock patches (rock outcrops and talus slopes, and quarries).

STRUCTURAL ELEMENTS

Surveys completed over the last several years have shown that certain structural elements that are often found after catastrophic fire disturbance (patches of unburned trees, scattered large snags, large downed logs) are missing or present in low densities in harvest created openings. Figures 1 - 4 display the densities of medium and large snags and down logs in different structural stages. The figures show that managed stands contain, on average, far fewer large snags and logs than unmanaged stands. Large snags and down log density are also influenced by stand structure and forest series. In general the large conifer stands have greater densities of large and medium sized logs than small sawtimber stands. The mountain hemlock zone contains far fewer snags and logs than the other series.

Forest LMP standards call for leaving enough snags in new harvest units to support, over time, at least 60 percent of the biological potential of cavity excavators. Estimates of biological potential currently tier to a model devised by Neitro, et. al. (1985). The model shows that approximately 2.6 snags per acre are necessary to achieve 60% biological potential for woodpeckers at the stand level. A weakness of this approach is that no agreement exists that this level of snag retention provides for an equivalent level of biological potential for other snag users (eg., nearly all bats, arboreal rodents, bluebirds, swallows, and denning carnivores). At this time, snag levels appear to be "above" the LMP standard in all large conifer stands, below LMP standards in most small saw stands, and below LMP standards in all managed stands. The last decade's emphasis on retaining and topping wildlife trees after harvest has definitely improved the picture, but snag density in managed stands (especially plantations older than ten years) is still low. A proactive way to deal with this is suggested. Leave additional standing snags within 50 feet of early and mid seral plantations. This could provide high quality snag habitat on the edges of these habitats.

Firewood cutting seems to have contributed to the low availability of large down logs in recent harvest units. Far fewer decks are available for cutting than in the past and firewood gatherers have been observed far into harvest units in flat


Collawash Watershed
Vegetative Structure
Closed Sapling / Pole
Closed Small Saw
Grass / Forb /Shrub
Large Conifer
Leave Tree / Shelterwood
Meadow
Rock / Talus
Open Sapling / Pole
Open Small Saw
Shrub
Lakes and Ponds
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METERS
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areas. This trend is likely to continue in the future and future harvest units may only temporarily meet the Northwest Forest Plan standards for down log retention.

Many species in the Pacific Northwest evolved to use the large snags and logs that were historically abundant in the landscape. The loss of snag and log density from managed stands affects biodiversity and potentially could cause a loss of critical function in the landscape such as control of forest insects. The recent outbreak of the Douglas-fir bark beetle suggests that some loss of function may have already taken place. *Twenty-seven neotropical migratory bird* species occurring within the watershed have significantly declined over the last two decades, based on Breeding Bird Survey data (Sharp, 1992). Of these 27 species, half are snag dependents and insectivorous or birds of prey feeding on forest birds. Some of these declining species were not evaluated for population viability in the FSEIS (USDA, et.al., 1994) because they are not necessarily associated with late seral habitats.

Snag and log density analysis is based on the 1986 Forest Inventory data (unmanaged stands), 1992 Forest Inventory data (managed stands in mid seral stages), and 1992 contract data (early seral stands). See the district wildlife biologist or forest ecologist for more information.

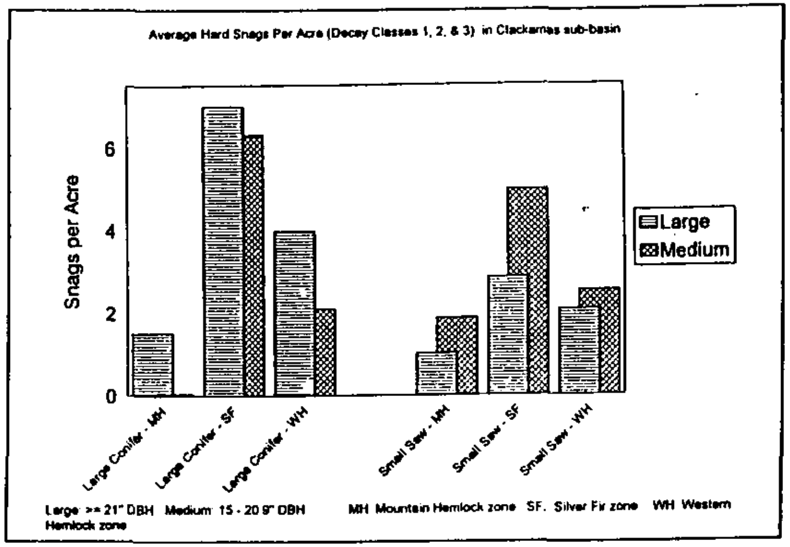


Figure 1
Snag Density - Unmanaged Stands

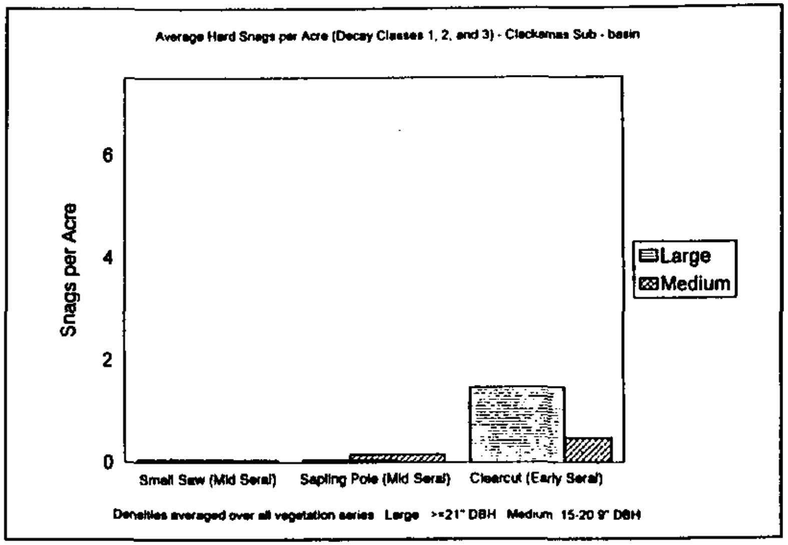
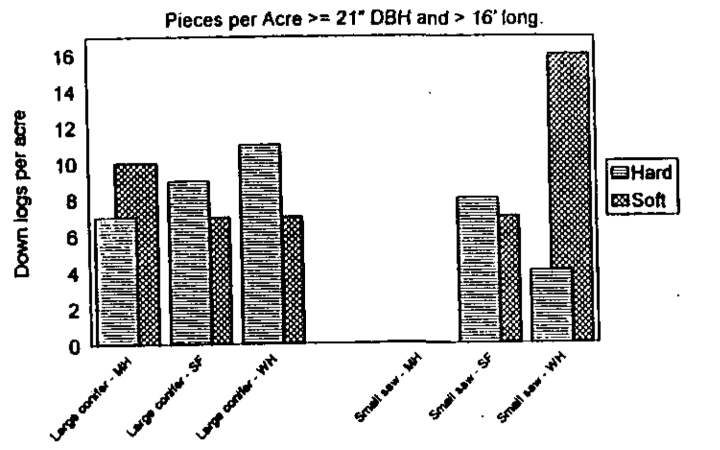
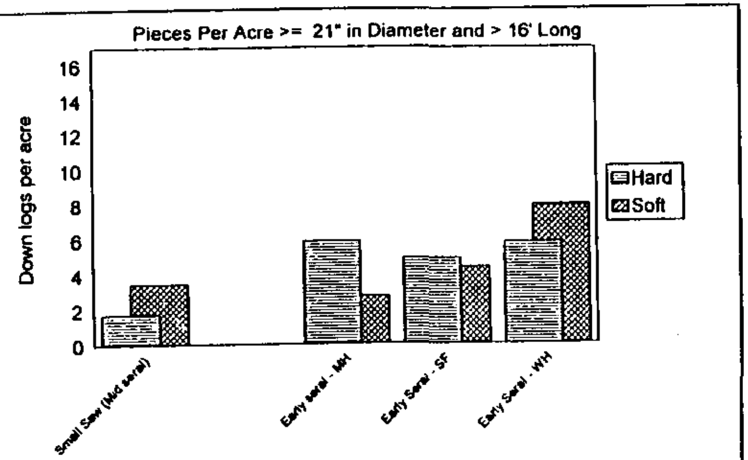


Figure 2
Snag Density - Managed Stands



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

Figure 3
Downed Log Density - Unmanaged Stands



Based on forest-wide managed stand survey (mid seral data) and 250 recently cut plantations measured in 1992 in Clackamas sub-basin. Hard: Decay Classes 1, 2, and 3. Soft: Decay Classes 4 and 5. MH: Mountain Hemlock series. SF: Silver Fir series. WH: Western Hemlock series

Figure 4
Downed Log Density - Managed Stands

SERAL STAGES

Map 13 shows the current distribution of seral stages within the Collawash/ Hot Springs Fork watershed. Seral stages within the watersheds can be grouped into three broad developmental stages: early, mid and late seral. The three seral stages vary by both species composition and structure of the vegetation. Seral stage is an important ecological driver within the watershed affecting a variety of ecosystem functions, including: wildlife species use and migration, nutrient cycling, hydrologic function, production of snags and coarse woody debris, and disturbance processes (fire, insects, disease, and windthrow), among many others. Seral stage also greatly influences aesthetic and potential economic aspects of the watershed.

For this analysis, seral stages were defined according to stand structure rather than stand age. This means that some older stands on poorer, high elevation sites are included in the mid seral rather than the late seral category. Late seral stands were defined as stands dominated by conifers at least 21 inches in diameter (these stands are generally older than 80 years). The late seral category includes both old-growth and mature stands that have developed some *old-growth characteristics*. The mid seral category included closed sapling/pole stands (average stand diameter less than 8 inches, dense canopy) and small sawtimber (stands dominated by conifer trees ranging from 8-21 inches in diameter). The early seral category

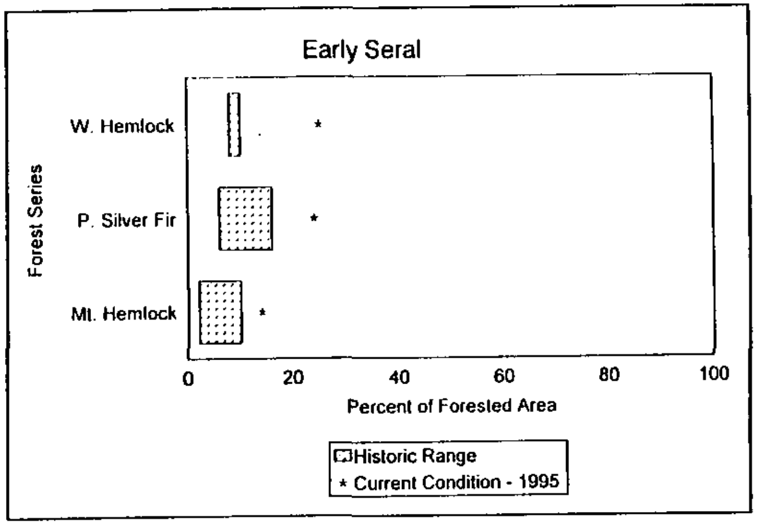


Figure 5
Range of Natural Variability - Early Seral

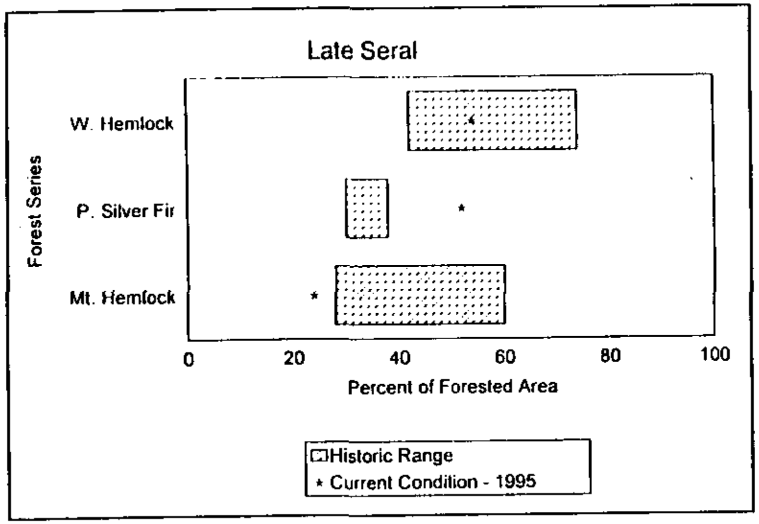
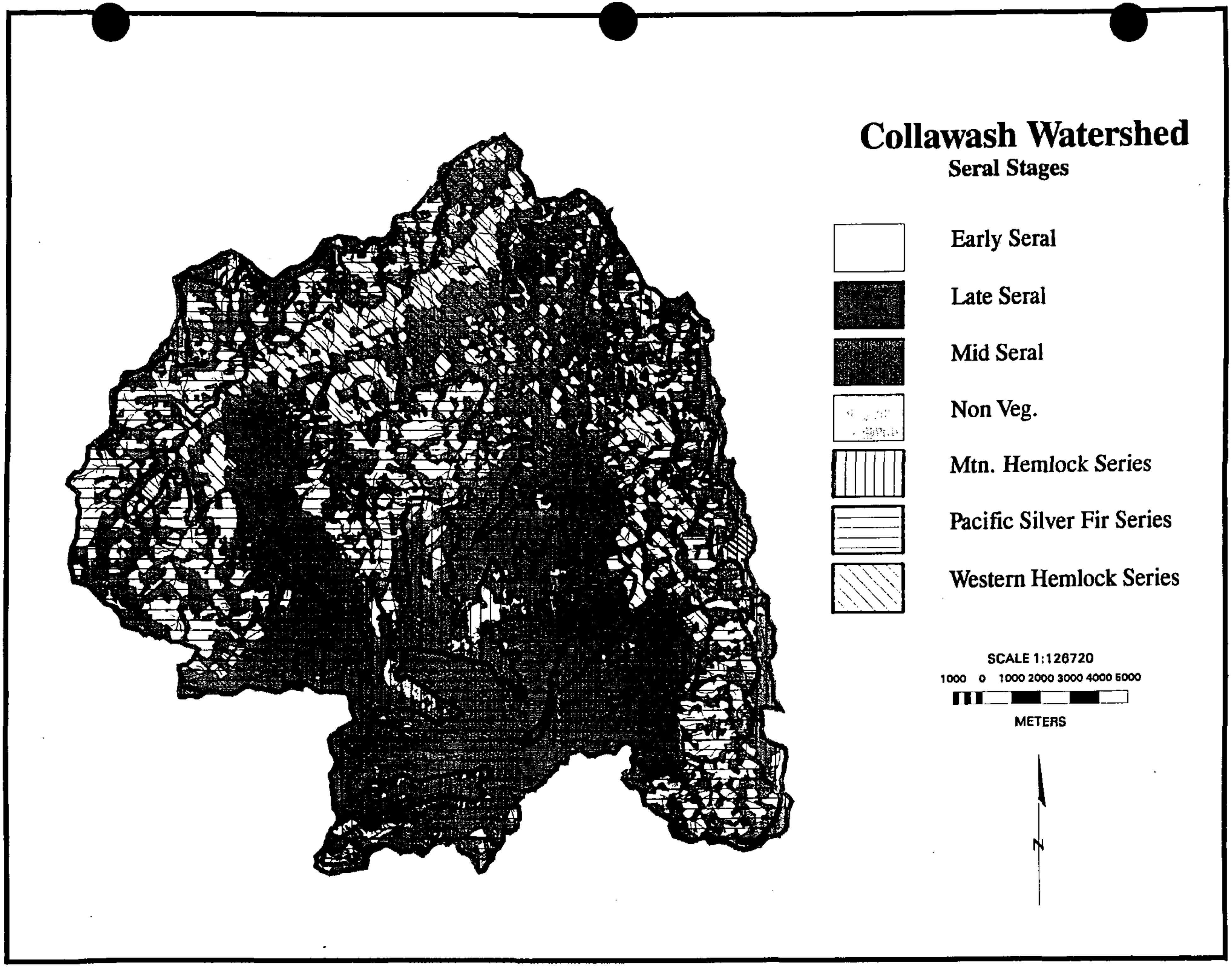


Figure 6
Range of Natural Variability - Late Seral


Collawash Watershed
Seral Stages
Early Seral
Late Seral
Mid Seral
Non Veg.
Mtn. Hemlock Series
Pacific Silver Fir Series
Western Hemlock Series
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consists of grass/forb/shrub stands (primarily recent clearcuts that have not yet advanced to the sapling/pole stage), shelterwood and leave tree stands, and open sapling/pole stands (conifers *greater than 10 feet tall, less than 60%* canopy cover). Currently, 24% of the Collawash/ Hot Springs Fork watershed is in an early seral condition, 26% in mid seral and 50% in late seral.

FOREST SERIES

Map 13 also shows the forest series that occur within the Collawash/ Hot Springs Fork: western hemlock, Pacific silver fir, and mountain hemlock. The three forest series here represent major differences in ecological factors such as forest community composition, growing season length, snow accumulation, productivity (particularly, the maximum size attained by mature trees), and wildlife use patterns.

RANGE OF NATURAL VARIABILITY

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

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

Figures 5 and 6 show the relationship between the current condition of the Collawash/ Hot Springs Fork watershed and the estimated RNV in the Clackamas subbasin (from REAP) for two of the identified key ecosystem elements: amount of early and late seral vegetation. These numbers are expressed as percent of the total area (either watershed or subbasin) within each forest series.

Figure 5 shows that all three forest series are outside the RNV in terms of amount of early seral vegetation. There is currently 15% more early seral within the western hemlock series than would be expected under the natural disturbance regime, 8% more in the Pacific silver fir series, and 4% more in the mountain hemlock series. This is due almost entirely to timber harvest and some associated blowdown; there has been very little recent disturbance from fire within the watershed.

Under the natural disturbance regime there was probably a great deal of variability between watersheds within the Clackamas subbasin. At any one point in time some watersheds probably had a higher proportion of early seral than other watersheds. Previous watershed analyses in the upper Clackamas subbasin (Fish Creek, Upper Clackamas, Eagle Creek) have shown that the current amount of early seral vegetation consistently exceeds the estimated RNV throughout the subbasin.

Figure 6 shows that the amount of late seral vegetation in the watershed is currently within the RNV in the western hemlock series. There is 14% more late seral in the Pacific silver fir series than in the natural range. It is important to note that for the Clackamas subbasin the Pacific silver fir series had a very narrow estimated range compared to the other forest series. The mountain hemlock series currently has 4% less late seral than in the natural range. There is a large amount of mid seral vegetation in the mountain hemlock series. This is the result of a combination of poorer growing conditions and some stand replacement fires that occurred in the early 1900's.

MANAGEMENT RELATED SEDIMENT

DESCRIPTION

Map 14 depicts sediment production sites and potential delivery routes directly attributed to existing human disturbances in the watershed. The map shows exactly where chronic sediment source locations and delivery points are, primarily related to roads, some related to harvest. Also, it can be compared to the reference sediment regime map; the background sediment regime is not portrayed here. Past effects from clearcut harvest, intense broadcast burning, and cumulative sedimentation are not on this map.

Existing management related sediment production and delivery in the watershed comes primarily from the road system. The dominant processes contributing to sediment production from roads are cut bank and fill slope related erosion, and erosion related to concentrated flows. Currently, there is a greater amount of sediment production and delivery sites than what existed under the reference sediment regime. Many upland forested sites that were not sediment sources in the past are now sites of chronic production; most can directly be attributed to roads. Pathways for sediment transport have been expanded by road related drainage (see hydrology section for related road effects analysis).

Dry ravel, raindrop splash, and sheetwash, widespread sediment producing mechanisms not historically significant in the watershed now occur more frequently. The quantifiable difference between the existing range of sediment production and delivery as compared to the reference range is unknown. Considering increases in: 1) sediment production sources, 2) sediment delivery sites, and 3) the timing of annual production; it is believed that qualitatively the range of existing sediment production and delivery is greater than the background range.

DATA SUPPORTING THE FINDINGS

There are approximately 380 miles of road in the watershed. Approximately 345 miles (91% of total) are surfaced with various qualities and quantities of aggregate. Some have native surfacing and 35 miles are paved with asphalt. Since roads with aggregate surfaces comprise the greatest percentage of road miles in the watershed, they present a higher potential for sediment production than all other roads combined. Road density in the portion of the watershed outside the wilderness area is approx. 3.5 mi/sq. mi. Approximately 85 miles of road exist within riparian reserves. There are 665 stream crossings; 520 are on road sections with various qualities of aggregate. Thirty-two miles of road exist on very unstable slopes and landforms.

INFORMATION GENERATION

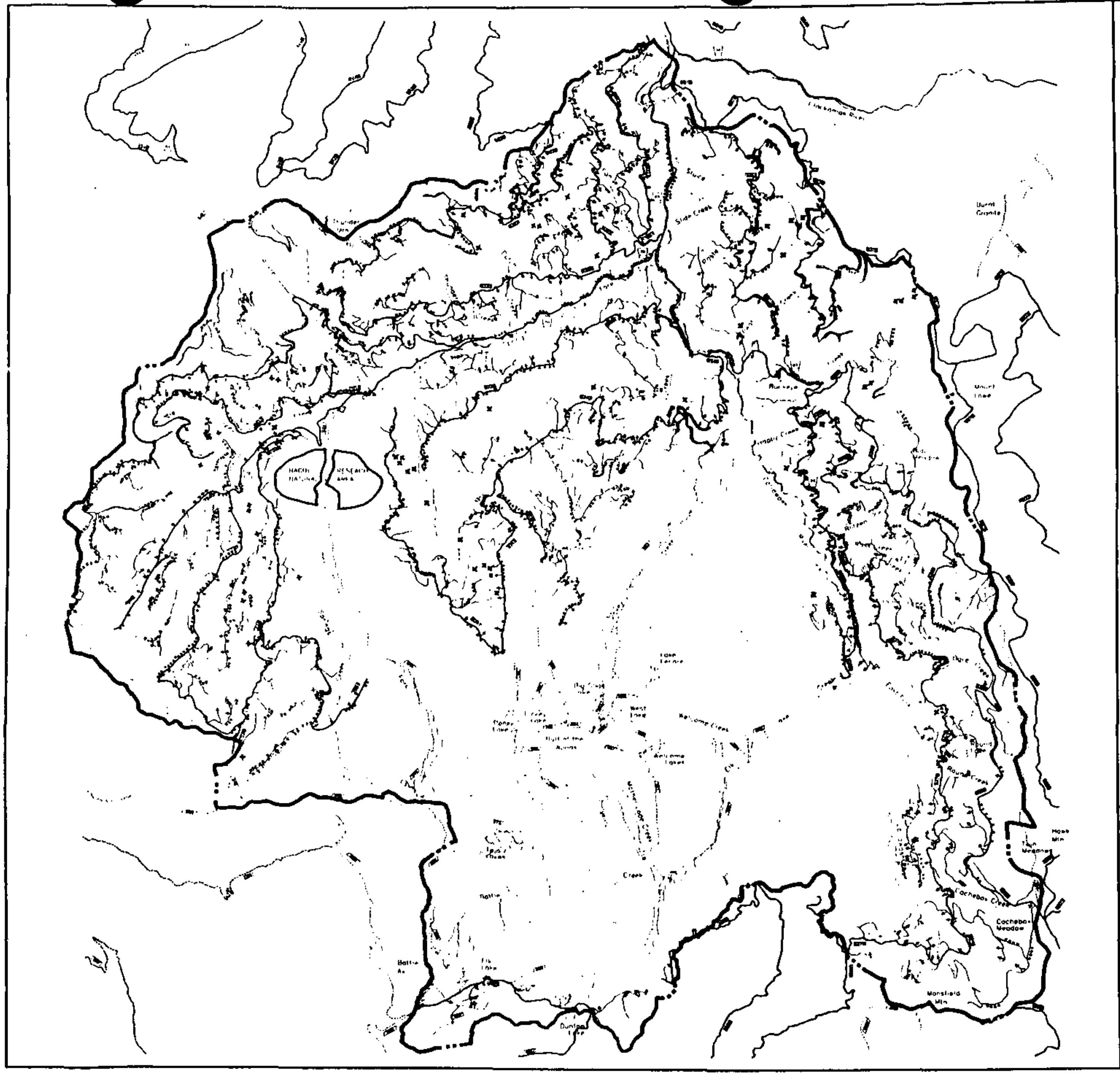
This map was produced by overlaying a variety of maps to interpret which physical features and processes interact with road and harvest related features to affect the reference sediment regime in the watershed. Aerial photo interpretation was used to help verify conclusions. Maps and GIS overlays used:

Landform	Mass wasting
Geology	Slope
Soils (SRI)	Streams
Roads layer	1"/mi '89 aerial photos
Topography	Base map

Aerial photo and map overlay interpretation, confirming predicted sediment production and delivery sites, was validated by the following District personnel and records:

- C & M Manager
- C & M Maintenance Logs
- District Roads Manager
- Watershed Improvement Needs Inventory

Assumptions were used to help formulate questions and hypotheses concerning the effects of roads and timber harvest on the reference sediment regime. Rain splash, overland flow, dry ravel, dust, and wind erosion were not the primary sediment producing mechanisms in the reference sediment regime (excluding the effects of stand replacement fires). Asphalt paved roads produce less sediment than aggregate surfaced roads. Road sections within 200' of a stream, or a stream crossing, have a higher potential for sediment delivery than other road sections. Contact the Soil Scientist on the Estacada Ranger District for further information. Primary references used are listed in the Reference section.



