United States
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Forest Service

**Pacific
Northwest
Region**

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UPPER WHITE SALMON

WATERSHED ANALYSIS

MT. ADAMS RANGER DISTRICT
GIFFORD PINCHOT NATIONAL FOREST

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Cover Photo: Mt. Adams, the highest point in the watershed at 12,276 feet elevation, as viewed from Lookingglass Lake, the only fish bearing lake in the watershed. Photo by Betsy Scott.

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SUBWATERSHED	Thresholds	C	D	E	F	G	H	I	J	K	M	Y	Z	ALL	ALL (FS Only)	
NAME		Upper Whi	Headwater	Cascade C	Wicky Cr /	Gotchen C	King Mtn	Lower Whi	Buck Cr	Green Car	Ninefoot C	No Name (	Middles W	UWSR		
Total Area																
Federal (FS) Area																
EROSION (FS only)																
Active Failures Acres			2							49			1365		1416	
Potentially Unstable Soils Acres				38											38	
Severe Erosion Potential				38											38	
Road Generated Sediment (tons/sq mile/yr)		22	11	1	17	23	26	34	15	37	22	32	29		20	
VEGETATION																
Non-Forest Acres		133	210	4191	2331	1837	107	418	56	53	71	2	13	9422		
Early-Sucessional Forest Acres	<6%, >52%	741	640	1599	504	910	2352	598	684	493	399	152	339	9411		
Mid-Successional Forest Acres	<6%, >80%	703	1856	3232	2880	6209	4805	1328	1952	1304	248	281	745	25543		
Late-Successional Forest Acres	<15%, >90%	2537	2263	716	1077	3788	3808	1666	1973	1030	999	557	1727	22141		
Old-Growth Forest Acres																
PSQ Regen Acres (FS)		107	66	24	0	83	118	44	178	116	71	0	85		892	
Regen Acres Cut Since 1994 (FS)		42	38	33	0	61	153	0	249	0	26	0	65		667	
Remaining PSQ Regen Acres		65	28	0	0	22	0	44	0	116	45	0	20		225-330	
WILDLIFE																
Interior Habitat																
Interior Late-Successional																
Fragmentation (ranking)																
Spotted Owls w/in 1.8 mi																
Owls in Take Condition	Any															
Owls in Gotchen LSR																
Open Road Density	>2.0															

HYDROLOGY																
Aggregate Recovery % (ARP)	<75%	76	91	98	99	94	70	80	77	79	71	79	75	85		
Rain-on-Snow %		33	0	9	7	36	48	92	26	95	13	90	95	36		
Road Density	>3.0	3.7	1.4	0.2	0.9	2.1	3.5	4	2.3	4.4	3.6	4.4	3.1	2.3		
Drainage Density Increase		67%	24%	3%	13%	45%	90%	77%	61%	91%	61%	84%	67%	46%		
DNR 2-Year Peak Flow	>10%	2%	2%	na	na	2%	6%	5%	2%	4%	2%	6%	4%			
Peak Flow Risk	High	H	L	L	L	L	H	M	M	H	M	H	H	L		
STREAM CHANNELS																
Rosgen Type A		0.9	8.5	1.2	9.2	25.0	28.5	6.2	9.5	3.4	5.1	2.0	1.9	101.4		
Rosgen Type AA		10.9	14.3	39.7	29.0	20.6	9.5	6.8	4.5	4.2	3.9	2.4	4.5	150.5		
Rosgen Type B		2.3	1.7	3.9	5.9	5.1		0.9	1.6	3.9	0.1	0.2	4.9	30.3		
Rogen Type C, E, F, or G		6.4		1.4				3.7		1.0			0.3	13.7		
Riparian Early-Successional	<5%, >30%	7	3	20	9	7	17	13	13	21	23	12	4	12		
Riparian Late-Successional	<23%, >92%	72	55	10	26	30	31	23	47	36	63	57	84	38		
WATER QUALITY																
Temperature (Grab Sample)	≥16.0															
Coliform (Peterson CG)	Any															
Sediment (Rd & Stream Xings)		40	16	2	13	57	44	10	19	32	9	13	9	264		
FISHERIES																
Fish Bearing Streams		Yes	Yes	Yes	Yes			Yes		Yes	Yes		yes			
Pools per mile	<7.7	2.2	2.2	no data	13			no data		41.0	8.8		no data			
Width:Depth	>14.6	6:01	6:01		13.9					7.5	14.3					
LWD/Mile	<4.3	0.1	0.1		6.3					0.2	42.2					
Max Water Temperature (C)	≥16.0	13.5	13.5		6.5					17.5	7.5					
Channel Stabilty Rating	Poor															
HUMAN USES																
Dispersed Campsites																

CHAPTER I - INTRODUCTION

This report documents the 1998 watershed analysis conducted for Upper White Salmon River (UWSR) watershed. This analysis responds to the President's Northwest Forest Plan, which specifies watershed analysis as an integral component of its Aquatic Conservation Strategy. This analysis follows the process described in *Ecosystem Analysis at the Watershed Scale: Federal Guide for Watershed Analysis Version 2.2* (USDA-FS et al. 1995). This is the second iteration of this watershed analysis; the initial watershed analysis was completed in February of 1995. For this second iteration, the analysis includes all lands in the watershed, federal and non-federal, from the summit of Mt. Adams to the White Salmon River's confluence with Trout Lake Creek.