Collawash Watershed

Management Related Sediment Regime

- Culvert Stream Crossing, Potential Sediment Delivery Site
- High Sediment Production Sites, Existing Source
  - Cut-bank erosion, failures or dry ravel
  - Fill slope erosion or failure
  - Road maintenance hot spot
  - Road prism slump, crack or drainage malfunction
- Roadways on Unstable or Very Unstable Landforms, High Failure Potential
- Unpaved Roads, Moderate Potential
- Harvest Related Slump or Slide

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AQUATIC AND RIPARIAN CONDITIONS

HYDROLOGIC PROCESSES

To ease analysis, the watershed has been subdivided into 22 subwatersheds, ranging in size from 1,129 acres to 10,524 acres (See Map 15). Table 4 displays several watershed parameters influencing hydrologic processes within each subwatershed:

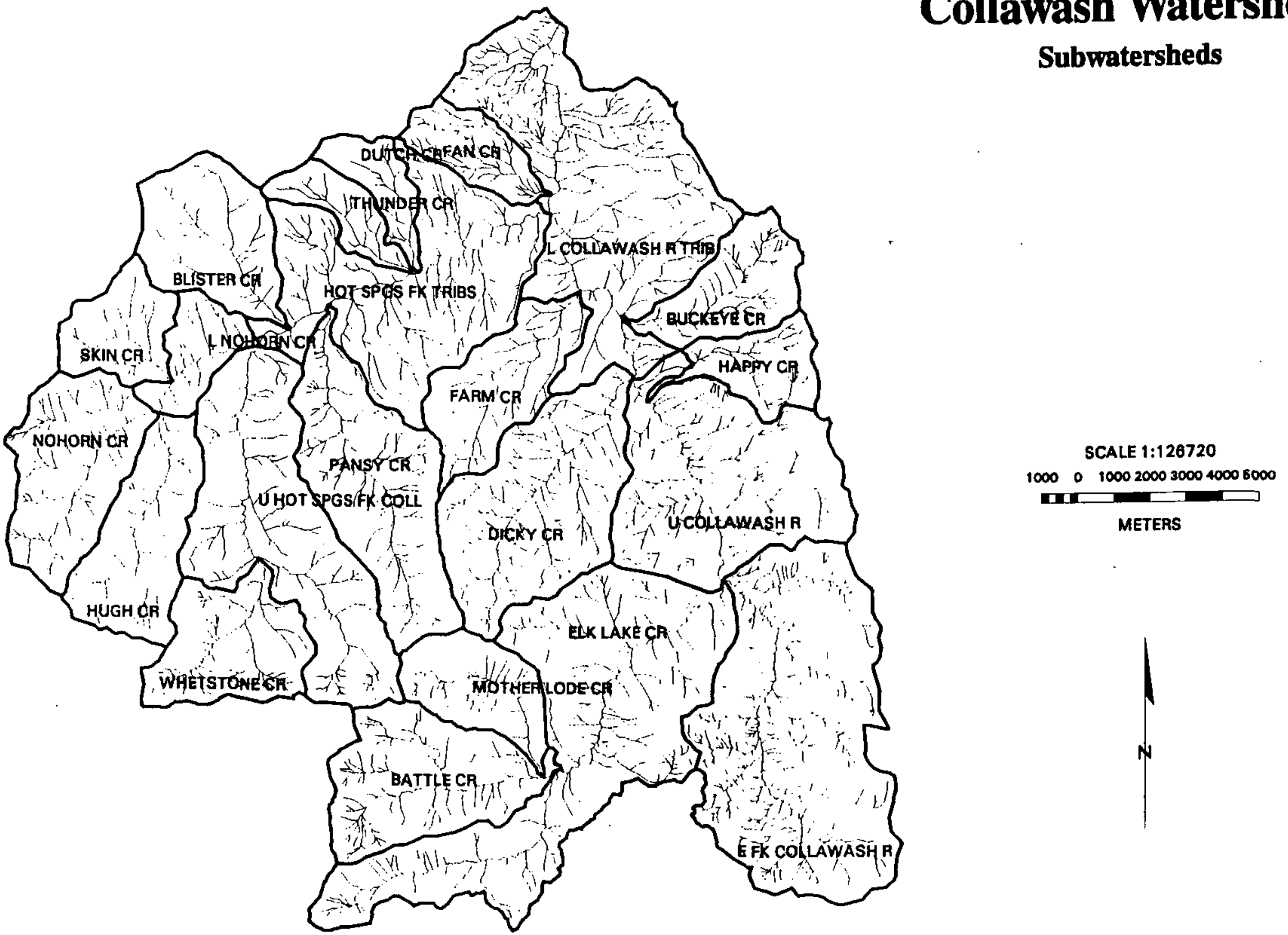
***Streamflow*.** The quantity of streamflow affects aquatic habitat and other beneficial uses in several ways. Annual water yields and the timing and magnitude of peak flows and low flows affect fish habitat characteristics and water availability for beneficial uses such as water-based recreation and downstream consumptive and non-consumptive uses. The magnitude, duration, and frequency of peakflows affect channel morphology, fish habitat, spawning success, and fish survival. Low flows influence fish migration, availability of habitat, effects of water temperature on fish survival and growth, and the health and diversity of other aquatic organisms. Lacking long-term monitoring of streamflow for the

Subwatershed	Area (acres)	Total Roads (miles)	Road Density (ml/sq.mi.)	Total Streams (miles)	Drainage Density (ml/sq.mi.)	Stream Crossings (#)	Stream Crossings (# / sq.mi.)	Channel Expansion Low est. (%)	Channel Expansion High est. (%)	Hydro Recover ARP (%)
Fan Cr. (10A)	1,504	14.55	6.2	16.52	7.0	50	21.3	22.9	57.3	57.8%
Farm Cr. (10B)	2,911	20.02	4.4	19.64	4.3	33	7.3	12.7	31.8	56.4%
Buckeye Cr. (10C)	2,339	10.43	2.9	12.66	3.5	7	1.9	4.2	10.5	73.6%
Dicky Cr. (10D)	5,892	3.67	0.4	44.66	4.9	9	1.0	1.5	3.8	98.1%
Happy Cr. (10E)	1,646	7.00	2.7	9.08	3.5	13	5.1	10.8	27.1	79.9%
Elk Lake Cr. (10F)	10,524	8.50	0.5	65.35	4.0	13	0.8	1.5	3.8	99.5%
Battle Cr. (10G)	4,341	0.00	0.0	28.97	4.3	0	0.0	0.0	0.0	100.0%
E. Fk. Collawash R. (10H)	10,392	48.74	3.0	71.46	4.4	88	5.4	9.3	23.3	79.5%
Mother Lode Cr. (10I)	2,269	0.00	0.0	13.42	3.8	0	0.0	0.0	0.0	100.0%
U. Collawash R. (10J)	7,028	34.65	3.2	45.24	4.1	53	4.8	8.9	22.2	58.5%
L. Collawash R. (10Z)	9,576	58.24	3.9	69.27	4.6	134	9.0	14.7	36.6	83.2%
Thunder Cr. (26A)	1,194	5.05	2.7	7.55	4.0	11	5.9	11.0	27.6	68.6%
Pansy Cr. (26B)	5,312	18.91	2.3	34.04	4.1	29	3.5	6.5	16.1	80.7%
Blister Cr. (26C)	3,181	17.14	3.4	13.91	2.8	15	3.0	8.2	20.4	73.2%
Skin Cr. (26D)	1,735	13.37	4.9	10.33	3.8	24	8.9	17.6	44.0	48.4%
U. Nohom Cr. (26E)	3,283	20.02	3.9	26.26	5.1	42	8.2	12.1	30.3	52.2%
Whetstone Cr. (26F)	3,127	7.90	1.6	21.23	4.3	13	2.7	4.6	11.6	87.5%
Dutch Cr. (26G)	1,129	5.08	2.9	6.71	3.8	9	5.1	10.2	25.4	61.3%
Hugh Cr. (26H)	3,418	20.22	3.8	17.54	3.3	22	4.1	9.5	23.8	62.0%
L. Nohom Cr. (26I)	1,394	11.99	5.5	8.29	3.8	16	7.3	14.6	36.6	66.0%
U. Hot Springs Fk. (26J)	7,058	8.04	0.7	35.01	3.2	6	0.5	1.3	3.2	96.2%
L. Hot Springs Fk. Tribs (26Z)	7,309	46.28	4.1	52.87	4.6	78	6.8	11.2	27.9	70.7%
Total	96,562	379.8	2.5	630.01	4.2	665	4.4	8.0	20.0	79.9%

Table 4. Watershed Parameters Affecting Hydrologic Processes.

Collawash Watershed

Subwatersheds



Collawash River and its tributaries, most of these processes, interactions, and effects will be inferred from analysis of available data and interpretation of relevant research findings.

A limited amount of streamflow information is available for the mainstem Collawash from a gauging station in operation from 1966 through 1968, located immediately downstream from the confluence with the Hot Springs Fork. For the period of record, 85 percent of the annual water yield occurs in the months of November through May, with the greatest monthly amount occurring in February (18 percent). The lowest monthly amount occurs in August (1.4 percent).

In contrast, an analysis of streamflow for the Upper Clackamas River (above Big Bottom) reveals that 71 percent of the annual water yield occurs in the same period of November through May. However, water yields are more evenly distributed throughout the winter, with the greatest monthly amount occurring in May. Approximately 29 percent of the annual water yield occurs during the summer months, with the lowest monthly amount occurring in September.

Table 5 displays and compares mean monthly flows for the Collawash River, Upper Clackamas River and Fish Creek, all of which are significant watersheds within the Clackamas subbasin. Mean monthly flows have been "normalized" to reflect differences in watershed size.

	Upper Clackamas River @ Big Bottom (1920-1970) 136 sq.mi.	Collawasn River (1966-1968) 142 sq. mi.	Fish Creek (1989-1993) 45 sq. mi.
January CSM	4.4 CSM	9.4 CSM	6.5
February	4.3	11.3	7.4
March	3.8	4.7	4.4
April	4.6	6.1	7.1
May	5.2	6.7	3.7
June	3.8	3.0	2.2
July	2.2	1.0	0.7
August	1.9	0.8	0.4
September	1.9	0.9	0.3
October	2.2	3.1	1.1
November	3.4	5.2	7.2
December	4.3	8.0	6.3

Table 5. Mean Monthly Flows in Cubic Feet Per Second, Per Square Mile (CSM).

Figure 7 graphically compares and contrasts streamflows for the Collawash and Upper Clackamas Rivers, for 1966 through 1968, a period for which accurate flow data is available for both streams. The hydrographs display dramatic differences in the timing and magnitude of peakflows and low flows, reflecting differences in the hydrologic function of these two watersheds. During this period, both watersheds had experienced a similar level of management activity. In general, the Collawash River is seen to be quite "flashy," responding rapidly to precipitation and snow melt events, resulting in higher winter peakflows and lower summer baseflows.

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

Significant regional flood events have occurred historically on a fairly regular basis, influencing hydrologic function in the Collawash watershed. The most dramatic and well-documented flood event in the recent past occurred on December 22, 1964. Approaching the estimated

100-year return interval, this event caused extensive damage in the Collawash River watershed.

Transient Snow Zone. Collawash River flood events are similar to other documented floods in the Cascades. These peakflow events occur during the rainy season, following a rapid and substantial depletion of snowpack during a prolonged rain-on-snow period in the "transient snow zone" (a zone of significant snowpack accumulation). While approximately 80 percent of the watershed lies within the normally occurring transient snow zone, the entire watershed is subject to rain-on-snow events incorporating areas of lesser and greater snowpack accumulations.

Created Openings. Research elsewhere in the Cascades has shown that more snow accumulates in openings than under canopies and that during rain-on-snow events the runoffs from these areas are more rapid. Timber harvest activities (particularly clearcuts) and other created openings (roads, windthrow areas, fires, etc.) are areas of increased snow accumulation. Rapid runoff from these areas increases the magnitude of peakflows during a rain-on-snow event, resulting in channel scour, downcutting, and/or widening.

Roads. Road surfaces and cut slopes are essentially impermeable to rainfall and snowmelt. They intercept shallow subsurface flow and concentrate surface runoff. Road ditches

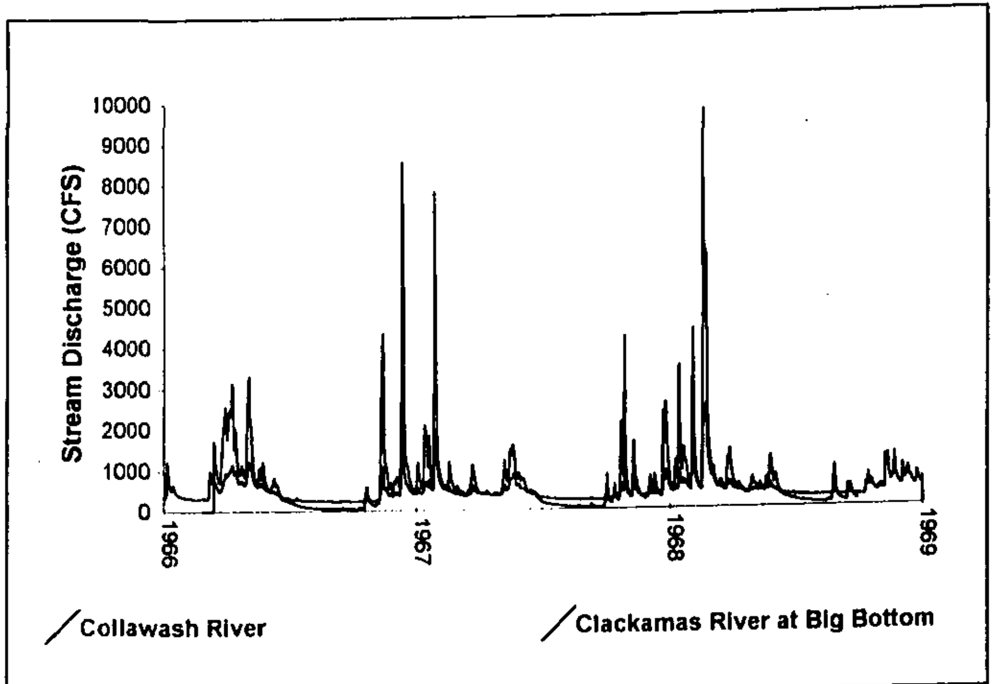


Figure 7
Mean Daily Stream Discharge, 1966-68

function as extensions of intermittent streams, increasing overall drainage density and transporting water more rapidly than natural processes. Increased road densities result in more water being delivered to streams within a shorter timeframe, affecting the frequency and magnitude of peakflows.

The potential channel network expansion attributable to roads was calculated by estimating the length of road directly accessing streams and adding that value to the length of the affected streams. Since the exact spacing of ditch relief culverts could not be determined for each road in each subwatershed, a "best case" scenario (200 feet spacing) and a "worst case" scenario (500 feet spacing) were analysed. The lower values appear to be realistic for most roads and watersheds, based on field observations and common construction practices. Channel networks appear to have expanded 8 percent overall, with values ranging from 1.3 percent to 22.9 percent for various subwatersheds (Table 4 and Figure 8). Road densities for the Collawash River watershed and several subwatersheds (excluding Wilderness areas) are among the highest for the Mt. Hood National Forest.

Roads may also encroach on stream channels, riparian areas, and floodplains, confining and straightening channels, generally accelerating velocities and increasing the magnitude and frequency of peakflows. As an example, Collawash peakflows associated with the

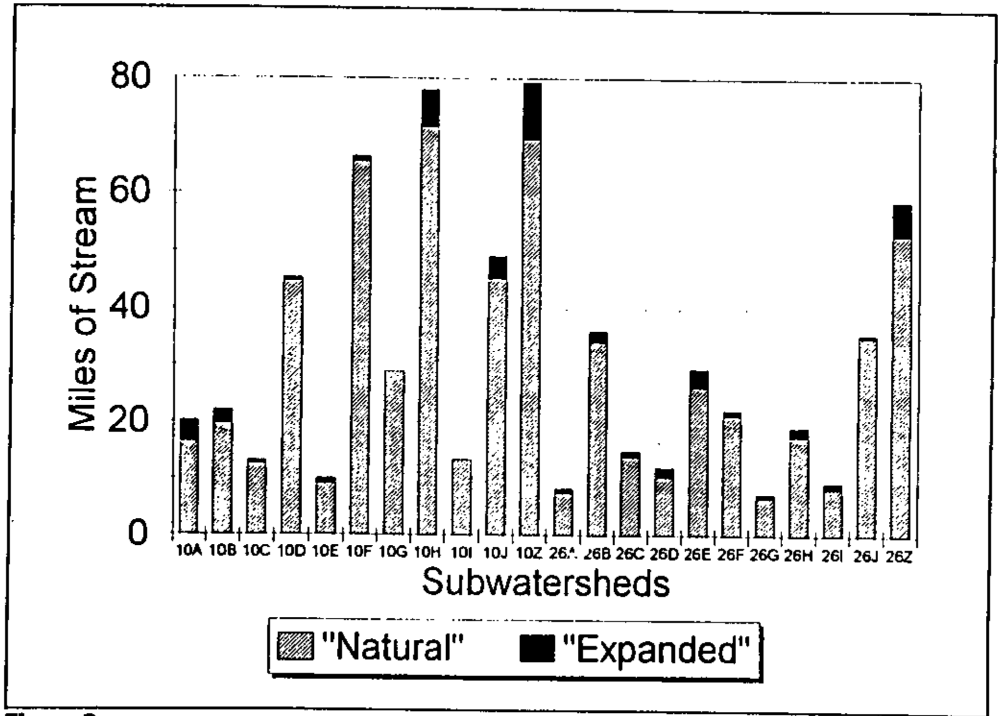


Figure 8
Channel Network Expansion Related to Roads

February 1995 rain-on-snow event, having an estimated return interval of 5 to 10 years, came within one foot of flooding the main access road, Road 63, where the road encroaches on the river.

The combination of channel network expansion due to road ditches, and created openings attributable to road surfaces and harvest areas is likely to have increased peakflows, though quantification of such changes is not possible with existing information.

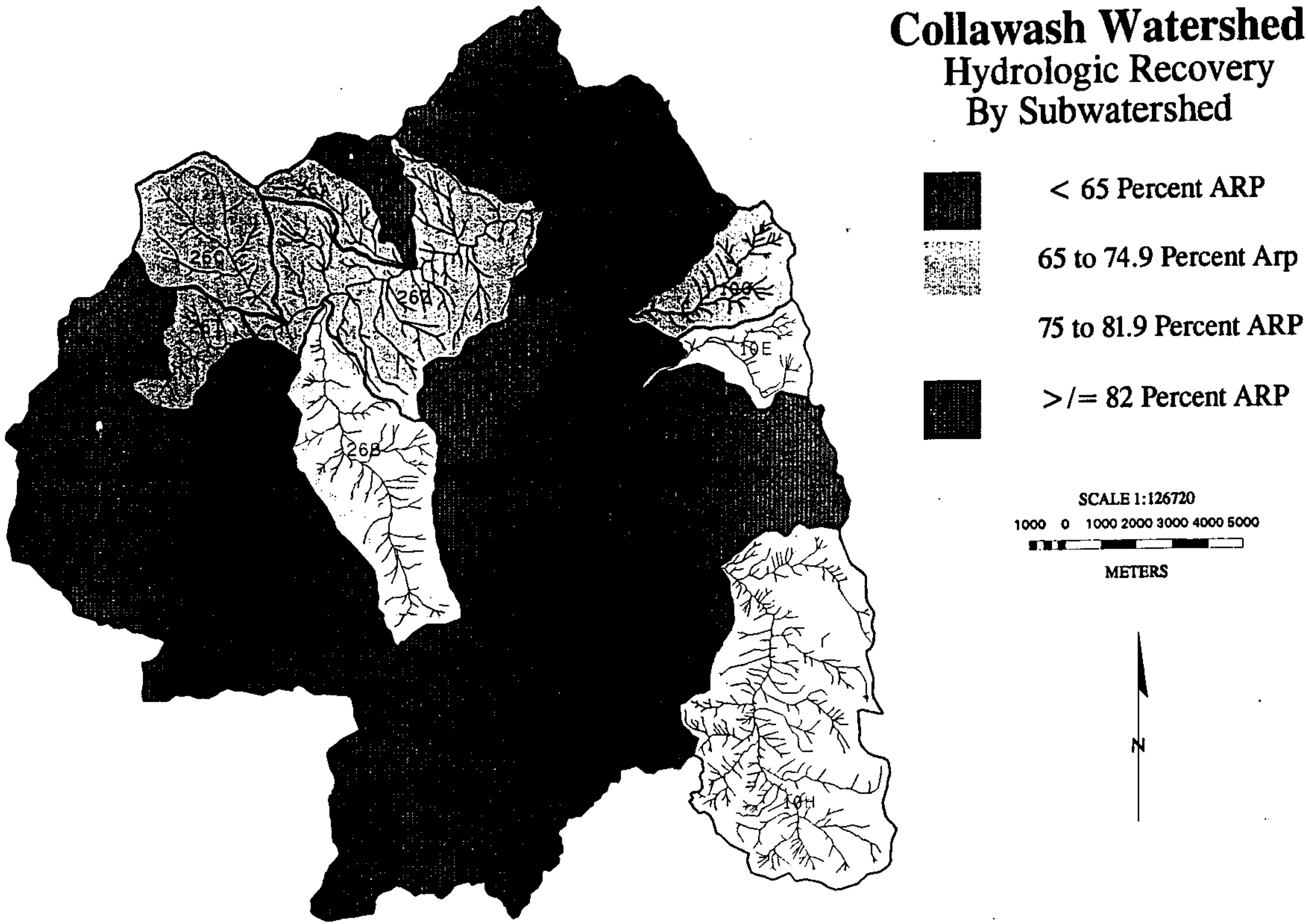
Aggregate Recovery Percentage (ARP). The effects of management activities on hydrologic function and hydrologic recovery were assessed using an analysis tool called the "aggregate recovery percentage" (ARP) methodology. Current ARP values for subwatersheds range from 48 percent to 100 percent, reflecting the extent and timeframe of created openings in the forest vegetation. ARP values greater than 75 percent indicate that a watershed is essentially "hydrologically recovered" as far as our ability to observe and measure increases in peakflows, either directly or inferred from channel conditions. The Mt. Hood National Forest Land and Resource Management Plan (LRMP), 1990, recognizing inherent aquatic and riparian values and a high degree of watershed senstivity (landslide occurrence and risk), established a more conservative "red flag" or "threshold of concern" value of 82 percent ARP for several Special Emphasis Watersheds, including the mainstem Collawash River and its principal tributaries. The LRMP also identified less sensitive watershed areas which were presumed to be at somewhat less risk of damaging peakflows and channel degradation when ARP values were in the range of 65 percent to 75 percent. ARP values of less than 65 percent suggest a very high likelihood of increased magnitude and frequency of peakflows associated with rain-on-snow events and subsequent channel degradation. The concept of a single absolute "threshold" has been called into question by recent research. While no absolute thresholds exist in the real world, subwatersheds with ARP values in the upper end of the "recovery continuum" are at relatively low risk, whereas those at the lower end of the continuum are at greater risk. Map 16 and Table 4 display the various subwatersheds in terms of relative hydrologic recovery.

Stream surveys and observations of channel conditions appear to correlate with the estimates of hydrologic recovery determined with this methodology, with the greatest amount of channel downcutting, scour, and habitat degradation associated with streams within subwatersheds having currently or historically low ARP values.

Changes in Peakflows Related to Management Activities. Changes in peakflows for the Collawash River and its tributaries can be inferred from an analysis of Fish Creek flows. Fish Creek and its tributaries are similar to the Collawash River tributaries in several respects, including the range of ARP values, geology and geomorphology, and the dominant precipitation regime. The analysis indicates that peakflows for the 2, 5, 10, 25, 50, and 100-year return intervals have all increased from 2 to 14 percent, with the greatest increases occurring for the 2-year, 5-year, and 10-year events. These are among the "channel forming" flows most affecting steeper mountain streams characteristic of most of the Collawash River tributary streams.

Baseflow. Baseflow is critical to watershed health during times of little or no precipitation, providing habitat to fish and other aquatic organisms, sustaining habitat for riparian flora and fauna, maintaining cover, forage, and travel corridors for other terrestrial wildlife, and providing water for human uses. Decreases in baseflows not only affect the amount of water available for these beneficial uses, but also the quality of water (temperature, dissolved oxygen, algae, pathogenic organisms, etc.).

No long-term records of baseflow are available for the Collawash River or tributaries. There are no dams or diversions within the watershed. Summer low flows during the limited period of record (encompassing years of average precipitation) are around 115 cubic feet per second (cfs), but likely drop to much lower levels during drought years. A comparison of the hydrographs of the Collawash and Upper Clackamas river suggests considerably less winter precipitation is retained in the Collawash


Collawash Watershed
Hydrologic Recovery
By Subwatershed
< 65 Percent ARP
65 to 74.9 Percent Arp
75 to 81.9 Percent ARP
>/= 82 Percent ARP
SCALE 1:126720
1000 0 1000 2000 3000 4000 5000
METERS
N
26C
26D
26B
10E
10H

watershed to contribute to summer low flows. Groundwater contributions are much smaller than those observed for the Upper Clackamas River. The extent to which management activities in the watershed may be influencing low flows is inconclusive. However, where increases in the magnitude and frequency of peakflows are likely, it can be inferred that relatively less water is available to sustain late summer low flows.

CHANNEL MORPHOLOGY

Stream channel gradients. For the mainstem Collawash River and Hot Springs Fork they average around 2% in lower reaches upwards to 5% in middle and upper reaches. Average channel gradients are very steep for tributary streams within the Collawash watershed, exceeding 9%. Channel sideslopes range from 35% to over 55% throughout the watershed.

Sediment/ Substrate. Historically and currently, the dominant sediment sources are landslide processes, particularly earthflow contributions in the lower reaches of both the Collawash mainstem and Hot Springs Fork. Other dominant sediment sources include debris slides and debris flows, associated with the steeper slopes, and channel scour. Dominant channel substrate is typically small boulder and cobble. High channel gradients apparently aid in flushing most contributed fine sediments. Rosgen channel classifications are typically B1, B2, B3, and B4 for mainstem reaches and A1, A2, and A3 for steeper tributary streams.

Channel Downcutting/ Floodplain Abandonment. Stream surveys and anecdotal observations suggest that channel downcutting and loss of coarse sediments has occurred, as evidenced by the partial abandonment of historic floodplains and natural side channels, particularly along lower to middle reaches of the Hot Springs Fork. These changes are attributable in part to the large-scale removal of large wood from these reaches during the 1960's and 1970's. These changes may also have resulted from or been accelerated by increases in peakflows.

Large woody debris. Large wood is delivered to stream channels naturally by landslides, entry from adjacent riparian areas, and transport from upstream areas. Large wood significantly influences channel morphology and is a major component affecting fish habitat. The 1964 flood was responsible for redistributing and transporting much of the naturally occurring large wood downstream. In the decades before the late 1970's there was an active policy of salvaging and removing large woody debris (LWD) from streams within the watershed. This resulted in lowering of habitat quality and quantity within many Collawash subwatersheds. Removal of instream wood likely initiated downcutting of stream channels at the time of removal. Timber harvesting has caused a several decade interruption of recruitment of LWD. Rehabilitation efforts over the past 10 years have focused on the reintroduction of large wood.

Projected large woody debris recruitment in the Collawash watershed in riparian reserves was modeled for this analysis. Table 6 displays the potential for large woody debris recruitment for fish bearing streams, perennial no-fish bearing streams, intermittent streams, and lakes, along with a grand total for all streams and water bodies in the watershed. It also shows the number of acres of riparian areas rated as having "low", "medium", and "high" potential for large wood recruitment, for each subwatershed. Riparian areas which are naturally unvegetated (rock outcrops, etc.) and have no potential for contributing to large wood are shown as "none".

Overall, around 20 percent of the riparian reserves within the Collawash watershed have a low large wood recruitment potential. When wilderness areas are excluded, this figure approaches 30 percent. Several subwatersheds have 30 to 40 percent of the riparian reserves rated low for large wood recruitment, most notably Fan Creek, Happy Creek, Thunder Creek, Pansy Creek, Skin Creek, Nohorn Creek (upper and lower), and Lower Hot Springs Forks Tributaries. Dutch Creek has over 50 percent in a low rating. This indicates that the potential supply of large wood has been seriously depleted in many subwatersheds, while overall values are not as critical.

Watershed		Fish-bearing Streams					Permanently flowing non-fish bearing streams					Intermittent Streams				
		Low	Medium	High	None	Total	Low	Medium	High	None	Total	Low	Medium	High	None	Total
10A	FAN CR	54	47	20	0	121	30	20	49	0	99	128	32	114	0	274
10B	FARM CR	17	210	47	0	274	25	59	62	0	146	72	124	68	0	264
10C	BUCKEYE CR	74	89	153	0	316	7	2	12	0	22	64	86	94	0	245
10D	DICKY CR	10	119	351	35	514	37	96	217	2	353	35	210	329	10	583
10E	HAPPY CR	84	49	111	0	245	5	0	0	0	5	35	22	84	5	146
10F	ELK LAKE CR	2	54	504	371	932	15	72	334	74	494	15	121	487	215	838
10G	BATTLE CR	0	25	252	5	282	7	148	84	2	240	7	161	213	0	381
10H	E FK COLLAWASH R	128	358	892	2	1,381	22	49	171	2	245	163	334	670	5	1,171
10I	MOTHER LODE CR	0	25	131	0	156	0	17	35	2	54	0	84	86	30	200
10J	U COLLAWASH R	385	366	761	0	1,512	12	64	210	0	287	108	96	235	2	440
10Z	L COLLAWASH R TRIB	222	467	885	10	1,584	32	89	195	0	316	225	215	450	0	890
26A	THUNDER CR	62	64	62	0	186	22	10	27	0	59	20	10	17	0	47
26B	PANSY CR	143	30	200	7	381	106	52	99	17	274	175	77	195	2	450
26C	BLISTER CR	106	0	250	0	356	20	64	42	0	126	27	10	79	0	116
26D	SKIN CR	15	5	49	0	69	47	0	64	0	111	57	7	54	0	119
26E	NOHORN CR	124	111	161	0	395	79	84	82	2	247	89	62	54	0	205
26F	WHETSTONE CR	64	0	321	0	385	2	25	166	0	193	52	17	151	0	220
26G	DUTCH CR	27	32	35	0	94	32	0	25	0	57	62	12	15	0	89
26H	HUGH CR	62	47	190	0	299	89	40	153	0	282	54	17	37	0	109
26I	L NOHORN CR	77	2	128	2	210	22	0	25	0	47	44	7	22	0	74
26J	U HOT SPGS FK COLL	0	32	593	0	625	25	44	499	0	568	17	7	185	2	213
26Z	HOT SPGS FK TRIBS	274	114	526	0	914	146	96	242	0	487	235	52	277	0	563
Total		1,932	2,246	6,622	432	11,233	766	1,030	2,792	104	4,712	1,683	1,764	3,917	272	7,636

Watershed		Lakes					Totals				
		Low	Medium	High	None	Total	Low	Medium	High	None	Total
10A	FAN CR	2	0	0	0	2	215	99	183	0	497
10B	FARM CR	0	2	7	0	10	114	395	185	0	694
10C	BUCKEYE CR	0	0	0	0	0	146	178	259	0	583
10D	DICKY CR	2	7	20	10	40	84	432	917	57	1,490
10E	HAPPY CR	0	0	0	0	0	124	72	195	5	395
10F	ELK LAKE CR	0	10	5	64	79	32	257	1,329	724	2,343
10G	BATTLE CR	0	35	0	20	54	15	366	549	27	956
10H	E FK COLLAWASH R	0	10	10	12	32	314	751	1,742	22	2,829
10I	MOTHER LODE CR	0	20	2	20	42	0	146	255	52	452
10J	U COLLAWASH R	0	0	0	0	0	504	526	1,206	2	2,239
10Z	L COLLAWASH R TRIB	0	0	17	0	17	479	771	1,547	10	2,807
26A	THUNDER CR	0	0	0	0	0	104	84	106	0	294
26B	PANSY CR	35	22	0	2	59	460	180	494	30	1,164
26C	BLISTER CR	0	0	0	0	0	153	74	371	0	598
26D	SKIN CR	0	0	0	0	0	119	12	168	0	299
26E	NOHORN CR	0	2	0	0	2	292	259	297	2	850
26F	WHETSTONE CR	0	0	0	0	0	119	42	638	0	798
26G	DUTCH CR	0	0	0	0	0	121	44	74	0	240
26H	HUGH CR	20	20	12	2	54	225	124	393	2	744
26I	L NOHORN CR	0	0	0	0	0	143	10	175	2	331
26J	U HOT SPGS FK COLL	0	0	12	5	17	42	84	1,290	7	1,423
26Z	HOT SPGS FK TRIBS	2	5	12	0	20	660	267	1,058	0	1,984
Total		62	133	99	136	430	4,463	5,174	13,430	944	24,011

Table 6 Large woody debris recruitment potential within riparian areas

WATER QUALITY

An examination of water quality encompasses several elements including temperature, clarity, chemistry, and microbiology. Stream water temperature is the most extensively monitored parameter and can serve as a useful indicator of the effects of management activities on water quality, habitat, and riparian condition. The various water quality data utilized in this analysis is available for review in files at the Estacada Ranger District. Baseline water quality data has also been gathered for lakes and ponds within the Collawash watershed and is available in the Forest Supervisor's Office.

Sediment and Water Clarity. Water clarity is a good visual indicator of suspended fine sediments. Suspended fine sediments increase turbidity, reducing water clarity. High turbidity levels may detrimentally affect fish or other aquatic organisms, especially if high levels are chronic and persistent. Turbidity levels in the mainstem Collawash River and, to a lesser degree, the lower reaches of the Hot Springs Fork increase and remain high in direct response to precipitation and snowmelt. Intermittent turbidity monitoring and anecdotal observations of many forest personnel suggest that turbidity levels in the Collawash River are consistently higher and persist longer when compared to any other streams in the Clackamas subbasin.

Turbidity levels are directly related to stream discharge, diminishing as streamflows diminish, but generally remaining elevated for several days following streamflow peaks. Streams draining areas of chronically active landslides frequently have visibly elevated turbidity levels for up to a week or more. Tributary streams exhibit generally lower turbidity, except those streams that occur in the earthflow terrain of the watershed. The predominant sources of fine sediments and elevated turbidity are earthflows, which continuously enter the Collawash and Hot Springs Forks. Higher flows impinging on these unstable landslide features accelerate erosion and sediment contribution. To a lesser degree, other sources of sediment and elevated turbidity are debris slides, surface erosion from disturbed unvegetated areas (including roads, streamside dispersed recreation sites, etc.), and bank erosion. Relatively high stream gradients and stream velocities tend to transport fine sediments rapidly out of the watershed. Tributary streams usually clear more rapidly than the mainstem Collawash.

Pathogenic Micro-organisms. Concern over the potential introduction of pathogenic micro-organisms (bacteria, virus, protozoa, etc.) has arisen in recent years, due in part to the increased human use associated with dispersed camping and recreation occurring in riparian areas adjacent to the Collawash, Hot Springs Fork, and their principal tributaries. Evidence of unsanitary disposal of human fecal matter near streams and other water bodies is common. Limited monitoring of a tributary to the Hot Springs Fork, near Bagby Hot Springs, has revealed elevated levels of microorganisms associated with human fecal contamination (*e.coli*, fecal streptococci). Elevated water temperatures associated with the hot springs and concentrated human use probably account for the observed levels of contamination. For the watershed in general, the extent and potential effects of microbial contamination are unknown.

Riparian Canopy Condition and Stream Water Temperature. Stream water temperature is influenced by several factors including solar radiation intensity, air temperature, stream morphology, stream discharge, and vegetative or topographic shading. Direct solar radiation is a principal factor in raising stream temperatures and is largely affected by the quality and quantity of shade-producing vegetation. Natural disturbance agents such as fire, windthrow, and storm-induced channel scour; and human activities such as timber harvest, road construction, and riparian-based recreation have the potential to influence stream temperature by altering streamside vegetation and channel form.

Before 1950, riparian areas throughout most of the watershed were well vegetated with mature old growth Douglas-fir, true firs, cedar, and hardwoods. Early aerial photos (1946) reveal little evidence of extensive natural disturbance to riparian areas, with notable exceptions in areas where earthflows occur. During the 1950s through the 1970s, removal of streamside vegetation during timber harvesting was a common practice throughout the watershed. Beginning in the 1980s more attention was paid to leaving buffer strips along principal streams, however windthrow and subsequent salvage frequently resulted in the loss of canopy shade. Consequently, many perennial and most intermittent streams associated with harvest areas throughout the watershed lacked, for years, the necessary *shading to maintain cool stream temperatures*. Along many of these affected streams, deciduous vegetation has reestablished and now provides sufficient shading.

Figure 9 graphically illustrates the proportion of Riparian Reserve in early, middle, and late seral stage, for each subwatershed. Note that the more intensively managed subwatersheds have greater proportions of Riparian Reserve in early and mid seral. In particular, Fan Creek, Happy Creek, Thunder Creek, Skin Creek, and Dutch Creek have over 40 percent of the total Riparian Reserve area in early seral stage. Map 17 displays the current seral stage of vegetation within the Riparian Reserves delineated for streams within the Collawash watershed.

Figure 10 displays maximum water temperatures for three principal tributaries to the Collawash River, as measured in the summer of 1994. Monitoring at eleven National Forest sites throughout the Clackamas subbasin in 1993 indicates that summer daily maximum values for

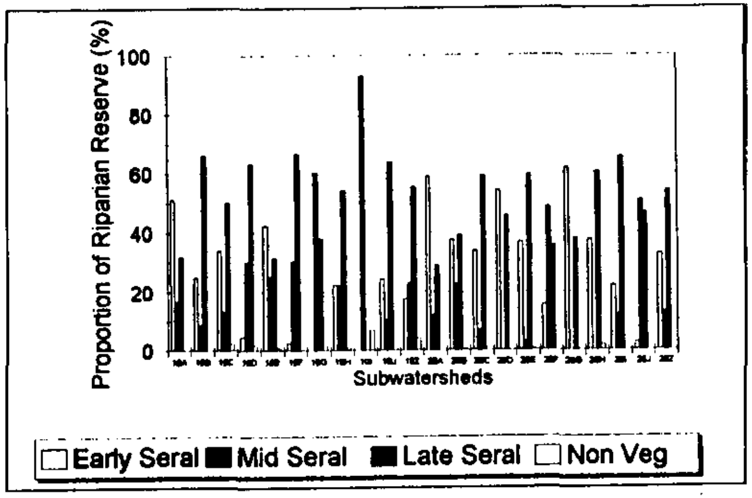


Figure 9 Proportion of Riparian Reserve Area by Seral Stage and Subwatershed

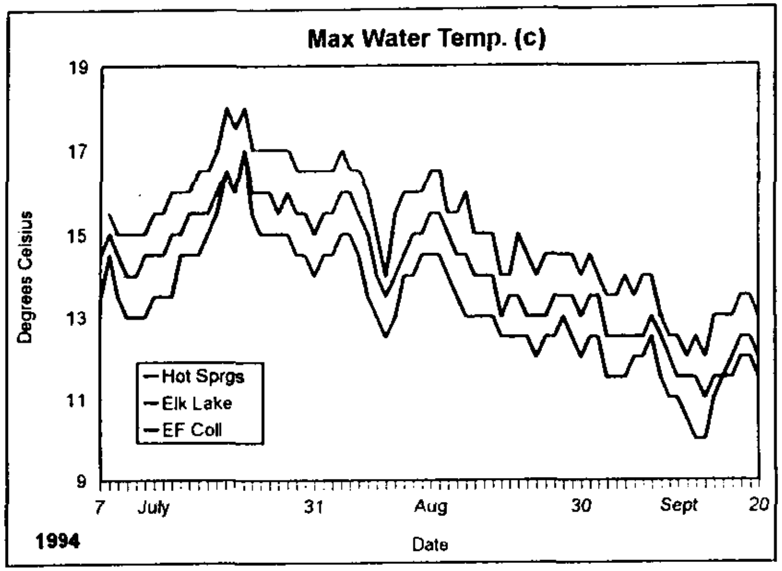


Figure 10 Maximum Water Temperatures

Collawash Watershed

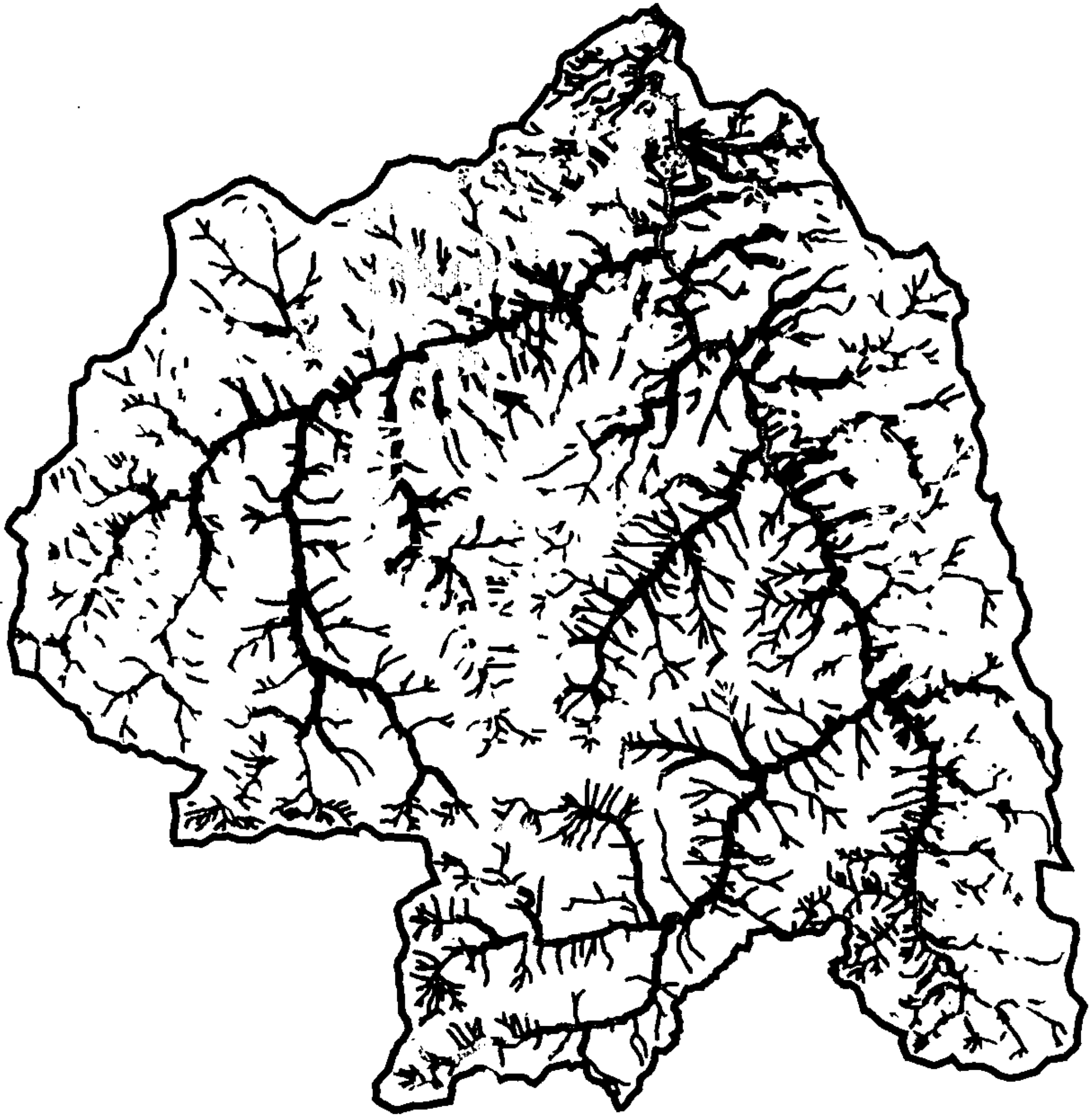
Interim Riparian Reserves
With Seral Stage

Early

Late

Mid

Non Veg



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METERS

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several streams within the Collawash watershed are among the highest in the subbasin, with the Hot Springs Fork showing the highest temperatures. This exceeds the State of Oregon threshold water temperature (14.4 degrees C.) although because of limited data the amount of the contribution is unknown. Higher summer stream temperatures are probably endemic in this watershed.

Interestingly, relatively little loss of riparian vegetation has occurred along reaches of the Hot Springs Fork above the sampling point. However, the wider channel of the upper Hot Springs Fork and predominant south-north orientation of the stream and it's tributary, Whetstone Creek, may be partially responsible for the elevated stream temperatures. The upper reaches of Elk Lake Creek have a similar orientation, possibly explaining elevated stream temperatures in a relatively undisturbed subwatershed.

RIPARIAN AND STREAM DEPENDENT SPECIES

Breeding harlequin ducks have been located on the Hot Springs Fork and the mainstem Collawash River. Cope's salamander, Pacific giant salamander, Dunn's salamander, tailed frog, and Columbia torrent salamander are also expected in most streams in this drainage. Few surveys have been conducted and there is little local knowledge on the distribution of aquatic amphibians relative to stream gradient, temperature, shade and sediment. Bald eagles have been observed on the main rivers but eagle breeding potential in this watershed is probably low because of the narrow width of the river bed.

Bats forage primarily over streams and wetlands and return to the forest to roost. They are the only group of species (excepting swifts and swallows) that exhibit such movement patterns. According to Christy and West (1993) this daily cycle plays a potentially significant role in the transfer of nutrients from aquatic areas to upland habitats. Foraging habitat is important even above wetlands smaller than an acre and experts consulted for the FSEIS felt that the lack of buffer protection provided to small wetlands under the interim riparian reserve boundaries could compromise viability for several bat species (USDA, et. al., 1994).

FISH STOCKS: ANADROMOUS

Estimates of historic numbers for anadromous fisheries have been made for the entire Clackamas River subbasin (ODFW, 1992), but are not available specifically for the Collawash (See map 18).

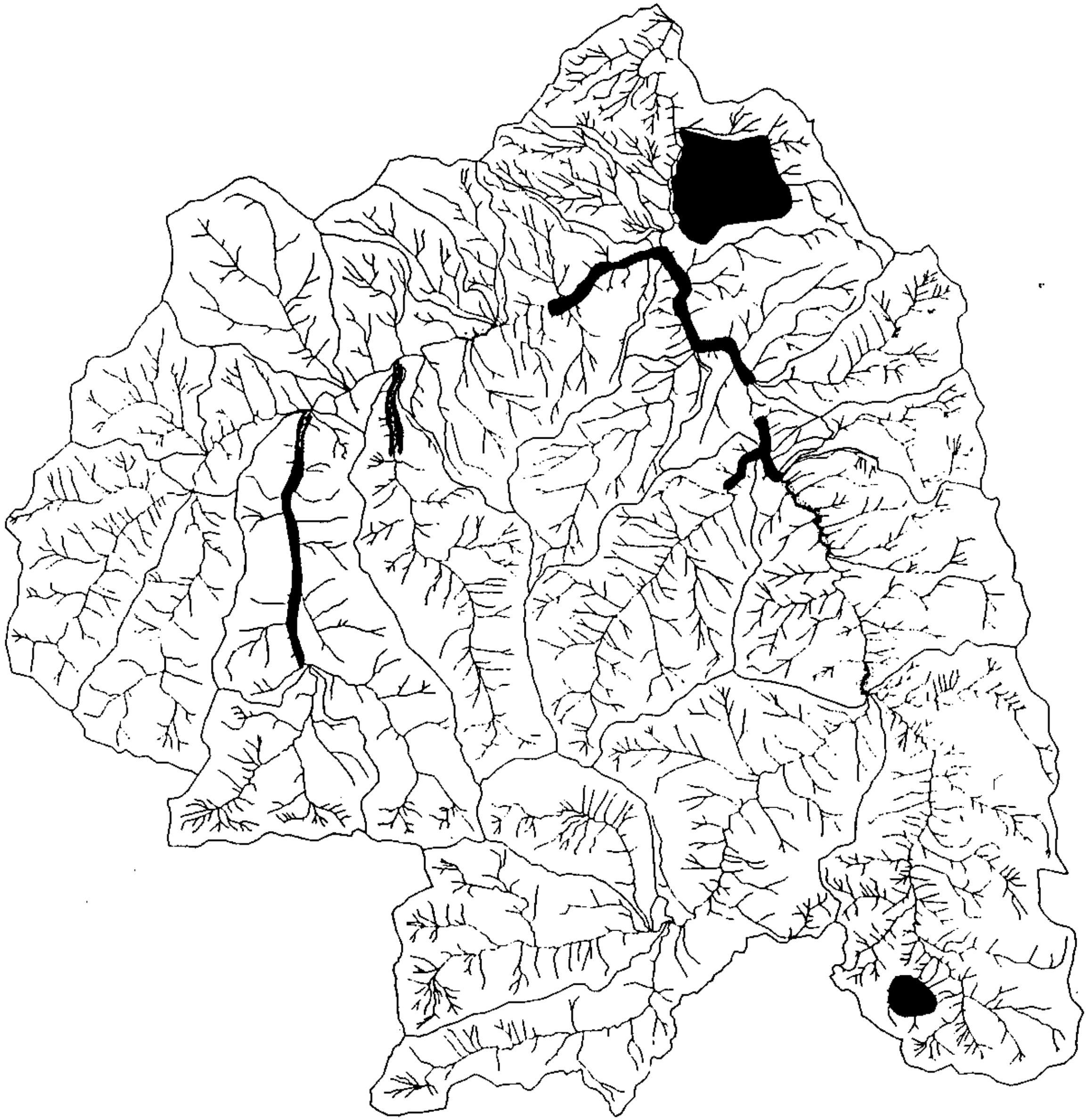
Winter Steelhead. Assuming full seeding, more than 13,000 steelhead may have spawned above the present site of the North Fork Dam historically (ODFW, 1992).