LOCATION AND SETTING

The UWSR Watershed is located in southwestern Washington just east of the Cascade crest. Its headwaters originate from the south side of Mt. Adams. The general drainage pattern is southerly to the town of Trout Lake, WA, and the confluence with Trout Lake Creek. While this is lowest point for this delineation of the UWSR watershed, the White Salmon River flows another 26 miles before depositing into the Bonneville Pool of the Columbia River (see Map A).

CLIMATE

Being just east of the Cascade crest, the watershed lies in the transition zone between the temperate marine climate and a continental climate. Winters are cool and wet. Summers are dry. Mean annual precipitation ranges from 45 to 140 inches per year, depending on elevation, most of which occurs between November and April and is composed of rain and snow.

TOPOGRAPHY

The steep flanks of Mt. Adams become dissected mid-slope. Further down, the land begins to flatten, being very gently sloped to the east and south towards the agricultural fields surrounding Trout Lake. Since the watershed includes the summit of Mt. Adams, the elevation range is vast, from 12,278 feet to 1,950 feet at the Trout Lake Creek confluence.

ECOLOGICAL SCALES

UWSR Watershed covers 66,509 acres or approximately 104 square miles. The entire White Salmon River Watershed is 391 square miles. The next larger ecological unit would be the Hood-Wind Subbasin, as defined by the First Approximation of Ecosystem Health (USDA-FS 1993). The Hood-Wind Subbasin is a collection of watersheds that drain into the Columbia River between The Dalles and Bonneville Dams (see Map C). It includes the Hood, Wind, Little White Salmon, and White Salmon Rivers. The Hood-Wind Subbasin is important in that it is the scale at which the historical range of natural conditions for several resources (e.g. acres of late-successional forest or maximum water temperatures) are analyzed. Going further up in scale, the Hood-Wind Subbasin lies within the Lower Columbia River Basin.

FEDERAL LAND ALLOCATIONS

Most of the UWSR Watershed is situated within the legislated boundary of the Gifford Pinchot National Forest. The lower one-fifth of the watershed (8,620 acres) is a mix of private and Washington Sate lands. Management direction for Forest Service lands is provided by the Gifford Pinchot National Forest Land and Resource Management Plan (LRMP) as amended by the President's Northwest Forest Plan. Per the LRMP, the Upper White Salmon River Watershed includes both Key and Non-Key watershed designations (see Map D). The dominant land allocations are Wilderness, Late-Successional Reserve, Wild and Scenic River, and General Forest.

CHAPTER II - CHARACTERIZATION

This chapter identifies the dominant physical, biological, and human processes or features of the watershed that affect ecosystem function and conditions. Location of the watershed, ownership pattern, and major land allocations are presented on Maps A, B and E.

GEOLOGIC AND PHYSICAL PROCESSES

- The topography of the western half of the watershed, designated Key, is much more dissected than the eastern half, designated non-key. This division is reflected in many of the subsequent ecological processes discussed in this analysis.

- Volcanic, glacial, and debris torrents have contributed to the topography and stream channel morphology.

- Mass wasting is a factor in the western half of the watershed. On the eastern half, slopes are much more gentle and stable

VEGETATION

- Vegetative conditions reflect a west to east transition from mesic Pacific silver fir forest ecotypes to drier grand fir forest ecotypes. A transition also occurs moving up the slopes of Mt. Adams, changing into the cold mountain hemlock ecotype, to even colder subalpine fir ecotypes, and then into alpine communities. The fire history includes several large burns in the 1800's. Old-growth forest comprises the middle part of watershed on federal land.

- The watershed lies within a known lightning track from Flattop Mountain north to Eckart Butte and to Mt. Adams..

- Historical conditions (1800's) suggest more ponderosa pine and more open conditions in the east half of the watershed perhaps due to frequent underburns.

TERRESTRIAL WILDLIFE

- The communities and special niches of this watershed include late-successional conifer forest, basalt lava flows (Aiken Lava Bed), wetlands, upland meadows, and snag habitat.

- Distinct wildlife communities are present, though there is some overlap in habitat used by wildlife.