Late Run Coho. Very little historical information is available. From extrapolating catch data since the 1960's (PGE, Cramer and Cramer, 1994), the historic run likely far exceeded 20,000 adults for the entire subbasin. As recently as the period from 1965 to 1977, the average number of native Clackamas coho harvested by all fisheries was 9,670 adults.

Spring Chinook. Before 1899 the Clackamas River was considered the premier spring chinook fishery in the Pacific Northwest (ODFW, 1992). In 1893 and 1894, 12,000 and 8,000 spring chinook were harvested from the lower Clackamas River. Even in the 1890's, salmon runs had been noticeably reduced. Since 1980 the average passage over North Fork Dam into the upper subbasin has been 2,854 fish.

Within the Collawash/ Hot Springs Fork the range of anadromy has changed only slightly (See Fig.11). Some expansion of the range has occurred due to fish passage projects at Pegleg Falls and at Collawash Falls. Collawash Falls was only a partial barrier to anadromous fish before the passage improvement project. Winter steelhead have probably always had some access to areas above both falls. Some habitat for anadromous fish has been limited due to impassable road culverts but this has affected only a minor amount of habitat area. Culvert passage barriers are more common in areas having only resident fish. The recent status of several species follows.

Collawash Watershed
Aquatic "Hot Spots"



- Aquatic Diversity
- Anadromous Rearing
- Resident Rearing
- Steelhead Spawning

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1000 0 1000 2000 3000 4000 5000

METERS

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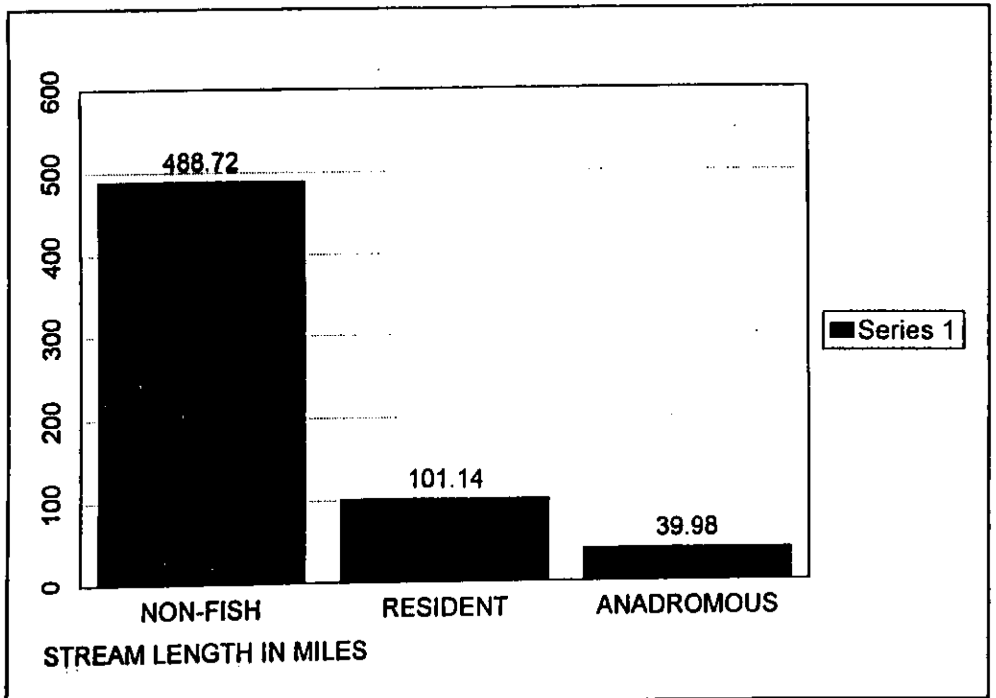


Figure 11
Watershed Stream Type

Clackam.:s Wild Winter Steelhead. This is the strongest stock of wild anadromous fish in the Collawash/ Hot Springs Fork. Steelhead redd surveys in 1994 showed that approximately 50% of the run of wild winter steelhead, present in the subbasin above Two Rivers, used the Collawash watershed (Late Winter Steelhead Spawning Survey, Clackamas Subbasin, 1994). Nehlson, et al. (1991), lists the Clackamas wild winter steelhead as a "stock at risk." This stock has averaged 1,400 fish in recent years at PGE's Clackamas River fish counting facility at North Fork Dam.

Clackamas River Late Run Coho. This is the other Clackamas "stock at risk" listed in Nehlson, et al. (1991). The Clackamas late run coho probably are the last wild population of coho found in the entire Columbia River Basin. This stock is on the Region 6, Sensitive Species List. One of three year classes for this stock is very weak (< 70 fish) and has a high potential for extinction. While late and early run coho derived from hatchery stock are found in the Collawash watershed, this watershed has probably provided marginal habitat even historically. Surveys have found only minor use. Juvenile coho have been observed using the large side channel on the main stem Collawash at Fan Creek. The Collawash watershed is a steeper gradient system and has less off-channel and slow water velocity, habitat that coho typically prefer. Another factor that may affect usage of the watershed is the higher summer water temperatures.

Chinook Salmon. Spring chinook are found in both the Collawash and Hot Springs Fork stems of the watershed. These fish are a mixture of Willamette hatchery stock and the original spring chinook found in the subbasin. Incidence of hatchery fish straying to upper subbasin areas is believed to be very high. There is only occasional use by chinook above Collawash Falls and Pegleg Falls on the two main forks of the watershed.

Summer Steelhead. Summer steelhead provide a popular fishery established via annual stocking of hatchery smolts beginning in the 1970's. Some natural production of this stock is also taking place. Although not considered native to the Clackamas, it is possible that a native race of summer steelhead may have once existed in the subbasin (ODFW, 1992).

FISH STOCKS: RESIDENT

Bull Trout. Bull trout are probably extinct within the Collawash. They are listed on the Region 6, Sensitive Species List. A healthy bull trout population once resided in the Collawash but declined by the 1970's and seems to have disappeared by the early 1980's. No bull trout were found despite extensive surveys in 1991 in the upper Clackamas subbasin.

Other Salmonids. Non-anadromous rainbow trout and cutthroat trout are found as native, wild populations in the Collawash watershed. Good populations can be found in many tributaries to the main Collawash and Hot Springs Fork. There may possibly be non-anadromous, migratory stocks (fluvial life history) of the above trout in this watershed.

Whitefish. Mountain whitefish are moderately abundant in the Collawash watershed below Collawash and Pegleg Falls.

Introduced (exotic) Salmonids. Kokanee salmon, brown trout, and brook trout populations are the known, introduced salmonid species in the watershed. All three species exist as naturally reproducing populations within the watershed. Potentially, introduced exotics, like brook trout or brown trout, can destroy native fisheries from competition, and/or interbreeding, and direct predation on native species. Introduced salmonid populations have also provided highly desirable fisheries. Exotics should have some level of monitoring to determine if populations are expanding into new areas or are merely stable.

Kokanee are limited to one lake, Elk Lake, at the southern edge of the watershed. Brown trout are found only in Round Lake. Round Lake contains a trophy brown trout fishery and produces large brook trout as well. Brook trout are found in many other high lakes and are usually stocked biannually in those lakes that do not have spawning habitat. They have also escaped some lakes and ponds having outlet streams and are now naturalized in some subwatersheds.

Other Resident Fish Species. Sculpins, suckers, and dace species are known or believed to be present in the Collawash watershed. Sculpin species are widespread in this watershed and fishery surveys have found them in many tributaries and the main stems. Suckers and dace are believed to occur in the lower main Collawash.

HABITAT CONDITION

Summer stream temperatures and loss of shade. In riparian areas that have been harvested, increased input of solar radiation may have contributed to higher summer water temperatures in some tributaries and also the main Hot Springs Fork and Collawash River.

Numeric standards for pools/CWD. Because of limited data and historical information, an attempt was not made at revising Forest Land Management Plan (LMP) and Policy Implementation Guideline (PIG) standards to reflect realistic watershed values (Table 7).

Positive contribution of timber harvest. Removal of mature forest cover near smaller streams has been shown at times to increase overall invertebrate biomass and fish growth due to increased solar input. Benefits may be localized if higher temperatures negatively

Stream Habitat Numeric Standards		
Pool Frequencies (pools /mile)		
Average Stream Width (ft.)	LMP* Desired Future Condition	PIG** Desired Future Condition
< 5	> 151	184
5-10	75-211	96
10-15	50-106	70
15-20	38-70	56
20-25	30-53	47
25-50	15-42	26
50-75	10-21	23
75-100	8-14	18
Large Woody Debris (# pcs./mile)		
Size Class	LMP Desired Future Condition	PIG Desired Future Condition
(24 - 36" x 50')	85	
(>36" x 50')	21	80

* LMP - Mt. Hood National Forest Plan 1990
** PIG - Pacfish (Policy Implementation Guide 1994)

Table 7
Stream Habitat Numeric Standards

affect downstream fish (Wilzbach and Cummins, 1986; Murphy and Hall 1981).

Road culverts. Many road culverts within the watershed restrict access of fish to historic spawning and rearing areas. Most of these culvert problems affect resident fish.

Fisheries habitat restoration projects in Hot Springs Fork. Projects have replaced some LWD lost in previous decades from management actions. LWD fixed placements are promoting accelerated recruitment of additional wood, stream bedload, and riparian vegetation to stream margins.

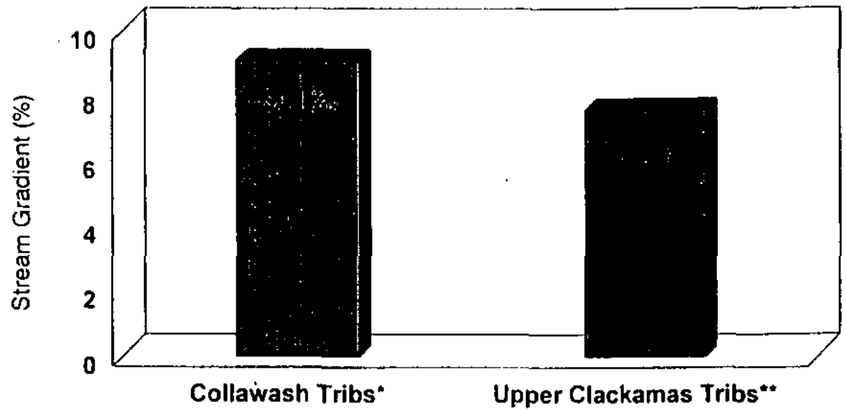
Hot Springs Fork benthic invertebrate bioassessment. A study of eight streams (Estacada R.D., Benthic Invertebrate Biomonitoring, 1991) in the Clackamas subbasin showed the Hot Springs Fork (73%) has a higher Ecoregion Reference Value than Roaring River (70%) which is a non-impacted watershed.

Collawash watershed has very high average stream gradient. This is apparent when comparing Upper Clackamas watershed tributaries with an average gradient of 7.6 %, to the Collawash tributaries that average 9.1% (Fig. 12). The Collawash has an average gradient 19.7 % greater than the Upper Clackamas watershed.

HABITAT COMPOSITION (A Mixed Situation)

Pool Habitat and Large Wood. Aquatic habitat within the mainstem Collawash and Hot Springs Fork appears to meet LMP standards for pools but does not meet PIG standards. A mixed situation exists for both of the above standards for large and small wood in the watershed. Three earth flow streams, (Paste, Peat, Sluice) have very high counts of wood but are below standard for pools. Great differences even seem to exist between adjacent subwatersheds with similar management impacts (see Table 7).

The standards for habitat composition may not always reflect real life, baseline, unimpacted conditions for streams in this watershed. It is interesting to note that for the three non-impacted, essentially roadless watersheds (Battle Creek, Elk Lake Creek, and Upper Hot Springs Fork) that only one meets the Forest Land Management Plan standards for pools and none of the streams meet the Policy Implementation Guide standard (See Table 8). A similar situation exists for large wood. Even where habitat meets or exceeds standards for woody debris, such as in the mainstem of the Collawash, it is believed that historically, larger amounts were present in the main stems of the rivers.



* Average of 7 Collawash 3rd and 4th order tribs
** Average of 9 Upper Clackamas 3rd and 4th order tribs

Collawash has an average gradient 19.7% greater than U. Clackamas

Figure 12
Comparision of Average Gradient for Watershed Tributaries (Collawash and Upper Clackamas Watersheds)

FISH UTILIZATION AND PRODUCTION

All anadromous species are below productive potential of the watershed due to failure in most years to meet full seeding escapement. Even when it is met, as has happened with spring chinook, most of these fish are not naturally produced but strays from hatcheries and they are less successful at naturally replacing themselves.

Currently some of the watershed is in very good condition but even portions of this habitat were probably superior historically, before such things as stream cleaning of large wood began. Sediment production has increased in the watershed but actual impacts to fisheries are undetermined. It has likely lowered productivity. Stream temperatures have probably increased an undetermined amount, on what is naturally a warmer stream system.

The Collawash Watershed is quite capable of producing larger numbers of anadromous steelhead trout. These fish seem to tolerate higher temperatures and steeper gradient streams and are commonly associated with riffle habitat. These conditions are more typical in the Collawash

LAKES, PONDS, WETLANDS, AND MEADOWS

The many lakes, ponds, wetlands and meadows in the Collawash (see Map 19) are derived in large part from geologic influences. Permanent standing water ranges from high, oligotrophic lakes in formerly glaciated cirques just short of the highest wilderness ridges to eutrophic sag ponds in the earthflow benches of the Sluice/Slide/Paste, Fan Creek, and Happy Creek areas. Shrub wetlands (usually dominated by Sitka alder) are located on many steep headwalls in the Skin, Blister, Thunder, Dutch, and Pansy Creek subwatersheds. These sites are notable especially for their value to neotropical and resident passerine birds and also game species

STREAMS	#PIECES CWD/MILE >36" X 50'	>24" X 50'	#POOLS MILE	LMP* POOL # (STANDARD)	PIG** POOL (STANDARD)	AVG. CHANNEL GRADIENT %	AVG. CHANNEL WIDTH feet
COLLAWASH HEADWATERS							
BATTLE CREEK~	11.7	25.5	15.4	30 - 53	47	5.0	20.9
ELK LAKE CREEK ~	15.4	40.9	18.3	15 - 42	26	2.8	28.3
E. FORK COLLAWASH	11.3	5.0	37.5	38 -70	56	4.5	17.4
(group average)	12.8	23.8	23.7	———	....	4.1	22.2
EAST COLLAWASH							
HAPPY CREEK	18.4	65.2	14.4	75 -211	96	19.0	6.9
PASTE CREEK	109.0	194.8	63.0	>151	184	22.0	4.8
PEAT CREEK	124.1	118.2	45.0	75 -211	96	19.0	5.5
SLUICE CREEK	88.3		18.8	>151	184	32.0	4.6
BUCKEYE CREEK	21.3	99.7	13.3	75 -211	96	14.5	7.6
(group average)	72.2	119.5	30.9	....	....	21.1	4.7
NORTH HOT SPRINGS FORK							
THUNDER CREEK	25.1	44.1	124.5	75 -211	96		9.1
DUTCH CREEK	62.6	80.4	65.6	75 -211	96	6.0	7.7
SKIN CREEK	10.5	33.3	20.5	50 -106	70	12.0	11.6
(group average)	32.7	52.6	70.2	....	....	9.0	9.5
COLLAWASH R.	29.9	92.7	16.1	15 -42	26	2.0	39.0
MAIN HOT SPRINGS FORK	26.5	40.6	15.5	15 -42	26	1.5	28.2
UPPER HOT SPRINGS FORK -	12.9	70.0	19.9	38 -70	56	5.0	17.3

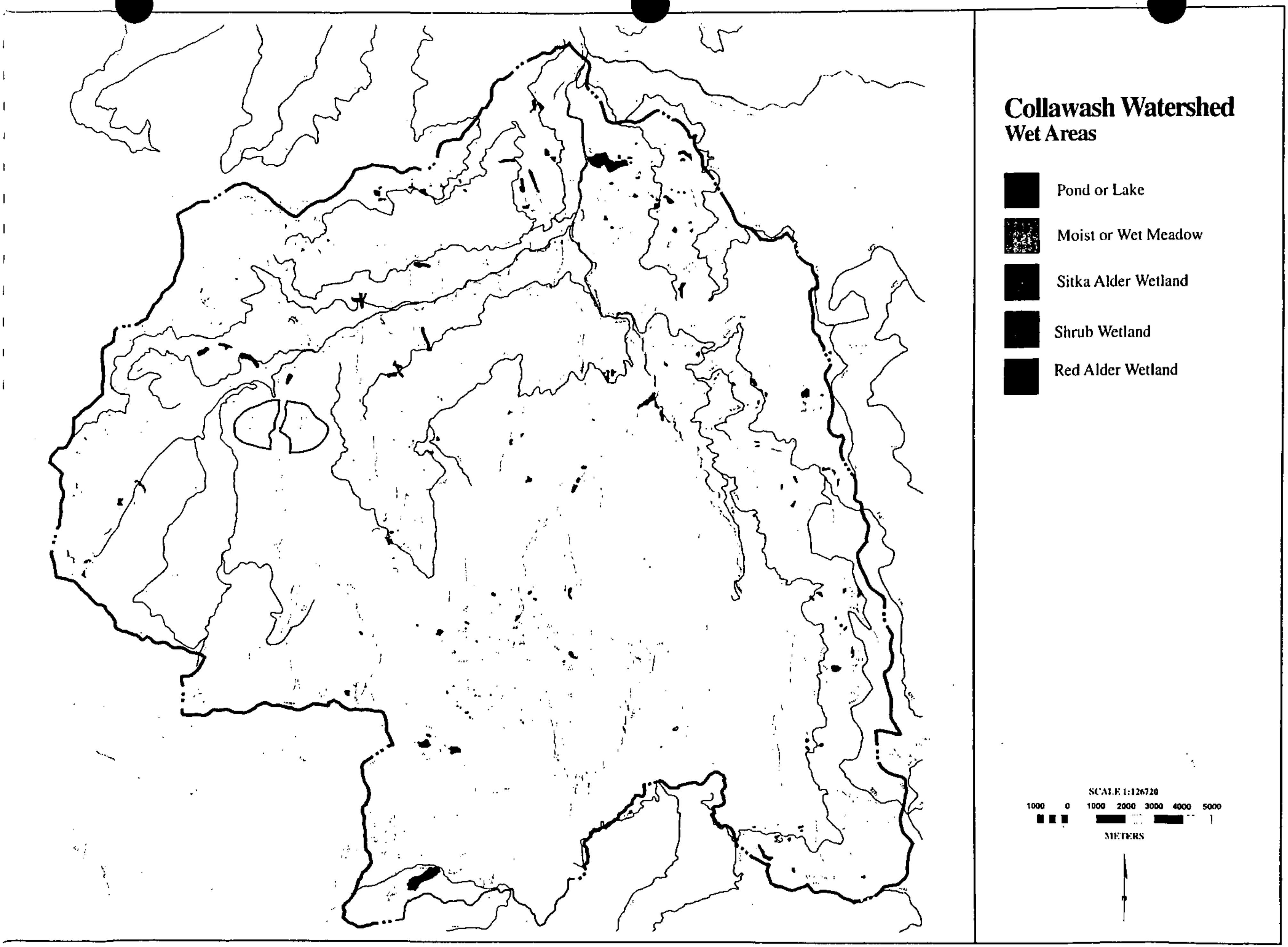
Above data collected from 1990-1994, Mt. Hood National Forest stream surveys. Streams not surveyed were not included. ~ Roadless area or wilderness streams.
* LMP = Mt. Hood National Forest Plan, 1990. (#'s vary with stream width)
** PIG = (Policy Implementation Guide, 1994) PACFISH (#'s vary w/ stream width)

Table 8 Stream Survey Information Within Watershed

that seek good forage in proximity to cover (deer, elk, and gamebirds) and predators. Edge species will likely rely increasingly on these habitats in the future.

Wet and moist meadows and flat shrublands are scattered randomly through the lower gradient portions of the watershed and many probably formerly supported beaver. At the current time, relatively high densities of beaver could probably be supported on many low gradient portions of streams reaching north of the Hot Springs Fork. However, few to no beaver are now occupying these sites. Many inactive beaver sites (evidence of old dams and/or cuttings) have been noted from the East Fork of the Collawash, Happy, and Paste Creek areas. Many of the meadow and shrubland areas and former forested swamps have been cut over. The effect to aquatic and riparian species has not been examined.

The Collawash Watershed contains 16 high mountain lakes one acre or larger in area with 14 out of 16 lakes located in the Bull of the Woods Wilderness. The largest lake is 64 acres (Elk Lake) and the deepest is 50 feet (Upper Twin Lake). The trophic status of most lakes is either oligotrophic or mesotrophic. Three lakes (Round, West, and Elk) have known potential as trophy trout lakes (fish >14" in length). Five lakes (Big Slide, Elk, Pansy, Round, and Upper Twin) have high recreation use and impacts to shore habitat and other resources.


Collawash Watershed
Wet Areas
Pond or Lake
Moist or Wet Meadow
Sitka Alder Wetland
Shrub Wetland
Red Alder Wetland
SCALE 1:126720
1000 0 1000 2000 3000 4000 5000
METERS

All ponds, lakes, and moist or wet meadows may support waterfowl and/or wading birds for at least part of the year. Waterfowl present include hooded merganser, bufflehead, wood duck, green-winged teal, mallard, and gadwall. Duck nesting boxes have been placed and are used by waterfowl in many parts of the Clackamas Ranger District. With the possible exception of Cachebox Meadow and the large meadow west of Elk Lake, habitat appears to be poor for sandhill cranes. The Elk Lake site has not been surveyed for sandhill presence.

Most bats also rely heavily on lakes, ponds, wetlands, and meadows. Yuma myotis forges almost exclusively over lakes. Several of the bat species that are predicted to have a low probability of achieving a well distributed viable population are highly associated with wetlands and riparian areas for foraging.

Amphibian occurrence is expected in most of these habitats. Red-legged and cascade frogs have been documented from ponds and moist meadows in several parts of the watershed. These species are both diminished in numbers across their range. Other species known or suspected to occur include the northwestern salamander, long-toed salamander, rough-skinned newt and Pacific treefrog. In general, amphibians are good indicators of habitat conditions because of their interdependence on both aquatic and terrestrial habitats (the red-legged frog and all of the newts rely on terrestrial corridors for dispersal and underground burrows during seasonal temperature and moisture fluctuations). Most of the pond and wetland amphibians mentioned here are not particularly sensitive to warming water temperature or sedimentation regimes but are subject to predation by fish. Bullfrogs (non-native frogs widespread in the Willamette valley and lower elevational forests) are also voracious predators on native amphibian larvae but are not yet known to be present within the watershed. Dispersal between suitable habitats is likely the most significant future issue facing amphibian populations. Important dispersal links would include areas between ponds and wetlands, especially those areas not linked by streams.

Neither Northwestern pond turtles nor Western painted turtles are known to inhabit the watershed, though historically they may have been present below 2000 feet. Western painted turtles persist in the Willamette valley though reproductive success there is extremely low. Reintroduction of these turtles could buffer populations at risk elsewhere in the state and could potentially include any of the lower elevation ponds. Habitat enhancement may be required for successful reintroduction.

Fiedler (1992) studies elk density and movements within this watershed and observed that elk use wet meadow and riparian habitats as foraging areas far out of proportion to their availibility.

Known sensitive plant species occurring in wet areas within the watershed include: *Sisyrichium sarmentosum*, found in wet meadows; and *Ophioglossum vulgatum*, which is found on the edges fo ponds and wet meadows. There are several other plant species of concern that have potential to be found in wetland and riparian areas within the watershed. The Northwest Forest Plan calls for the survey and management of numerous species of fungi, lichens, bryophytes, and vascular plants. Information on these species within the Collawash/Hot Springs Fork watershed is lacking, especially for non-vascular plants. The watershed does contain potential habitat for many of them. There have been reported sightings of at least two of these species within the watershed: *Allotropa virgata* (vascular plant) and *Hydrotheria venosa* (aquatic lichen).

INFORMATION GENERATION

Maps created from GIS layers presently available on district, supplemented by photo interpretation of wetland habitats at 1:12,000 scale. See the Wildlife Biologist at the Clackamas Ranger District for wetlands survey information dating from early 1980s. Also see the Fisheries Biologist at the Estacada Ranger District for lakes survey data dating from 1948.

LATE SERAL HABITAT/ KEY CONNECTIVITY AREAS

Connectivity has been recognized as an important consideration in wildlife habitat management for late successional species (USDA, et. al. 1994). Connectivity is primarily an issue of dispersal and gene flow between and among populations. Along with frequency and abundance, vagility (dispersal capability) is considered one of the more reliable factors to use in predicting species vulnerability to local extinctions (Lehmkuhl and Ruggiero, 1991). Dispersal habitat must provide adequate foraging opportunities and resting areas. Connectivity is important to measure at the stand scale, the watershed scale, and the drainage (Clackamas River Basin) scale because of the enormous variation between species in dispersal capabilities.

STAND SCALE

Population of the red tree vole (a C-3 survey and manage species under the ROD) is dependent on high levels of stand connectivity for population mixing. Many other small species associated with late successional habitats have low vagility. Terrestrial species with the lowest vagility are all amphibians or forest floor small mammals. In large part these are also the species most dependent on high levels of large down logs in varying decay classes. The mammals comprise basic prey items for numerous mammalian and avian predators. These small, late successional associated species are likely reduced or absent in areas of the Collawash where late seral habitat is limited to isolated patches left amidst younger managed stands.

Current connectivity at the stand scale is considered low to moderate because of the low-moderate levels of snags and down logs present in mid and early seral stands.

WATERSHED SCALE

Map 20 displays current habitat availability for late seral associated species with large home ranges (1000-3000 acres). It is a good portrayal of current connectivity at the watershed scale. In the Collawash, such species include northern spotted owl, pine marten, fisher, pileated woodpecker, northern goshawk, barred owl, and wolverine (possibly).

The map is based on a model that assigns a relative value to each block of late seral based on its connectivity and size. For management purposes, the highest risk to these species would occur by fragmenting or removing habitat within the blocks assigned values of 1, 2, 3, or 4. Harvesting the small isolated blocks labeled assigned values 5 or 6 would not significantly affect habitat for the species listed above, but would affect populations of the small late seral associates discussed above.

The largest gaps in connectivity are apparent in the upper reaches of the East Fork of the Collawash river, and the lower reaches of Blister, Thunder, Skin, Fan and other small creeks flowing south into the Hot Springs Fork, including the powerline and the heavily harvested bench north of the Hot Springs Fork. The bench north of the Hot Springs Fork is largely in mid seral stands of ages that could support dispersal by many late seral inhabitants, if the components identified above are present in sufficient quantity. No monitoring data exists to determine whether the mid seral stands are indeed beginning to function well as dispersal corridors for late seral species, but this information would be very useful. In addition, enhancement projects could be undertaken to ensure a supply of late seral elements in habitat that could support dispersal.

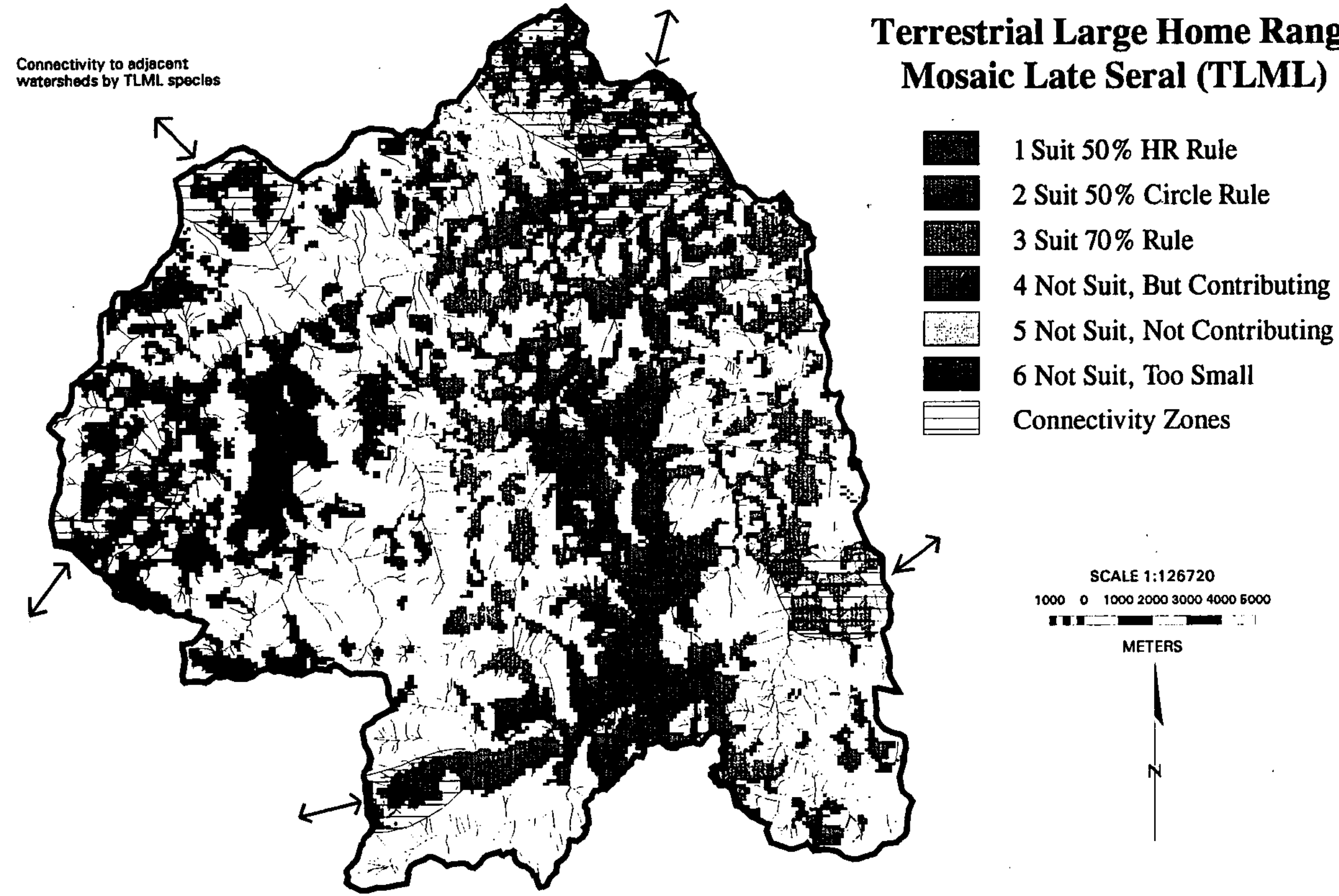
DRAINAGE SCALE

Key connectivity areas for late seral habitat currently existing between the Late Successional Reserve (LSR) and the neighboring watersheds are important to identify now since many stands within Riparian Reserves will require time to mature and function as envisioned under the ROD.

Important LSR's and protected areas located in neighboring watersheds include:

- Table Rock Wildnerness (Molalla)
- Clackamas River LSR (Upper Clackamas)

Collawash Watershed
Terrestrial Large Home Range Mosaic Late Seral (TLML)



• Headwater seep/spring complex (Fish Creek)

• Opal Creek area (North Santiam)

Within the Collawash/ Hot Springs watershed, the most obvious existing late seral connectivity blocks to neighboring watersheds occur via:

• Stands bordering the lower Hot Springs Fork and blocks along the lower Collawash River tributaries, particularly near Paste, Sluice, Slide, Peat, and Jack Davis Creeks

• Most of the southern portion of the Bull of the Woods wilderness

• The upper portion of Blister Creek subwatershed

• Stands in the upper reaches of Nohorn Creek

• The east side of the Collawash River, particularly near Ogre and Russ Creeks.

INTERIM RETENTION OF LATE SERAL HABITAT WITHIN MATRIX

A Forest wide assessment of current late seral distribution by watershed (Alvarado and Kennedy, draft report, 1995) recommended that one B-5 area in the Matrix within the watershed be maintained over the short term.

Our recommendation is to override this analysis and focus any additional interim late seral retention in the areas that play the most significant roles in connectivity. The key strategies that we recommend are:

• Promote connectivity at the stand scale by retaining and enhancing supplies of snags and down wood in plantations

• Defer harvest within the first 10-20 years in blocks of TLML 1 or 2 habitat in the Matrix.

• Retain areas identified as important links to neighboring watersheds in late successional forest. Retain and promote late seral components within these linkages.

INFORMATION GENERATION

Map 20 is based on a model of habitat for Terrestrial Large Home Range Mosaic Late Seral Guild (TLML) from Species Community and Conservation Assessment, Mt. Hood N.F. 1993; photo interpretation of interior habitat blocks. Additional information and maps displaying potential habitat for other wildlife guilds can be obtained from the forest wildlife ecologist. Scientific assessments of habitat needs of late seral species and population level responses are summarized in the FSEIS (USDA, et. al., 1994).

BIG GAME HABITAT: WINTER RANGE, CALVING AREAS, AND COVER ANALYSIS

ELK HABITAT AREAS AND MOVEMENTS

Far less is known about the movements and primary habitats of elk in the Collawash watershed than in the neighboring Upper Clackamas watershed (see Map 21). Only a few radio collared and visual collared elk have been transplanted into the area. (Blister Creek, Cap Creek and Farm Creek were selected release sites.) Like other elk brought in from Jewell Meadows, many died shortly after release. Those that survived did yield some information about the native herds in the area.

At least two elk herds occupy the Collawash. One roams the benchy area north of the Hot Springs Fork in winter and summer, remaining in lower elevations of the same general area through winter. This herd mixes on occasion with herds in the Tag Creek and Ripplebrook areas by way of forested stands flanking the lower Collawash and Clackamas River. Another herd wanders into the Upper East Fork from the Berry Creek area by way of Hawk Mountain and Cachebox Meadow, utilizing Scorpion Meadows and other wetland habitats in the south end. Potential habitat for a third native herd exists in the bench of Buckeye and Happy Creeks, but little is known about herd size and movement in this area. The Bull of the Woods wilderness has been recorded as a travel corridor for at least one bull elk.

Fiedler and O'Connor (1992) noted that elk exhibit a close association with riparian habitat in areas of low road density and gentle terrain. Seventy percent of all observations on radio-collared elk occurred within 100 meters of a stream or wetland. Elk were observed to browse on a wide range of native shrubs, trees, forbs and grasses as well as utilizing non-native grasses. The study also documented lower bull numbers in the Collawash than elsewhere in the study area.

Several potential calving areas are located near the northern tributaries of the Hot Springs Fork, particularly Rock Creek, Dutch Creek, Fan Creek, Jack Davis Creek, and Pink Creek.

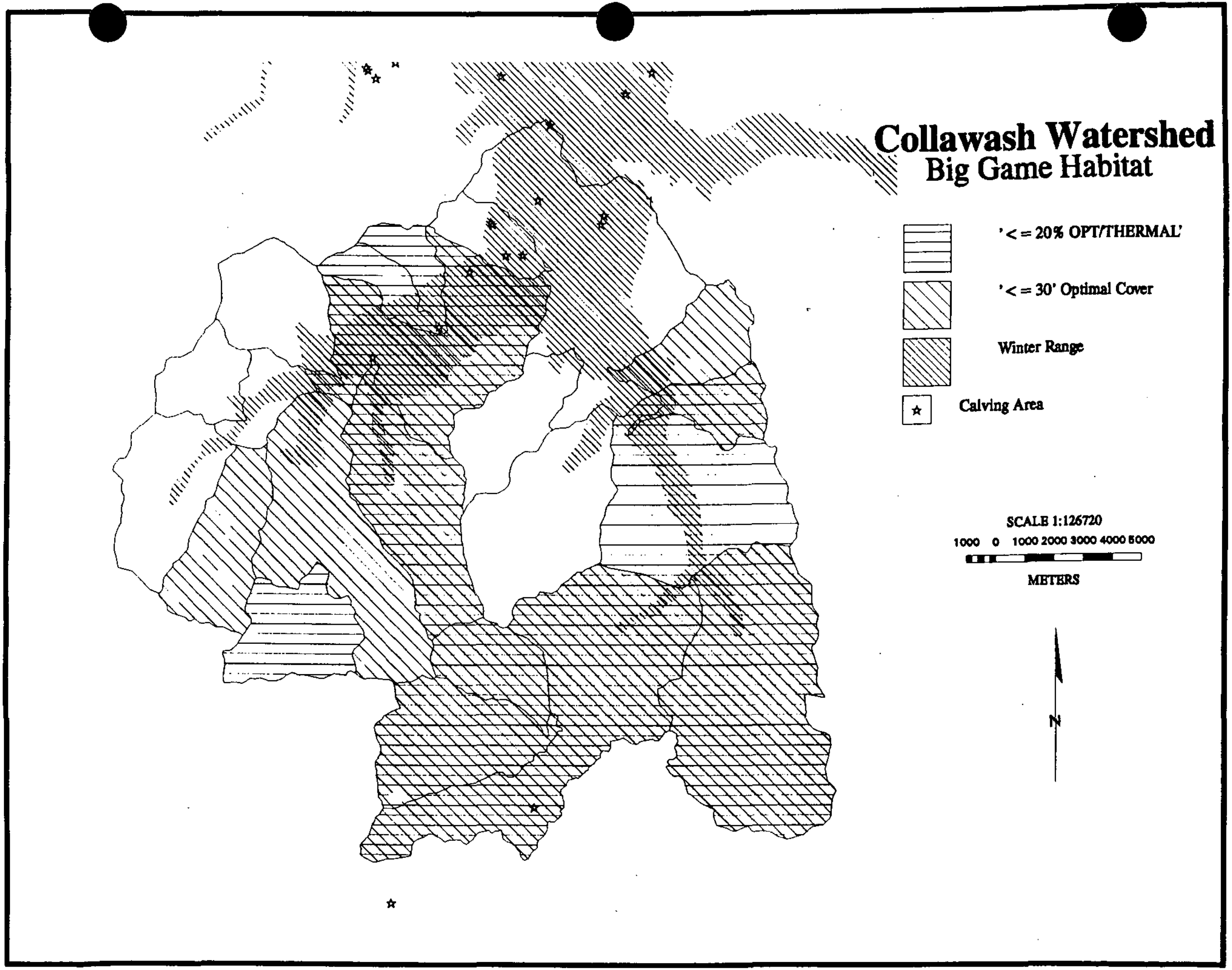
Fiedler and O'Connor also reported that elk within or moving through areas of high open road densities moved longer distances (several miles per day was not uncommon). Given the diminishing amounts of forage that will be present in the future as compared with the present, road closures will play a critical role in reducing the energetic demands upon the resident elk herds. Options to reduce open road densities especially in the locations identified as important to elk should be fully explored. Priority road closures should include: 6300-170, 6320 or 6322 from the -140 spur to the top. The hunting that occurs in the watershed is concentrated along the northern divide and within the Nohorn and Hugh Creek subwatersheds. Poaching is more difficult to track but several transplanted elk were suspected poaching victims.

COVER AND FORAGE

Interspersion of thermal and hiding cover with forage openings is considered ideal for deer and elk. Optimal cover availability is below LMP standards in several subwatersheds, including:

- Battle Creek
- Buckeye Creek
- East Fork of the Collawash
- Elk Lake Creek
- Happy Creek
- Hot Springs Fork Tributaries
- Hugh Creek
- Mother Lode Creek
- Pansy Creek
- Upper Hot Springs Fork

Optimal and thermal cover (includes marginal thermal cover) combined is slightly under Forest Plan standards for much of the area in winter range, but above standards for most areas in summer range.



Collawash Watershed
Big Game Habitat
'<= 20% OPT/THERMAL'
'<= 30' Optimal Cover
Winter Range
Calving Area
SCALE 1:126720
1000 0 1000 2000 3000 4000 5000
METERS
N

SPOTTED OWL HABITAT

CURRENT HABITAT AVAILABILITY/ POPULATION

As visible from map 22, primary owl habitat (habitat available for nesting, roosting and foraging) is present throughout the watershed, although in a fragmented condition.

Thirty-five activity centers are known within the watershed, with 2/3 of these occurring within the wilderness/LSR complex. One quarter of the LSR owls are at or near the minimum level of habitat required before "take" is expected to occur. Five-sixths of the Matrix owls are under or near take. Surveys of much of the current LSR were completed in 1991 and 1993. Surveys elsewhere were completed as needed for timber sale projects; most of the watershed was surveyed between 1991-1993. About 8 of the 35 owl centers identified have not been verified since 1990 or earlier.

No owl centers are known above 4200' elevation, though approximately 12-15% of the LSR/ wilderness complex is higher than this. Only three centers are located between 4000-4200'; 2-3% of the wilderness is in this band. This data suggests that owls are relying primarily on the lower elevational forests (Western Hemlock and Pacific Silver Fir series) in the LSR/wilderness to provide primary nesting, roosting, and foraging habitat.

Portions of the Matrix land - mainly Blister and Nohorn subwatersheds - are included within the bounds of the Critical Habitat Unit OR-12 (designated by the US Fish and Wildlife Service, 1992). Current USFWS management concerns/goals for this area are maintaining dispersal between the LSR/wilderness complex and the Clackamas River LSR #207 to the north and east. No local data on owl dispersal within the area exists. Given that owls have large home ranges and high dispersal capabilities, owl dispersal could be occurring in all portions of the watershed through suitable dispersal habitat (which is relatively well distributed in the watershed, though large holes exist north of the Hot Springs Fork).

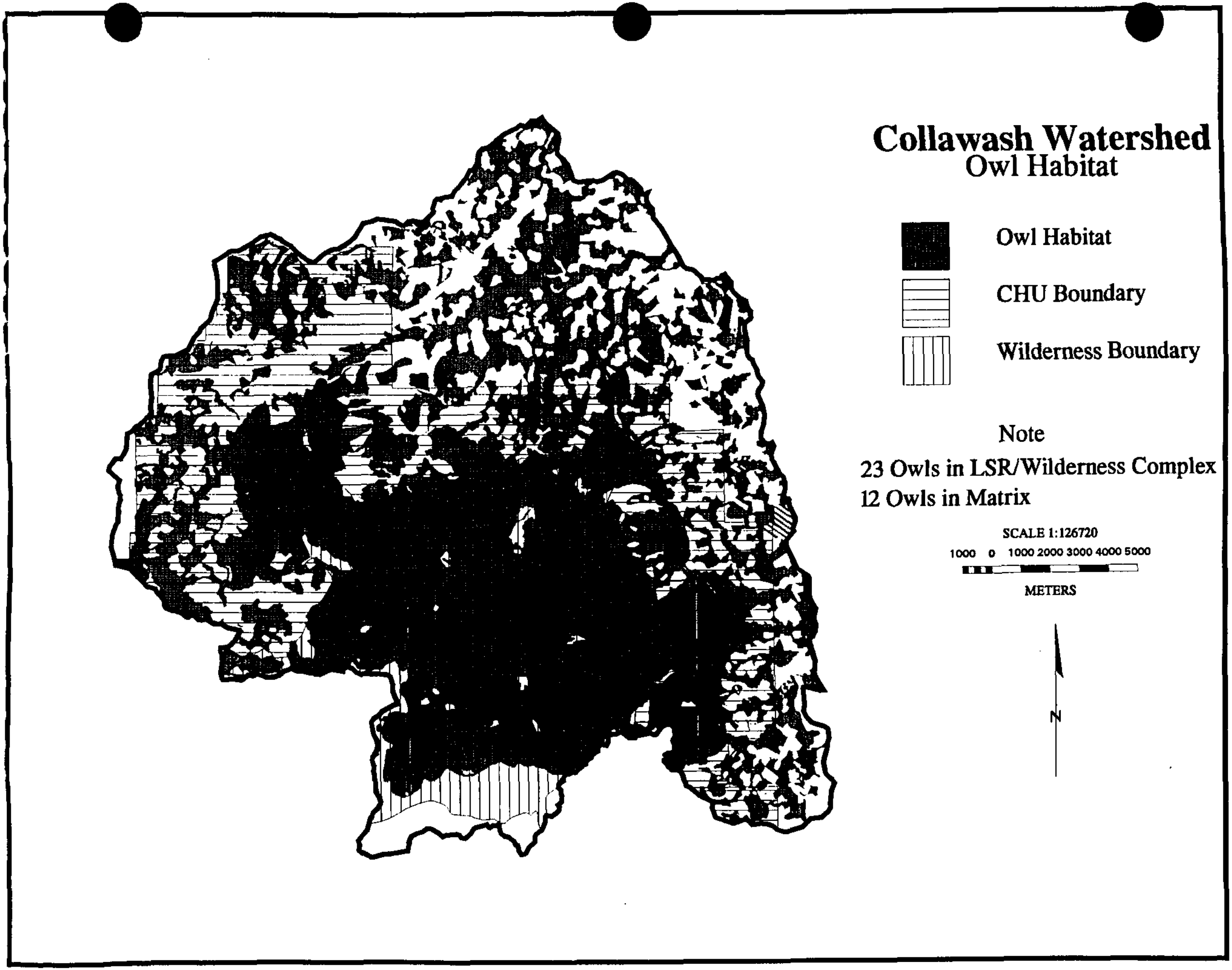
HABITAT AVAILABILITY TRENDS

A formal growth analysis projection for young and mid seral stands was not performed. However, based upon analysis completed in the FSEIS (1994) and the Upper Clackamas watershed analysis, it is unlikely that most mid seral stands will develop owl nesting habitat characteristics within the next 50 years. Exceptions to this rule may be found in the wilderness where advanced mid seral stands can be found.

Thus here, as in neighboring watersheds, the owl population will likely decline over the next several decades, but the rate of decline will depend on the location of harvest units, and the occurrence of fire, blowdown and other catastrophic events. A slow decline would pose less risk to the population and would be best achieved by concentrating harvest outside known owl activity centers or within the territories that are already below take - such areas are available within the upper reaches of Happy, Paste, and Skin creeks. Because so many of the Matrix owls are near take, a sensible strategy is to spread out the risks to these owls by scattering the harvest pattern over their collective territories. An annual rate of take reasonable for the Mt. Hood National Forest or the Clackamas subbasin has not yet been established.

INFORMATION GENERATION

The owl habitat map is derived from queries on Forestwide vegetation database - large portions have not been field verified. Survey information from District and Forest records, 1985-present. Consult the district wildlife biologists for owl locations, reproductive success, habitat information and survey history.


Collawash Watershed
Owl Habitat
Owl Habitat
CHU Boundary
Wilderness Boundary
Note
23 Owls in LSR/Wilderness Complex
12 Owls in Matrix
SCALE 1:126720
1000 0 1000 2000 3000 4000 5000
METERS
N

ROCKS, TALUS, CLIFFS, CAVES, MINES, BUILDINGS, AND BRIDGES

These habitats are widespread in the Collawash; some of the Forest's highest concentrations of rock and talus type are located within Bull of the Woods wilderness. These special habitats potentially support many species of interest, including several TES species. Rock and talus habitat types are important for approximately one eighth of the 224 wildlife species thought to occur within the Collawash watershed, while cliffs, mines, buildings and bridges support highlighted species such as the peregrine falcon and the Townsend's big-eared bat. *Aster gormanii*, a sensitive plant species, is found on rocky ridgetops within the watershed.

Species potentially associated with these habitats include several granted certain protection buffers or management restrictions under the ROD (USDA, et. al., 1994). Such species *include all bats, the great gray owl and the* Larch Mountain salamander (a C-3 survey and manage species). Five bat species at low to moderate risk of viability across their range (USDA, et. al, 1994) rely on these habitats for roosting and hibernation sites.