- The Gotchen Late-Successional Reserve occupies 23% of the watershed. This area is intended as a source area for late-successional and old-growth forest dependent species in the larger landscape.

- The threatened northern spotted owl occurs in this watershed as do wintering bald eagle. It is also within the historical range of grizzly bear, gray wolf, and northern lynx.

HYDROLOGY

- Annual maximum peak flows currently occur in response to rain-on-snow events (similar to surrounding watersheds).

- Several intermittent streams change rapidly from little to no flow to high flow following individual storms and during high rainfall/snowfall periods.

- Glacial melt sustains relatively high summer and spring flows in Cascade Creek, Wicky Creek, Morrison Creek, and the mainstem White Salmon River.

- The non-key portion of the watershed is comprised of streams that are completely dry throughout much of the year and have no surface water discharge to the White Salmon River. Hole-in-the-Ground Creek and Gotchen Creek go subterranean where they enter agricultural fields surrounding the town of Trout Lake.

- The lower watershed includes a number of irrigation ditches, which divert water into the neighboring Trout Lake Creek and Cave-Bear Creeks watershed.

STREAM CHANNELS

- Stream channels reach types in the mainstem White Salmon River and it's tributaries are mainly transport reaches rather than depositional.

- Channels in the east part of the watershed (e.g. Hole-in-the Ground Creek, Gotchen Creek) tend to go subterranean as they drop in elevation and gradient.

- There are four known water diversions/ditches. In some cases these ditches divert water into adjoining watersheds.

WATER QUALITY

- Water quality is important in the watershed for fisheries, domestic use, and for flow in the White Salmon River. The middle reach of the White Salmon River (from Gilmer Creek near BZ Corners to Northwestern Lake) has been designated "Recreational" per the Wild and Scenic River Act. The upper reach that is within this analysis area is proposed "Wild" and "Scenic".

- Primary water quality parameters of concern in the watershed include fecal coliform, sediment or turbidity, and water temperature. .

- Glacier Springs, located near the White Salmon River below the Forest Boundary, provides domestic water for the town of Trout Lake.

- Effects of surface water on the quality of ground water or water discharge to the White Salmon River has not been established.

FISHERIES

- There are no anadromous or federally listed threatened or endangered fish species present; although, habitat for bull trout is present. Rainbow and brook trout inhabit the White Salmon River, and rainbow trout are found on many of the major tributaries.

HUMAN USES

- The full range of forest recreation occurs in this watershed. This includes cross country skiing and snowmobiles in the winter. A portion of the Mt. Adams Wilderness area covers 28% of the watershed.

- Agricultural activities occur in the lower watershed in the community of Trout Lake..

- Grazing occurs both on Forest Service land (Mt. Adams Cattle and Horse Allotment) and off-Forest in the King Mountain Coordinated Resource Management Plan.

- The entire watershed is land ceded by the Yakama Indian Nation and federal land is subject the Yakama Indian Treaty of 1855.

- The Yakama Indian Nation and other tribes have used the watershed both historically and currently. Mt. Adams itself is considered a sacred site to the Yakama Nation. Huckleberry and other native plant gatherings occur in the watershed.

- Stream channel manipulation and irrigation ditch construction began with the early settlers of Trout Lake and Glenwood.

- The lower watershed (town of Trout Lake) was logged in the 1800's using splash dams on the White Salmon River.

- Timber harvesting today occurs on federal, state, and private lands.

ISSUES AND KEY QUESTIONS

GEOLOGIC AND PHYSICAL PROCESSES

ISSUE: Erosion Processes

Landslides and debris flow can add substantial amounts of sediment and large woody debris to stream systems. These events can be significant though infrequent. These processes are perhaps more important in the steeper western half of the watershed than in the eastern half with its gentle slopes and stable soils.

KEY QUESTIONS:

1. Where are the potential or active mass wasting sites in the watershed?
2. Where are the potential mass wasting sites that are likely to be accentuated by management actions?
3. In what part of the watershed is surface soil erosion likely to occur and get into steams?
4. What is the natural rate of sediment production?
5. Which surface soils are subject to increased erosion from management actions (e.g. roads, timber harvest, grazing, recreation, and fire) and to what extent has soil compaction and displacement increased erosion and sedimentation?
6. What is the road erosion potential?
7. What stream crossings (roads) are at risk for culvert failure?

VEGETATION

ISSUE: Disturbance (Fire and Insects)

Either through human or natural ignitions, fire has been one of the major sources of disturbance in the watershed. The occurrence intervals for natural large fires range between 125 and 500 years. Due to lightning, total fire occurrence is relatively high, but large fires resulting from these ignitions have been infrequent. Increased human settlement and fire suppression efforts over the past half century may have changed the historical pattern of fire on the landscape. Fire suppression may have also changed the species composition and tree density. This in turn may have effected the current health of the forest.