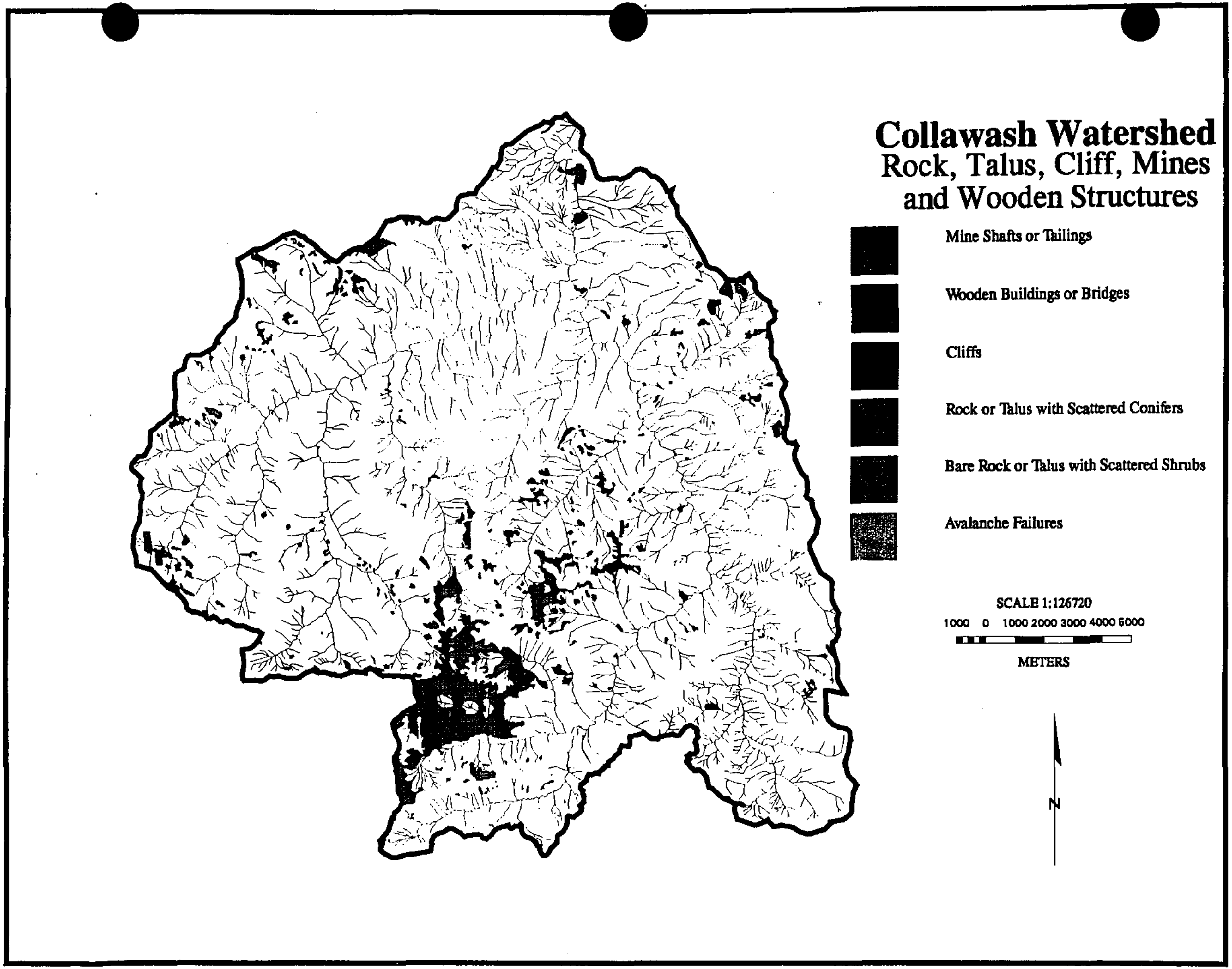
Some surveys were completed for bat species within the watershed in 1994 and 1995. Roosting bats were located under nearly all of the bridges surveyed, including many concrete structure bridges. Fringed myotis, long-legged myotis, Townsend's big-eared bat, long-eared myotis, and silverhaired bat, little brown myotis and big brown bat were located from various points within the Clackamas subbasin during the same survey, including several in the Collawash (Perkins, 1994). Surveys for the Larch Mountain salamander may occur in the spring/fall of 1995. Caves and mine tunnels are particularly important as winter hibernacula for many bats. No caves are known in the area, but several mine shafts are present.

Mammalian predators, including fisher, wolverine and cougar may seek out rock and talus habitats while foraging. Wolverine and cougar use rock or talus areas for denning. Bull of the Woods wilderness may represent some of the Forest's highest potential sites for wolverine breeding, based upon the density of talus and rock and the very isolated character of the wilderness. Finally, rock and talus sites help support reptiles that are otherwise uncommon in the forested habitats of the Western Cascades.

The single occupied peregrine falcon eyrie on the Mt. Hood National Forest is located on a cliff within this watershed. Several other cliff sites with high potential to support peregrine nesting are present. Only 22 peregrine eyries are known in the state of Oregon at this time. A management strategy for the occupied sites is under review in the Supervisor's Office and involves limitations on disturbance and maintaining or enhancing the peregrine prey base within 0.5- 3.0 miles from the eyrie site. A road approaching the occupied site is closed but not obliterated at this time. Surveys at several high potential cliff sites are scheduled to occur in the spring of 1995 and 1996.

INFORMATION GENERATION

Map 23 was compiled from vegetation database for the Collawash watershed, supplemented by photo interpretation at 1:12,000 scale and existing information on file at district offices. See the forest wildlife biologist or the forest wildlife ecologist for Species and Community Conservation Assessment information. See the district wildlife biologist for scientific literature covering bats, wolverine, peregrines and other species mentioned.


Collawash Watershed
Rock, Talus, Cliff, Mines and Wooden Structures
Mine Shafts or Tailings
Wooden Buildings or Bridges
Cliffs
Rock or Talus with Scattered Conifers
Bare Rock or Talus with Scattered Shrubs
Avalanche Failures
SCALE 1:126720
1000 0 1000 2000 3000 4000 5000
METERS
N

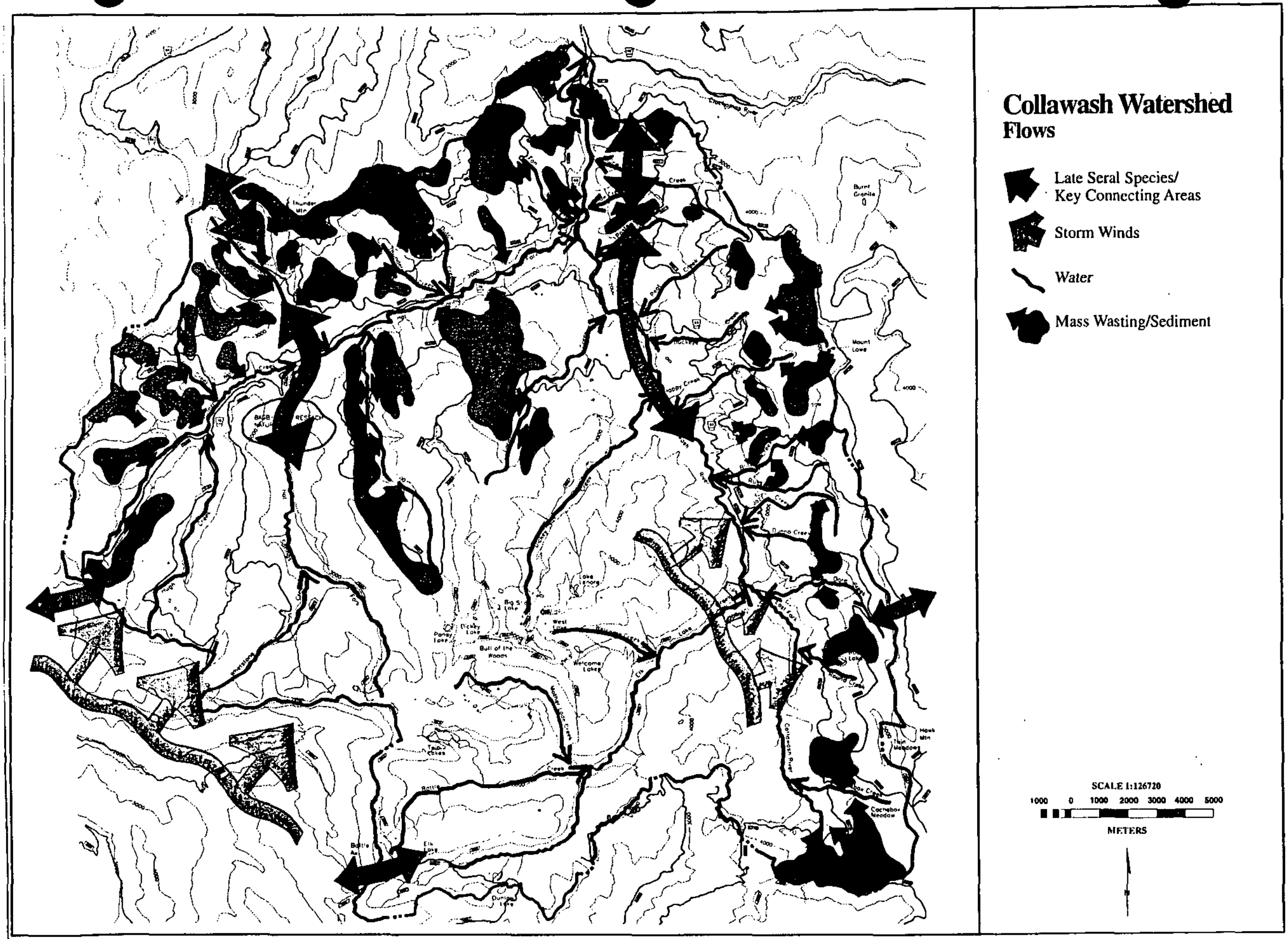
LANDSCAPE ECOLOGIC FLOWS

Map 24 represents the most prominent "flow" elements in the watershed. Flows are those aspects of landscape ecology that move through the landscape. They both influence and are influenced by landscape pattern and structure. Table 9 illustrates the relationship between these flows and landscape structure. (TLML species are related to mature forest structure). The first section describes the character of the flows. The second section shows the relationship of flow to vegetative structure.

FLOW	CHARACTER
WINDS	Main storms from S/SW. 5-10 year interval events.
WATER	Steep streams, flashy, high energy, low resilience.
PEOPLE	Follow historical land routes, destination oriented, multi-modal, seasonal, use is growing.
LATE SERAL SPECIES	Mature forest shapes the flow. Some can use corridors.
MASS WASTING	Steep slope on weak rocks, valley floor earthflows, highly unstable watershed.

FLOW	NATURAL OPENINGS	EARLY SERAL FOREST	MID SERAL FOREST	LATE SERAL FOREST
WINDS	Stable	Windfirm but edges affect adjacent forest.	Windfirm if thinned, adjacent edges stabilized.	Windfirm except for major events. Edges subject to blowdown.
WATER	Wetlands store water. Low snowpack retention, lack of shade, can raise water temperature.	Low snowpack retention, high runoff contributes to flashiness, lack of shade raises water temperature. Lacks LWD.	Adequate snowpack retention stabilizes stream energy. Moderates water temperature. Lacks LWD.	High snowpack retention slows stream energy, cools water temperature, and contributes LWD.
PEOPLE	Aesthetic viewing, wildlife viewing, botanizing, sunshine, views from within.	Low aesthetics, good for hunting, small product opportunities.	Adequate aesthetics in middle ground, poor in foreground due to low diversity.	High aesthetics draws visitors. Cool in summer. Edible mushrooms available.
LATE SERAL SPECIES	Variable.	Species avoid edge effect. Lacks snags, LWD.	Adequate cover facilitates travel. Lacks snags, LWD.	Ideal structure.
MASS WASTING	Many exist due to unstable landforms.	Lower shear strength can cause sliding.	Adequate shear strength.	Good shear strength.

Table 9
Landscape Ecologic Flows


Collawash Watershed
Flows
Late Seral Species/ Key Connecting Areas
Storm Winds
Water
Mass Wasting/Sediment
SCALE 1:126720
1000 0 1000 2000 3000 4000 5000
METERS
Burnt Granite
Mount Lowe
Lake Lenore
Bull of the Woods
Welcome Lakes
Cachebox Meadow

PRESENT RECREATION USE

Map 25 illustrates the present use patterns, and to some extent, intensity in the Collawash/ Hot Springs Fork watershed. It shows that human use is closely tied to landscape structure and vegetation patterns. For example, most human use is associated with the main rivers, and the natural forest structure found in the Bagby area and Bull of the Woods wilderness. Exceptions are activities more associated with fragmented forest structure, such as big game hunting, berry picking, and other product gathering. Landform and topography also are obvious influences on human use patterns, particularly the development of "human corridors." Essentially we use the same corridors today that American Indians used for thousands of years, although we have changed their character greatly.

Recreation use trends have been developed by drawing from the Oregon Outdoor Recreation Plan, which tracks recreation use patterns. For the purposes of the Collawash analysis, we have divided recreation activities into three categories: high, medium, and low growth. (Table 10)

Use of Bull of the Woods wilderness shows a slow increase over the past 4-5 years. The highest concentration of use appears to be in the Twin and Pansy Lakes areas.

Bagby Hot Springs is the area of highest concentrated use in the watershed. There are unconfirmed estimates of 40-50,000 visits per year, and use is year around. The trailhead for Bagby is a site of frequent vandalism and car clouting. Friends of Bagby (FOB) provides a presence at the springs, and a source of volunteer workers. There have been strains in the relationship between the Forest Service and FOB over illegal firewood cutting and lack of FS funding for capital improvements.

The trend in developed site recreation is downward in terms of FS capital spending as well as operations and maintenance. There is a strong national push to get all developed sites into a market based fee structure and under management by private operators. Bagby, with 40-50,000 visitors a year, is a prime area for establishment of a use fee. FOB is on record as opposed to making Bagby a fee site, however.

The two existing developed campgrounds in the watershed, Kingfisher and Raab, are presently being managed by a private operator.

One other significant development in the Collawash watershed will be the construction of the Urban Link Trail, a long distance route that will connect Portland and the Pacific Crest Trail at Olallie Lakes Scenic Area. This will likely increase use along Rhododendron Ridge and introduce new visitors to the watershed as a whole.

Information was gathered by consulting with the recreation group for the Clackamas watershed, public input received at a workshop, and by reading existing recreation documents about this area.

High Growth		Medium Growth		Low Growth	
Road bicycling	105%	Scenic Driving	45%	Backpacking	29%
Mountain biking	93%	ORV use	42%	Bank Fishing	21%
Day hiking	67%	Picnicking	35%	River boating	20%
Boat fishing	62%	Tent camping	35%	Bow hunting	5%
Wildlife viewing	52%	Big game hunting	34%	Bird hunting	3%

Table 10
Recreation Activities Growth

Collawash Watershed
Recreation Use

PART IV
Recommendations

RECOMMENDATIONS FOR MANAGING LONG TERM LANDSCAPE PATTERNS

Map 26 illustrates the recommendation of the Collawash watershed analysis team for how to manage the forest pattern and structure over the long term. By providing a picture of the desired landscape structure, our hope is that silvicultural treatments at the site scale will be designed within this larger framework.

The landscape pattern design was arrived at by considering several overriding natural and cultural influences in this watershed, as follows:

• The Northwest Forest Plan (NWFP), combined with land allocations from the Mount Hood Forest Plan, provides clear direction regarding landscape patterns within (LSRs), Riparian Reserves, natural opening buffers, and spotted owl nest areas. For the Collawash and Hot Springs Fork watersheds, the result is large areas (perhaps 70% of the total area), where the goal is to grow or retain late seral forest structure. The rest of the watershed is within the "Matrix," and falls under several Forest Plan land allocations, including Special Emphasis Watershed, Scenic Viewshed, and Wild and Scenic River. Management of landscape pattern and structure in these areas can range from uneven age, single tree select, to large scale regeneration openings.

• The watershed under consideration is believed to be the most unstable (geologically) on the entire Mount Hood Forest. There are large areas of high-risk earthflow and/or weak resistant rock types on steep slopes underlying much of the Matrix. This limits the creation of large scale regeneration timber harvest.

• Analysis suggests that this watershed has a high risk of catastrophic windthrow compared to other parts of the national forest. Windthrow appears to be closely correlated to development of fragmented patterns due to timber harvest. This places narrow Riparian Reserves and the windward edges of the LSR's at great risk of blowdown, if large scale regeneration timber harvest is continued.

• The Collawash/ Hot Springs Fork serves as a "core area" of late seral biodiversity within the regional framework of the NWFP. Maintenance or restoration of connectivity to adjacent watersheds for late seral species is considered important by the team.

• The aesthetic condition of the harvested portions of the watershed (generally outside the wilderness and main river corridors) is far below Forest Plan standards. This is due to the geometric, fragmented pattern created over multiple timber entries.

• There are regeneration problems in the Mountain Hemlock Zone, particularly along Rhododendron Ridge in the southeast portion of the watershed. Experience shows that very small openings amid forested conditions or dense shelterwoods do regenerate well, but large openings will not.

These factors, and others, led the team to conclude that the most appropriate silvicultural management strategy for the Matrix would be to move gradually away from a fragmented landscape pattern (defined as greater than 30% of a given area in large openings), and towards a more "perforated" pattern (20-30% of a given area in small, 2-5 acre openings). This would minimize the risk of triggering mass wasting, would likely be reasonably windfirm, would maintain or improve connectivity for late seral dependent species, and would improve the aesthetics to within Forest Plan standards. In the Mountain Hemlock Zone, we recommend management toward a finer textured, "patchy" pattern of even smaller openings (less than 2 acres) to improve conditions for regeneration.

Figure 13 helps illustrate the landscape pattern intent. It should also be noted that the team looked at opportunities for narrowing the width of Riparian Reserves along intermittent streams, given that a perforated forest structure would provide a good buffer for these areas. However, given that past timber harvest has removed much of the forest cover on intermittents, we concluded that the interim standards identified in the ROD should remain in place until forest recovery is well advanced (perhaps 3-4 decades). Then options for narrowing or perhaps even eliminating buffers could be considered, if the perforated forest is functioning as intended.

LONG TERM LANDSCAPE PATTERN

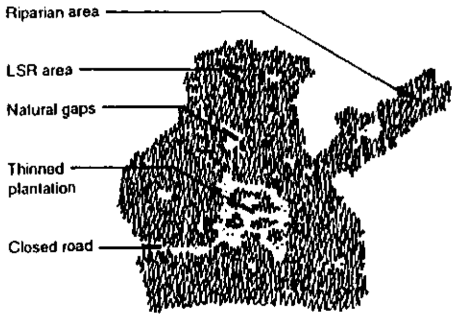
PATTERN TYPE	LANDSCAPE OBJECTIVE	INCLUDES
• Retain or Promote Late Seral Forest Structure	• Habitat for Late Seral species • Protection of aquatic resources • Connectivity	• LSR • Interim riparian reserves • 100 acre owl centers • Special habitat buffers • Active, ancient landslides (earthflows)
• Perforated Forest	• Economical timber production • Minimize mass wasting and erosion • Minimize windthrow • Buffer reserves • Meet scenic quality objectives • Promote forest connectivity • Maintain natural hydrologic function	• Matrix lands within Western Hemlock and Pacific Silver Fir associations
• Patchy Forest	• Same as above, plus regeneration protection	• Matrix land in Mountain Hemlock associations along Rho Ridge

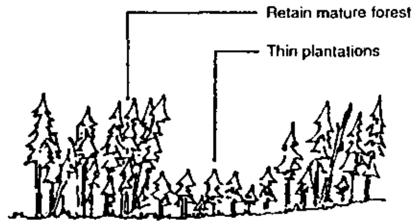
Figure 13. Long Term Landscape Pattern

FOREST MANAGEMENT

- Fire suppression
- Thin plantations to promote Late Seral structure
- Create or promote snags and LWD where lacking
- Promote shade along streams
- Salvage if this contributes to area objectives
- Close unneeded roads

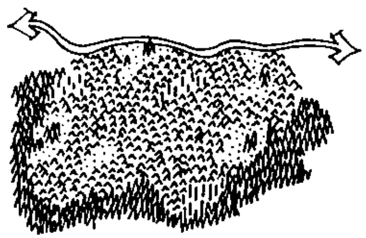
PATTERN ILLUSTRATION



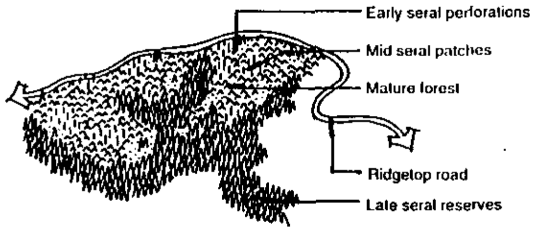


PATTERN ELEVATION

- Small regeneration harvests (2-5) acres
- Retain 70-80% of each design cell in closed forest (mid or late seral)
- Retain a minimum of 15% of harvested area in green trees
- Maintain or promote adequate snags and LWD



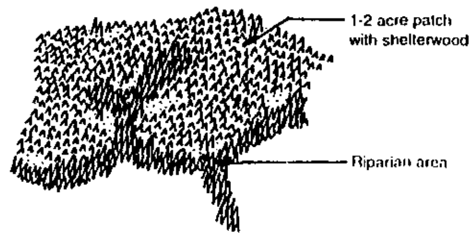
TYPICAL PERFORATED DESIGN CELL PLAN



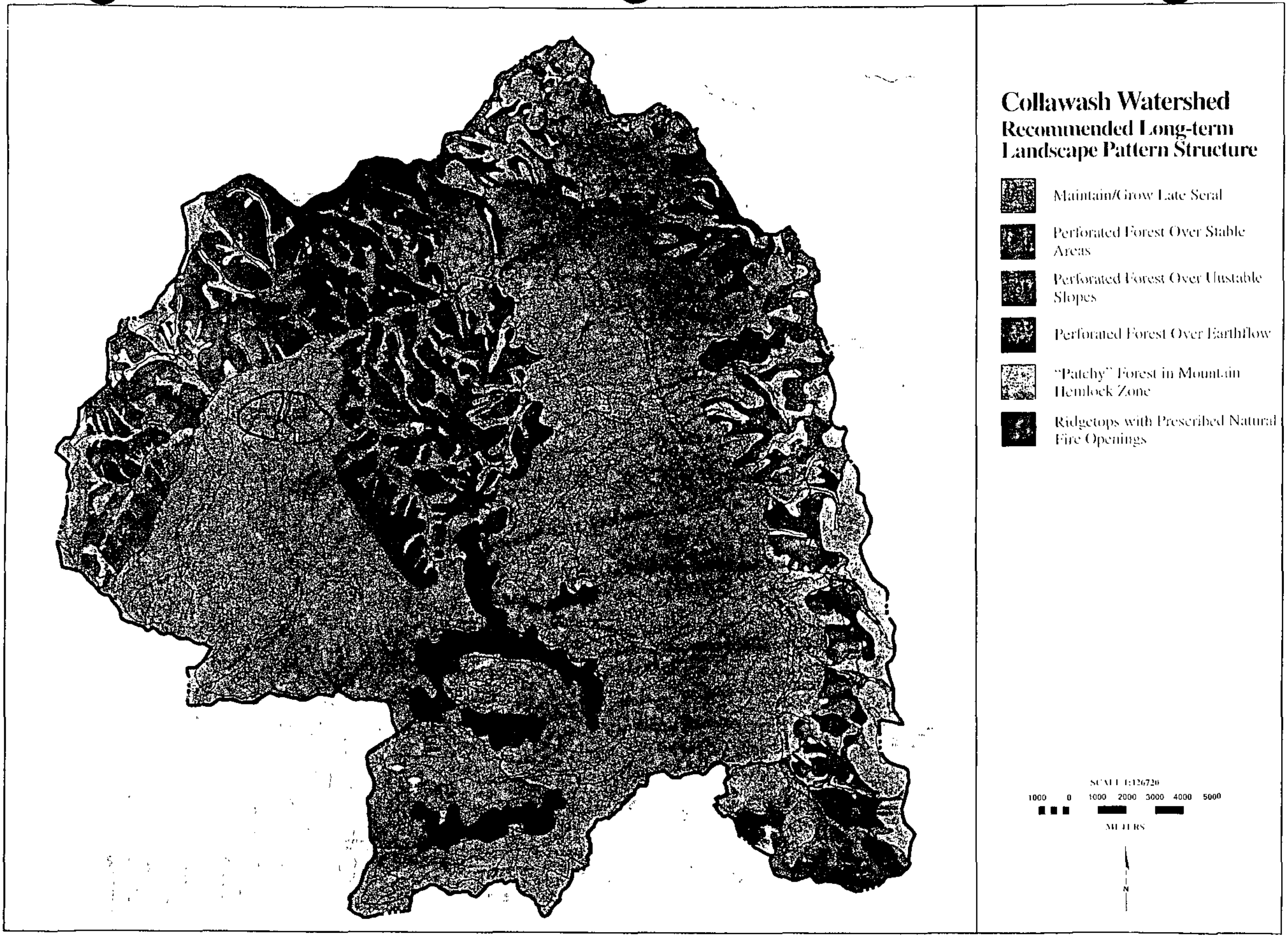
PERSPECTIVE

Similar to above, but with smaller openings (1-2 acres) and retention of shelterwood overstory

TYPICAL "PATCHY" DESIGN CELL PLAN



PERSPECTIVE


Collawash Watershed
Recommended Long-term Landscape Pattern Structure
Maintain/Grow Late Seral
Perforated Forest Over Stable Areas
Perforated Forest Over Unstable Slopes
Perforated Forest Over Earthflow
"Patchy" Forest in Mountain Hemlock Zone
Ridgetops with Prescribed Natural Fire Openings
SCALE 1:126720
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RECOMMENDATIONS FOR MANAGING VEGETATION PATTERN AND STRUCTURE OVER THE NEXT TWO DECADES

Map 27 provides a graphic illustration of the Collawash team's recommendation for management of the vegetation pattern and structure over the short term of 10-20 years. The basic premise is that a short term strategy is needed to complement the long term one, since the existing pattern and structure are so very different from the one desired.

This map was developed by integrating the long term objectives (map 26) with the existing seral stages, the landform analysis, the status of hydrologic recovery in subwatersheds, and short-term terrestrial wildlife needs (connectivity, owls). The intent is to break the landscape into design cells that can be managed on an integrated basis, where silvicultural prescriptions can be developed that will go from existing towards a more desired vegetation structure.

The design cell types fall into the following categories:

- ***Retain Existing Mature Forest:*** areas where the existing forest structure should be retained for at least the next 1-2 decades. It includes areas in LSRs, Riparian Reserves, active earthflows, areas in subwatersheds below ARP of 60%, and areas considered important for maintenance of terrestrial habitat connectivity.

- ***Variable Thinning of Plantations:*** areas within the Matrix that are presently highly fragmented. Thinning is viewed as an interim strategy promoting the long term goals of minimizing hydrological impacts and maintaining connectivity until more progressive management toward a perforated structure becomes possible. See figure 14 for illustrations of our intent.

- ***Thin Plantations Toward Eventual Late Seral Structure:*** areas characterized by young stands (early to mid seral) within LSRs and Riparian Reserves. Thinning would be done only to achieve LSR and Riparian Reserve objectives. Thinning within LSRs would require a LSR assessment.

- ***Promote Forest Connectivity Under Powerlines:*** design cells that straddle the BPA Powerline corridor, within Riparian Reserves. The idea here is to maintain or promote a good supply of down wood, snags, and "pygmy forest" cover to ease movement and blur the distinction from the mature forest at the upper and lower ends. See figure 14 for illustration of this.

- ***Begin Development of Perforated or Patchy Structure:*** design cells that have mostly mature forest cover, and are within healthy subwatersheds. Thus it is possible to begin development of the long term pattern in the near future. See figure 14 for illustration.

- ***Thin Plantations; Avoid Creating New Openings:*** design cells that are within subwatersheds where the ARP is below 65%. Thus management should retain as much existing forest structure as is possible.

SALVAGE

Insofar as tree mortality occurs in a fashion that is spatially and temporally unpredictable, salvage harvest is treated here not as a design cell, but as a set of recommendations that apply to all of the design cells. Like other sales, salvage sales should be planned in ways that help create the desired landscape pattern and structure.

- ***Salvage of Standing Dead Trees:*** salvage of standing dead trees is considered appropriate and consistent with the landscape design in Matrix areas, including subwatersheds with a low ARP value and on active earthflows.

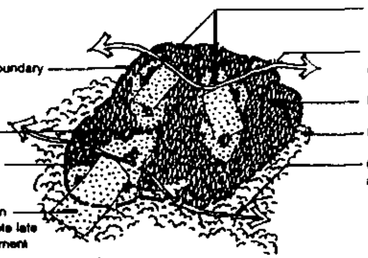
Because of the documented importance of snags as habitat components for late successionsl organisms and their contribution to large woody debris in aquatic systems, salvage of standing dead trees is not considered appropriate in LSRs (mapped and unmapped), "conventional" Riparian Reserves (not including areas added for slope stability reasons), areas identified for interim terrestrial connectivity, or generally, within 50 feet of plantations where current snag density is less than 15 trees per 10 acres. See figure 14 for illustrations of our intent. Salvage may occur in these areas if excessive mortality occurs over more than ten contiguous acres,

LANDSCAPE MANAGEMENT FOR FIRST TWO DECADES

LANDSCAPE TYPE	OBJECTIVE	INCLUDES
• Retain mature forest	• Late Seral habitat • Aquatic protection • Connectivity	• LSR • Interim riparian reserves • 100 acre owl centers • Special habitat buffers • Active earthflows • Areas in subwatersheds below 65% ARP • Areas important for habitat connectivity (short-term)
• Variable thinning of plantations and edge blending	• Timber production • Scenic improvement • Snag recruitement	• Matrix lands where subwatersheds are at or above 60% ARP and are presently highly fragmented
• Thin plantations towards Late Seral structure	• Accelerated growth • Windfirmness • Promote diversity	• LSR • Interim riparian reserves • Special habitat buffers • Active earthflows
• Promote forest connectivity under powerlines	• Develop and maintain appropriate forest structure to facilitate travel	• Riparian reserves under powerline

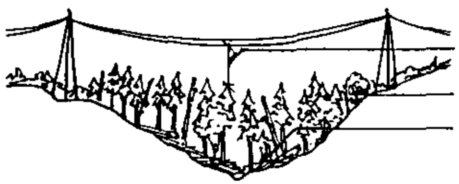
Figure 14. First Two Decades Landscape Management

FOREST MANAGEMENT	PATTERN ILLUSTRATION
• Suppress fire • Close unneeded roads • Salvage standing dead and blowdown in active earthflows. Avoid salvage elsewhere.	
• Suppress fire • Close unneeded roads, repair others • Use timber harvest to feather and round edges of existing clearcuts • Salvage blowdown and some damaged trees • Retain or promote snags if there are less than 15 trees per 10 acres	
• Suppress Fire • Close or repair roads • Thin towards long term goals	
• Create snags and down wood • Intensive selection forestry to maintain canopy at desired height • Frequent monitoring and entries • Poles, firewood, small downed logs • Mixed hardwoods and conifers	

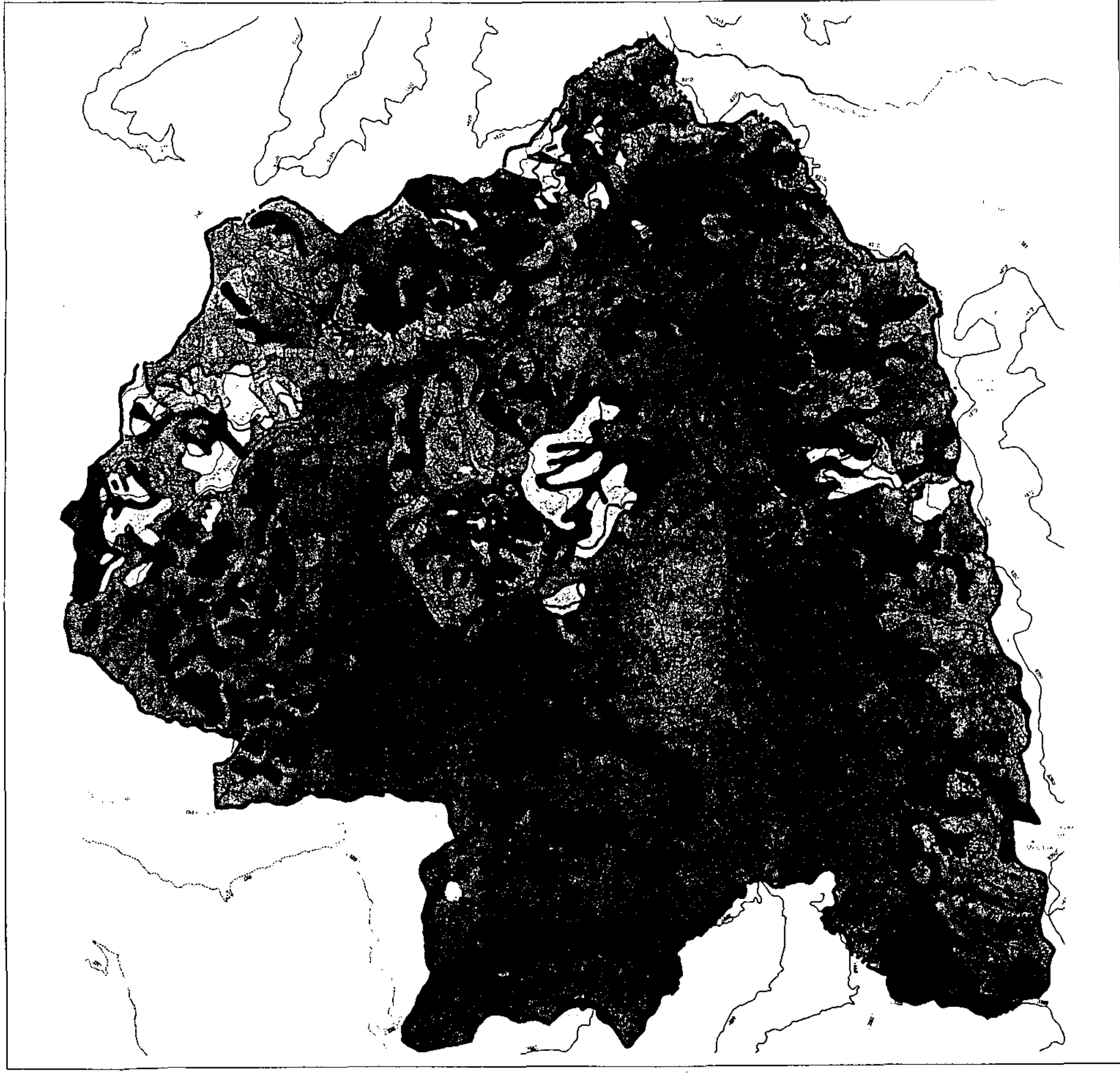


TYPICAL EDGE BLENDING AREA PLAN

PERSPECTIVE



TYPICAL POWERLINE SECTION



Collawash Watershed

Recommended Short-term (10-20 year) Management for Landscape Pattern and Structure

- Thin Plantations and Salvage Towards Eventual Perforated Structure
- Thin Plantations Toward Late Seral Forest Structure
- Promote Mature Forest Connectivity Under Powerlines
- "Blend" Edges of Plantations with Adjacent Mature Forest
- Develop Perforated or Patchy Forest Structure
- Retain Existing Mature Forest Structure
- Use Prescribed Natural Fire to Restore or Maintain Openings

Note: The polygons on this map are not meant as "fixed boundaries." The intent is to portray a concept strategy that fits within existing policy direction.

Design cell polygons should be adjusted during project design.

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and/or if necessary to meet Aquatic Conservation Strategy objectives.

• *Salvage of Windthrown Trees:* Windthrown trees should be salvaged from all areas except LSRs (mapped and unmapped), "conventional" Riparian Reserves (not including areas added for slope stability reasons), or where fallen into plantations with low existing or potential quantities of large down wood. Salvage should be considered in Riparian Reserves if necessary to meet Aquatic Conservation objectives (for example, if the blowdown is three trees deep over five acres and would likely retard regeneration). ROD rules of thumb should be consulted if considering salvage within the LSRs.

ASSUMPTIONS

Design cell boundaries are intended only to serve as a conceptual guide for subsequent timber sale projects. The team expects that these would be modified to better reflect on-the-ground conditions and more detailed forest structure analysis. We believe that a PSQ of approximately 4MBF (expected from this watershed as part of the NWFP) is achievable for the first two decades under this recommendation, but more precise modeling to verify this is warranted. Additionally, the team feels that more discussion needs to occur at the district level between all specialists to clarify the working definitions of perforated, patchy, and variable thinning. These are a bit imprecise at the moment and need tightening up.

RECOMMENDATIONS FOR TIMBER HARVEST

Timber harvest in the Collawash/ Hot Springs Watershed is expected to continue into the future under application of existing policy direction (NWFP and Mount Hood Forest Plan). Landscape pattern and structure will continue to be shaped by timber harvest, along with natural disturbances and succession. Present expectations are that an average volume of 4 million board feet per year (MMBf) for the first two decades can be extracted from this watershed. This translates to about 60-80 acres of regeneration harvest per year, if 15% of each harvest unit is left standing.

We did not attempt to develop any sophisticated computer modelling of how this harvest might occur. Our objective has been to focus on the pattern and structure of the forest vegetation that would be most in step with the essential ecology of the area. Timber harvest activity would then be the management method for creating this pattern.

Map 28 is intended to provide a visual image of forest structure that would be expected to be present in about 50 years, if the recommendations in this report are followed. It is based on the following assumptions:

- Initial timber management (1-2 decades) would focus on "edge blending". This transitional strategy is needed due to the existing fragmented character of the Matrix.

- No large scale stand replacing natural disturbances have occurred.

- Natural rates of forest succession and growth have been accelerated about 25% due to progressive thinning and fertilizing of existing plantations within LSRs, Riparian Reserves, and Matrix.

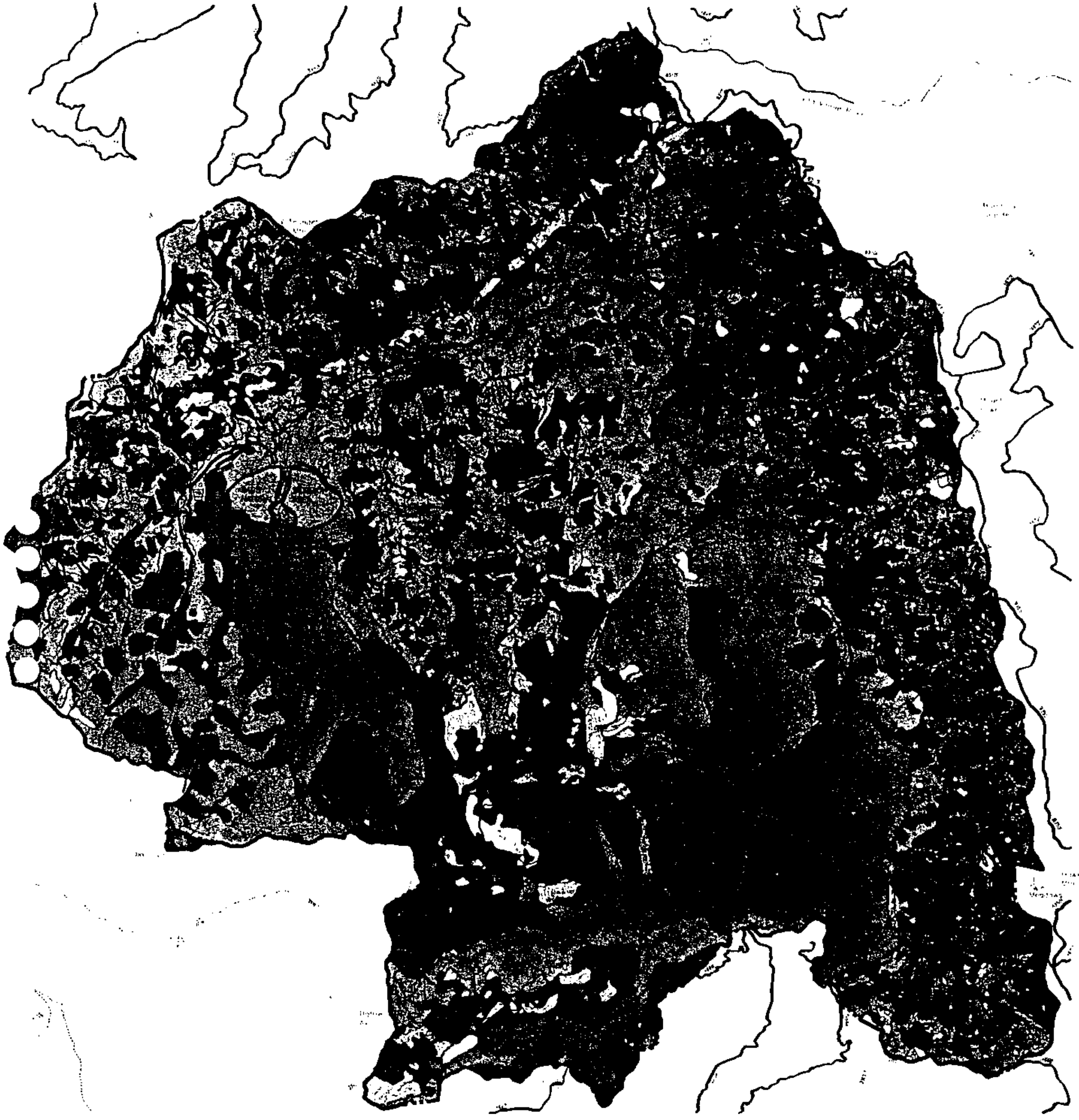
- Salvage opportunities will probably be relatively high for the first two decades, primarily because of windthrow along existing clearcut edges. As areas mature into mid seral condition, they will buffer natural stands, resulting in less windthrow overall.

- Commercial thinning opportunities will be quite limited for the first two decades due to the young age of existing harvest units. However, timber production from thinning will rapidly increase after the second decade, as many early seral stands in reserves and the Matrix reach commercial size (about 35 years of age). This trend will be quite advanced in 50 years, when thinning will likely make up the bulk of timber harvest opportunities.

- While there are very limited opportunities for initial development of perforated forest patterns, the few areas where this can be done should be planned as soon as possible to capitalize on existing knowledge, personnel, and momentum.

- Overall, the team would like to see a proactive, rather than reactive approach to managing and shaping forest pattern and structure. This means focusing resources on green tree harvest (in Matrix), prescribed fire (in wilderness), and thinning (in Reserves), as opposed to merely chasing salvage opportunities. Our concern is that too much reliance on salvage reinforces stereotypes about "wasted wood," and may result in a continuance of low snag densities and a less resilient ecosystem. An active salvage program is encouraged, but not at the expense of proactive silviculture.

Should these recommendations be followed, we expect that over the next five decades, timber production would gradually shift from edge blending and salvage (first two decades), to commercial thinning and perforation harvests (second two decades), to predominately thinning.



Collawash Watershed
Landscape Pattern After 50 Years

Landscape Pattern Expected to Evolve in 50 Years Under Management Recommendations.

Early Seral Forest

Late Seral

Mid Seral

Non-vegetated

Boundary of Matrix Areas Outside Riparian Reserves

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SUSTAINABILITY

The following discussion attempts to provide a rough analysis on the eternal question of "sustainability" over a fifty year period. We have chosen to focus on questions provided by Nancy Diaz, area ecologist for the Mount Hood and Gifford Pinchot National Forests. These questions have been raised to help find out whether key ecosystem elements can be sustained, under present management direction, in specific watersheds. Our analysis is purely qualitative, relying on using the visual image of projected conditions under present management scenarios.

Compare current, historic, and projected percentages of early, mid, and late seral forest structure.

Historic and current percentages for seral stages were discussed on pages 3-5 through 3-7. The map of our 50-year projection shows that early seral structure will be significantly less than at present, and may fall below historic ranges, unless natural disturbances make up the difference. The amount of late seral forest structure will be about the same as now. There will be some loss around the edges of existing openings (due to edge management), offset by growth of some mid seral stands into late seral. There will be a large increase in the occurrence of mid seral forest structure. It is interesting to note that the RNV study for the Clackamas basin lacked information on mid-seral forest occurrence.

Compare current, historic, and projected percent of early seral in riparian zones.

Current data is presented in Fig. 9 (page 3-20). Our projection shows a virtual disappearance of early seral from within Riparian Reserves, unless natural disturbances overrule us.

Compare current and projected protection of unique and rare habitats.

In this watershed, many of these habitats fall into Riparian Reserves and are thus protected. Those in the Matrix have buffers, and the movement toward a perforated pattern will provide more wind protection than the present fragmented pattern.

Compare current and projected protection for habitats of TES species, C3 species, and species of local concern.

Most of the TES species and C3 species are reliant on late seral, aquatic and riparian, or special habitats of one type or another. The single wildlife exception to this is the wolverine. Wolverines may be declining because of the gradual encroachment of humans upon their traditional habitats. Human presence will probably increase. Under the landscape design recommended for this watershed, all of the riparian and special habitats should be protected sufficiently. Late seral habitat is projected to be present in roughly the same quantity; however it will be distributed differently and much of the late seral habitat present will be derived from managed second growth stands. If it is true that second growth forests can be managed in a way to emulate the primary conditions found in old growth forests (advanced structural development, deep shade, soil microbiota and fungal associations present), then late seral associated species should be sustained in this watershed over time as second growth forests mature.

Species of local interest include game species and other declining species not reliant on late seral, riparian, or special habitats. We do not anticipate that populations of elk and deer will disappear, however, they will probably decline. Other declining species include some early seral associated neotropical migratory birds. They may continue to decline partly because of the reduction in early seral habitat and partly due to factors outside our influence.

Compare current, historic, and projected future behavior of key ecological disturbance processes.

The key natural disturbance processes in this watershed have been fire, wind, insects, and earthflows. Our projection is for fire disturbance to increase on the higher ridges of the wilderness (prescribed natural fire), resulting in more open conditions above 4000 ft elevations. Elsewhere fire would continue to be suppressed. Windthrow will diminish to levels closer to, but still higher than, historic as the early seral stands mature and the perforated pattern takes shape. Slope instability and accelerated erosion caused by past timber harvest and road building is expected to diminish over time as problem roads are removed, and root strength increased in unstable areas. However, we suspect that these will remain somewhat above background levels due to continuation of many roads and timber harvest at a reduced rate.

Compare current, historic, and projected stream temperatures, LWD, and other stream attributes.

As early seral stands move into mid seral, shading will increase and stream temperatures moderate somewhat. Natural production of LWD will not increase in the 50-year period however, since mid seral stands cannot provide this attribute. Siltation should diminish as problem roads are removed and root strength increases. As recreation use increases along streams, some additional localized loss of riparian vegetation is expected to continue.

We have added two questions relating to human use of the watershed.

How will scenic character and "experiential values" change over time?

Reduction of road density will lessen opportunities for dispersed recreation access, such as hunting, camping, and product gathering. However, semi-primitive opportunities will increase with less roads. Scenic quality will improve significantly as the LSR and riparian areas recover. The perforated pattern should meet forest plan objectives for scenic quality of modification in the Matrix areas. Overall, the public will have a more primitive, "wilder" landscape, but one with more people in it.

How will "special places" change?

We did not do much analysis on all the special areas in the watershed. Our answer will focus on four areas of concern; Rhododendron Ridge, the mainstems of the Collawash and Hot Springs, Bagby Hot Springs, and Bull of the Woods.

Rho Ridge: This area will improve significantly as cutover areas recover, some roads are removed, the Urban Link trail is opened, and smaller scale vegetation management initiated. We expect that it will become a popular use area within the larger context of the Clackamas basin.

Mainstem rivers: Increased use may diminish the recreation and aesthetic experience in these areas over time. The Forest Service lacks adequate funds or a workable strategy for dispersed, riverside related uses at this time.

Bagby Hot Springs: We expect that Bagby will retain its semi-primitive, historic character, but it will likely be a fee site under concession management. Thus it will feel more "managed" and less "free" than now. Some traditional users will not be happy about this, but in 50 years there will be a lot of turnover in users, and we can assume the next generation will adapt their expectations to this change.

Bull of the Woods: The gradual growth in recreation use is expected to continue over the next several decades, as the population of Oregon and the Portland area grows. Most wilderness areas regionally appear to be moving toward a permit system that could limit users at one time, thus dispersing use seasonally and into weekdays. Implementation of a prescribed fire policy on the higher ridges would improve aesthetic conditions by opening views. Also, the view from the wilderness out to the surrounding landscape (LSR and Matrix) will improve over time as the forest matures and a more perforated pattern of harvest develops.

ACCESS AND TRAVEL MANAGEMENT PLAN

DESCRIPTION

Access and Travel Management (ATM) objectives were determined by identifying access needs for various Forest Management activities. Objectives of the ATM help focus priorities for maintenance and funding and identify restoration opportunities. Objectives were based on access needs of primary resource areas like fire, public, timber, recreation, and other special interests such as BPA (see Map 29). Roads identified to stay on the Forest Road System are listed (Table 11) along with the resource areas that requested them for access.

The number and kind of resource areas that need access to particular sections of the same road are variable. For example, access to a certain road may be needed by three or more resources for the first half of its length, while access to the second half of its length may be needed by only one resource area.

Roads identified to stay on the Forest Road System are not necessarily recommended for year around access. Restricted access and use is currently imposed on certain roads, primarily by gates or berms. Additional restrictions may be identified at the project level and are not recommended here.

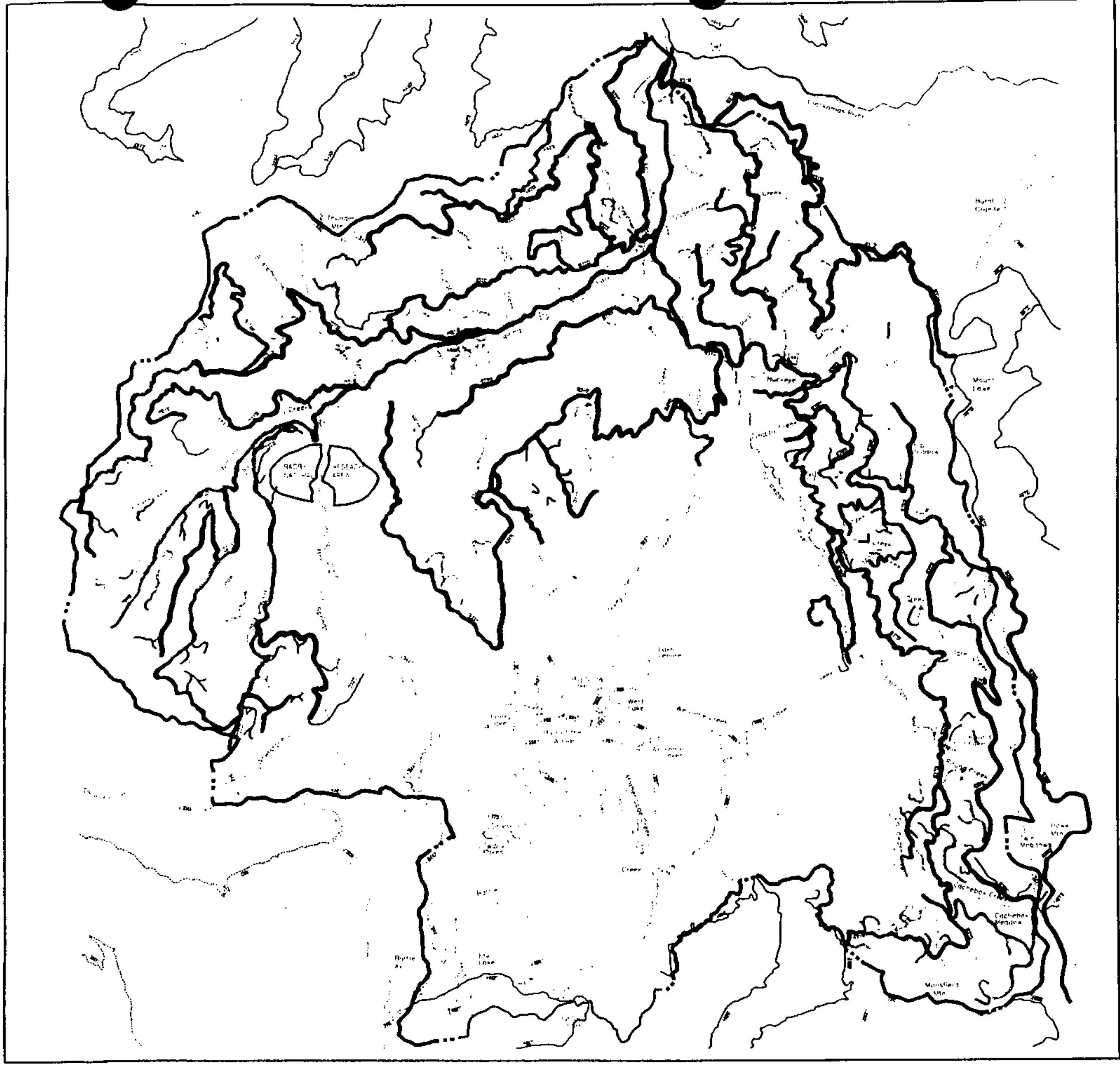
Roads that are not identified as being needed for access objectives become opportunities for restoration and potential road decommissioning. A listing of roads identified and prioritized for decommissioning can be found in the section addressing restoration opportunities. Roads not needed for access but not classified as restoration priorities become "gray area" roads; their fate will need to be considered at the project level.

INFORMATION GENERATION

A representative from each primary resource area identified all the roads needed for their access.

- *Fire*
- *Recreation*
- *Timber*
- *Stewards*
- *Other* (ex. BPA)

For more information contact the stewards or the district road manager on the Estacada Ranger District.



Collawash Watershed
Road Access and Travel Management

Mainline Roads

3 Resources Need Access

2 Resources Need Access

1 Resource Needs Access

Roads That Have Been Obliterat

Roads Proposed for Decommissi
(Restoration Priority)

No Access Identified, Closure Potential to be Decided at the Project Level

SCALE 1:126720

1000 0 1000 2000 3000 4000 5000

METERS

	Road Number	Section of Road
Mainline Access Roads	63	entire length
	6350	entire length
	70	to Bagby Hot Springs
Three Resource Areas Need the Road	4620	jct. 6322 to Thunder trailhead (TH)
	6310	entire length
	6320	to jct. 6322
	6322	entire length
	6340	to Bull of the Woods TH
	6341	to Pansy Creek TH
	7010	to Skin Creek (BPA access)
Two Resource Areas Need the Road	4620	6322 jct. to 025 spur
	6300-170	to Peat Creek
	6320	6322 jct. to Dutch Creek
	6330	to 180 spur
	6340-140	entire length
	6341	from Pansy TH to 019 spur
	6355-150	entire tie-in w/6370
	6370	from Ogre Creek to end
	6370-220	to 150 spur
	70	from Bagby Hot Springs to jct. 7040
	7010	from Skin Creek to forest boundary
	7020	entire length
	7030	entire length
	7040	70 jct. to 140 spur
Keep Road on System for Long-Term Timber Needs	4620	from 025 spur to watershed boundary
	6311	entire length
	6320	from Dutch Creek to 170 spur
	6320-170	entire length
	6321	6320 jct. to 150 spur
	6322-120	entire length
	6330	from 180 spur to 017 spur
	6340-280	to 0.5 mi. past Farm Creek
	6341	from 019 spur to end
	6350-160	entire length
	6355	to 150 spur
	6360	to Happy pit
	6370-170	to 019 spur
	7010	from forest boundary to 270 spur
	7010-160	to 200 spur
	7015	to 0.5 mi. past Circle Creek
	7020-170	entire length
	7020-180	entire length
	7021	to Whetstone Creek
	7030-120	to old 133 spur
Keep Roads on System for Short-Term Timber Needs	6300-170	Peat Creek to end
	6300-185	entire length
	6300-190	entire length
	6311-140	entire length
	6311-160	entire length
	6311-170	entire length
	6350-160	entire length
	6350-180	entire length
	6350-210	entire length
	6350-240	entire length
	6370-218	entire length
	6380	entire length
	6380-130	entire length

Table 9. Roads to Keep in the System

RESTORATION PROJECTS

Restoration goals are based on the key issues discussed in the introduction. To prioritize restoration funds, areas should be selected based on the factors outlined in Table 12. Project types are examples and the list is not meant to be exhaustive.

SPECIFIC RESTORATION OPPORTUNITIES

• Fan Creek side channel is a naturally occurring side channel at the mouth of this creek. It is one of the few areas where young coho have been observed. A better connection with Fan Creek is needed as well as additional large wood. A large dispersed recreation site immediately upslope needs evaluation.

• Elk Lake (administered by Willamette N.F.) has heavy impacts from dispersed recreation. This remote, sensitive, aquatic habitat needs more attention.

• Accelerate development of late seral habitat within Riparian Reserves where previous harvesting has created uniform plantations of trees.

• Potential use of Elk Lake as a recovery and reintroduction area for bull trout.

Table 12 Restoration Projects

Goals	Factors to Consider in Area Prioritization	Project Types
Sediment reduction and hydrologic recovery	- Subwatersheds currently with low ARP - Subbasins with high unpaved road density and/or stream crossings - Areas of high road density on active earthflows - Hot spots in LSR	- Obliterate roads. Recontour where funds available and benefits are high. Rip, seed and mulch elsewhere. - Promote growth of plantations and natural second growth in subwatersheds with low ARP.
Restore stand structure in Riparian Reserves and LSRs	- Subwatersheds with Riparian Reserves >30% early seral - Areas near key rearing or spawning areas; areas within owl territories of concern	- Retain, recruit and import down coarse woody debris. - Thin and underplant.
Improve aquatic habitats	- Streams with high percentage of early seral in Riparian Reserve - Create snags and place nest structures - Streams with high number of road crossings - Streams below potential for CWD/pools	- Plant hardwoods and cedars in riparian areas. - Reintroduce beaver to overgrown meadows and streams with suitable habitat. - Obliterate roads. - Place instream structures. - Restore CWD. - Remove culverts that block access to historical fish spawning and rearing areas. - Implement projects to restore and mitigate dispersed recreation areas that lie within Riparian Reserves and conflict with Aquatic Conservation Strategy. - Concentrate on removing and restoring unneeded roads that lie within Riparian Reserves and cross unstable, high risk, sediment producing areas.
Maintain and restore ecological function in Matrix	- Plantations within primary connectivity pathways - Breeding and foraging areas for TES species	- Replicate natural diversity in plant species and structure. - Maintain / create edge snags to mitigate lack of snag habitat in plantations. - Reduce human disturbance near critical TES areas. - Eliminate exotic and weed species.

ROAD RESTORATION (Decommissioning) OPPORTUNITIES

DESCRIPTION

This is a listing of roads identified as priorities for decommissioning. These roads were not needed for access by the primary resource areas of fire, recreation, and timber. This listing does not include all roads NOT needed for access reasons.

Roads are grouped by priorities based on ROD land allocations, subwatershed conditions, previous planning efforts, and proximity to each other.

- Road decommissioning that could be funded by in-progress planning efforts (KV) is considered to have the highest degree of priority.
- Roads covered under previously written and signed NEPA documents (CE's).
- Roads with special habitat or wildlife concerns.
- Roads in the LSR allocation where KV funding may not be readily available. Roads are further prioritized by subwatershed condition and proximity to each other.
- Roads in other subwatersheds outside the LSR are prioritized by subwatershed condition and grouped by proximity to each other.

Decommissioning all the roads recommended for closure could take many years. It is unlikely

Table 13
Roads Recommended for Decommissioning (Grouped in order of priority)

<u>Key to abbreviations</u>:

ls - on unstable slopes	er - on very erosive soils
rr - in Riparian Reserve	wl - in critical habitat/ connectivity
ss - on steep slopes	rm - high road maint., chronic problem
hs - easy & cheap to close	pp - was previously planned for closure
nd - covered by signed NEPA doc.	lsr - in late successional reserve

* If nothing listed under Section of Road, entire length is indicated

	Road Number	Section of Road	Reasons
Potentially KV funded by an ongoing planning effort (South End Salvage)	6340-170	220 spur to end	ls hs lsr pp
	6340-250		rr wl hs pp
	7010-215		nd pp ls
	7010-240	last 0.5 mi	nd pp ls
	7010-270		ls rr pp
Roads to be decommissioned under previously signed NEPA documents	7010-160	last 0.5 mi.	pp nd
	7010-180, 190, 200, 210		pp nd
	7020-136, 137, 140, 150, 160		pp nd lsr
	7030-130		pp nd partly complete
	7040-130		pp nd ls partly complete
Other Roads in LSR's, prioritized by subwatershed condition and grouped by proximity to each other			
Fan Creek, Lower Hot Springs Fork, and Lower Collawash Tributaries	6310-013		ls er hs lsr
	6310-014, 015, 016		hs ls lsr
	6310-035		ss ls lsr
	6310-120		ls er hs lsr
	6310-162		ls er lsr
	6310-245, 246		ss ls lsr
	6320-012		rr hs lsr
	6320-014		hs er lsr
	6330-011		hs ls lsr
	6330-150		rr ls hs lsr
	6330-190		rr ls lsr
Upper Collawash, Buckeye, Happy, Farm, and Dickey Creeks	6300-016, 173, 175, 176, 180, 183		hs ls er lsr
	6340-030		rr wl
	6340-130		rr ls lsr
	6350-142		ss er pp psr
	6350-170	crossing to end	rr pp lsr
	6350-220, 223		rr hs pp lsr
	6350-250	254 spur to end	hs pp lsr
	6360-150		rr ls lsr
	6370-030		pp hs lsr
	6380-120		rr rm lsr
	6380-125		rr hs lsr

East Fork Collawash	6355-019, 130, 140		pp rr lsr
	6370-019		rr pp lsr
	6370-031, 127, 145, 147		pp hs lsr
	6370-150	last 0.5 mi.	pp hs lsr
	6370-170, 190, 200, 210, 215, 230, 253, 254, 256, 300		pp hs lsr
Hugh and Whetstone Creeks	7020-024		rr ls
	7020-130		ss rr lsr
Other Roads NOT in LSR's, prioritized by subwatershed condition and grouped by proximity to each other			
Tributaries North of Lower Hot Springs Fork			
Lower Hot Springs Fork and Lower Collawash Tributaries	6320-015		ls rr
	6320-020		er hs
	6320-021		rr hs
	6320-133		ss rr
	6320-156		ls er hs
	6320-165	past powerline	ls er hs
	6320-166		ls rr
	6321-011		rr hs
	6321-016		rr ls
	6321-120	last 0.5 mi	rr ls
	6322-160		ss ls rr
	6322-170		rr ss
	6322-180		ss rr
Lower Hot Springs Fork Tributaries	4620	jct. of 360 spur to end	ss ls rr
	4620-330		ss ls
	7010-012	past powerlines	ls hs
	7010-014		rr ss
	7010-016		hs rm
	7010-017		ss ls
	7010-127		wl hs
	7010-130		ss rr hs
	7010-134		ss rr
	7010-140		rr er
Tributaries South of Lower Hot Springs Fork			
Lower Hot Springs Fork and Lower Collawash Tributaries	6330	last 0.5 mi.	rr rm
	6330-014		ls hs
	6330-015, 017		ls rr
	6330-120	last 0.25 mi.	rr ls
	6330-210		ls er hs
	6330-220		ls rr er
	6340-025		wl rr
	6341-022, 023		ss ls
	6341-130		ss ls er
	6341-150		ss ls rr
Upper Nohorn	7040	140 spur to end	rr hs

that all roads listed will be decommissioned. Within a grouping, additional project level prioritizing of individual roads to be decommissioned will need to occur to best meet restoration objectives.

Many roads identified as restoration opportunities are small (approx. 0.25 mi. long) spur type roads; often they impose small impacts. However, some larger roads recommended for closure are chronic impact sites in the drainage. Individual road decommissioning prescriptions should be decided at the project level.

Table 13 lists the roads recommended for decommissioning (rationale for recommending decommissioning is listed with each road; rational descriptions are abbreviated above in a key).

INFORMATION GENERATION

Roads that were not identified for access needs became potential candidates for decommissioning. A rating process was used to decide the priority status of candidate roads. To be classified as priority, a road had to meet at least two of the following criteria:

Be constructed in or on:
- unstable slopes
- very erosive soils
- steep slopes
- Riparian Reserve

- late successional reserve
- critical habitat/connectivity

Or be:

- a chronic road maintenance problem
- easy and cheap to close
- a previously planned closure
- listed for decommissioning in an existing signed NEPA document

Roads not defined as decommissioning priority became "gray area" roads, their fate will need to be considered at the project level. They are all of the roads not found in either of the ATM or Restoration listings.

The long list of roads identified for decommissioning was evaluated further to decide where road restoration efforts should be focused. An assessment was employed to ascertain which subwatersheds have the greatest need for road related restoration. Based on certain criteria, the assessment rated each subwatershed as to it's relative existing condition. The following criteria were used to compare relative conditions within each subwatershed:

- *Aggregate Recovery Percentage (ARP)*
- *Road density (mi/sq mi)*
- *Road density in rip. rsrv. (mi/subws ac)*
- *Miles of road on unstable slopes*

The assessment ranked road restoration needs by subwatersheds. To maximize logistical efficiency, the list was further refined by grouping roads within proximity of each other. For example: Two roads may be in different subwatersheds but on the same road system, thus it was logical to group the roads together to reduce contract costs. For more information contact the soil scientist at the Estacada Ranger District or at the Clackamas Ranger District.

DATA GAPS AND MONITORING

DATA GAPS

• What were the effects of past floods and stand replacement fires on historic sediment production?

• What was the nature of vegetation and the landscape at the beginning of mass settlement (1845)? How can fire history/stand/vegetation structure information be refined in a statistically reliable way?

• What is the quantifiable difference between existing sediment production and delivery, and natural or background sediment production and delivery?

• What is the difference between existing stream temperature ranges and natural/background ranges?

• What is the current snag abundance and distribution both in Riparian Reserves and in upland areas?

• Are mid seral stands functioning as dispersal corridors for late seral associated species? Which species? What habitat components are present in these stands?

• Are wolverine inhabiting the Bull of the Woods wilderness?

• Is there a herd of elk occupying the benchy area of Buckeye and Happy Creeks? What is the herd size and movement patterns?

• What is the status of deer in the watershed?

• What rate of incidental take within this watershed will not jeopardize the spotted owl population?

• Where are juvenile spotted owls dispersing to? What habitat are they dispersing through?

• Are any "Survey and Manage" species present in the watershed?

• Is the watershed supporting more peregrine falcons than we know of?

• What are the effects of cutover habitat surrounding meadows, ponds, and other wetlands?

• What do amphibian surveys in streams show regarding distribution relative to stream gradient, water temperature, shade, sediment, and fish presence?

MONITORING

• Monitor soil condition to evaluate the effects of newer vegetation manipulation prescriptions as related to landscape structure and design strategy.

• Monitor slope stability. Considering the geology in this watershed, monitoring the effects of landscape structure and design strategy are paramount.

• Monitor long term temperature trends within watershed main stems and tributaries. Highly impacted streams like Fan Creek need to be monitored as soon as possible since they may make good indicators of recovery of watersheds.

• At long term intervals repeat Estacada Ranger District's monitoring of water quality, habitat quality, and channel attributes within the Collawash watershed. Intervals of monitoring at established transects should be every five to ten years or after major five year flow events such as floods.

• Develop fish production capability estimates and watershed specific limiting factors for anadromous stocks.

• Determine, if possible, reasons for changes in resident fish populations today, from historic and anecdotal accounts of past conditions.

• Monitor use and effectiveness of Fan Creek side channel for coho salmon rearing and use by other fish species.

- Are aquatic and riparian dependent species successfully dispersing between isolated ponds and wetlands? Monitor what pathways they are using.

- Are amphibian populations in the watershed stable, increasing, or decreasing?

- Are beaver reinvading old meadow and overgrown riparian habitats?

- Conduct surveys in the Elk Lake area to see if it supports sandhill cranes.

- Monitor population levels of late seral associates, especially those identified as having low to moderate chances of viability in Appendix J-2 of the FSEIS.

- Monitor how the implementation of the recommended timber harvest pattern affects populations of wide ranging late seral associated species.

- Determine whether mid seral areas are functioning as dispersal areas.

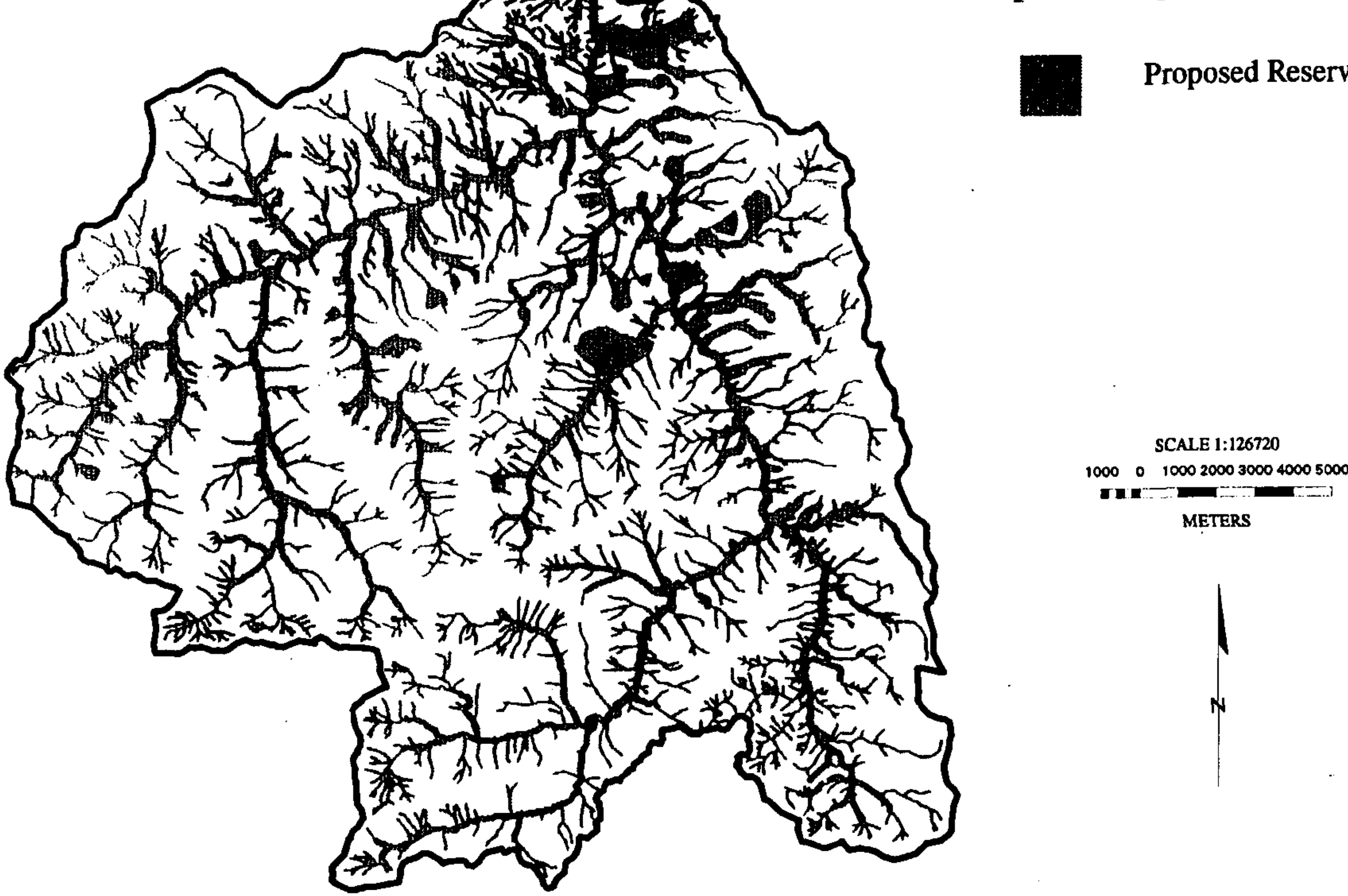
- Monitor down log retention, post harvest, post fuels treatment, and post firewood collection.

- Determine whether the management strategy that has been devised for the occupied peregrine site will work. Will peregrines continue to breed in the area?

- Monitor the presence of the brown headed cowbird.

- Monitor to what extent snags retained on the edges of old plantations expand the use of the plantation by cavity nesters.

Collawash Watershed
Proposed Riparian Reserves



GLOSSARY

• ***Connectivity:*** The spatial contiguity within the landscape. It is a measure of how easy or difficult it is for organisms to move through the landscape without crossing habitat barriers. (Diaz and Apostol, 1992.)

• ***Flows:*** Movement of materials, energy and organisms through the landscape. (Diaz and Apostol, 1992.)

• ***Matrix:*** Landscape ecology definition as opposed to the Northwest Forest Plan Matrix allocation (see Land Allocation section, Part I). The most connected portion of the landscape, the vegetation type that is most contiguous. In Pacific Northwest forests the matrix is usually mature forest. This becomes increasingly less true as forests become fragmented by clearcutting. (Diaz and Apostol, 1992.)

• ***Patch:*** An area of relatively homogenous vegetation (with respect to species composition, successional stage, etc.) and that differs from what surrounds it. For example, in a forested landscape clearcuts, wetlands, and rock outcrops are common patch types within the forested matrix. (Diaz and Apostol, 1992.)

• ***Take:*** As defined under the Endangered Species Act, "to harm, hurt, harass, pursue, kill," etc. Habitat loss around known owl centers is currently interpreted as take if the remaining habitat available totals less than 1182 acres within a 1.2 mile radius, or, less than 70 acres around the activity center. (USFWS, Biological Opinion, 1992.)

• ***Ecoregion Reference Value:*** Mean derived from a 1984 EPA study which examined minimally impacted streams in 8 Oregon ecoregions. The study examined 12 minimally impacted streams in this ecoregion, the Western Cascades Ecoregion. (Estacada Ranger District, 1991.)

• ***Flashy Streams:*** Streams whose hydrographs (a graph of stream discharge over time) are typically narrow and steeply peaked and which rise and fall rapidly. In contrast, "sluggish" streams are those which have wide, rounded hydrographs, with runoff spread over a longer time. The relative flashiness of a stream is dependent on several factors including slope and channel gradients, infiltration capacity of soils, groundwater storage, orientation of drainage basin in relation to prevailing storm movements, and channel detention storage characteristics. Steeper narrow channels, an absence of detention storage, soils with low infiltration rates, and basins oriented so that prevailing storms move across from higher elevations to lower elevations, all contribute to a more flashy streamflow. (Larry Bryant, forest hydrologist.)

PART V
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