KEY QUESTIONS:

1. How has the natural role of fire within the watershed changed?
2. How has the current spruce budworm outbreak affected forest health and fire risk?
3. What is the current risk of a large fire occurring within the watershed and where is the highest risk?
4. Where can we benefit from managed fires, either prescribed or natural ignitions?
5. What social and political concerns, including the protection of property and life, will affect fire protection, fire use and fuel treatment programs? Are there feasible measures to deal with these concerns while achieving overall resource concerns in the watershed?

ISSUE: Vegetation Structure and Composition

Historical vegetative structure and composition reflected fire disturbance on a large scale and numerous disturbance agents (fire, wind, disease, insects) on a small scale. The patch size of distinguishable stands was large, covering hundreds to thousands of acres. Within the past 60 years, timber harvest activities have increased the amount and distribution of single layer stands. These younger stands are distributed in small patches across the landscape. Widespread selective cutting of ponderosa pine has also affected the composition of stands that remain late-successional.

KEY QUESTIONS:

1. What was the historical vegetative structure and composition?
2. How do current conditions compare with the past conditions?
3. How much of the watershed is old-growth?
4. What are the implications for future conditions?

ISSUE: Gotchen Late-Successional Reserve

An analysis of the Gotchen LSR is contained within the Gifford Pinchot National Forest Late-Successional Reserve Assessment (1998).

KEY QUESTION:

1. To what extent do the objectives of the Gotchen LSR mesh with aquatic and terrestrial condition and issues for the watershed?

ISSUE: Plants of Concern

There are many special habitats in the watershed and numerous plant species of concern.

KEY QUESTIONS:

1. What special habitats occur in the watershed?
2. What survey and manage species occur within the watershed?
3. What listed species (federal, state, survey and manage) occur within the watershed?
4. How are habitats and plant populations of concern expected to change over time, especially given forest management within Matrix and the Gotchen LSR?

ISSUE: Noxious Weeds, Non-Native Plant Species

Noxious weeds and non-native plant species occur in the watershed and have the potential to spread.

KEY QUESTIONS:

1. What introduced species are present and where?
2. What has been and what is the potential effect of non-native populations on native flora and fauna and water quality?
3. What has been and what is the potential interactions of non-native plant populations and management actions?

TERRESTRIAL WILDLIFE

ISSUE: Threatened, Endangered, and Sensitive Species

The watershed contains suitable or potentially suitable habitat for threatened, endangered, and sensitive species including the northern spotted owl, bald eagle, peregrine falcon, grizzly bear, gray wolf, and North American lynx which has recently been proposed for listing.

KEY QUESTIONS:

Northern Spotted Owl

1. What are the spotted owl demographics. Where are the activity centers located, and in what management allocation do they occur?
2. What is the distribution of spotted owl habitat across the watershed? What are the habitat levels within the home range of known pairs?
3. What is the condition of the Riparian Reserves and other dispersal corridors. What is the relationship between these corridors and known owl activity centers and between the Late-Successional Reserves?
4. What is the habitat quality, in terms of interior forest, in reserves and critical habitat (CHU-WA 42)?
5. What is the habitat capability overall.
6. Can the movements of spotted owls through the watershed be characterized.

Bald Eagle

7. Are there any known bald eagle nests or winter roosts along the White Salmon River in this watershed?

Peregrine Falcon

8. Are there any suitable cliffs that may serve as nest sites?

Gray Wolf and Grizzly Bear

9. Does any part of the watershed contribute to a portion of a wolf pack’s territory? Are there any potential den or rendezvous sites in the watershed?
10. What is the habitat condition for the prey base (deer and elk)? What is the percent of thermal cover and road density in deer and elk winter range?
11. Relative to human presence, what is the watershed’s open road density?

North American Lynx

12. Are there any lodgepole or subalpine forest, or other lynx habitats, located in the watershed?

ISSUE: Other Wildlife of Interest

The watershed contains suitable or potentially suitable habitat for Larch Mountain and Van Dyke’s salamanders, numerous bats, cavity dependent birds, and the great gray owl. There are also nest sites for the northern goshawk and great blue heron rookeries.

KEY QUESTIONS:

Survey and Manage Species

1. Are there known populations of survey and manage species in the watershed? Where is the likely habitat and are land uses affecting habitat or populations?

Bats

2. Are there hibernacula, roost, or maternity sites in the watershed? What is the distribution of year round, open water which may provide foraging opportunities for bats?

Cavity Excavators

3. What is the abundance and distribution of snags?

Northern Goshawk, Great Blue Heron, and Great Gray Owl

4. Are there any known nest sites for these species? How has occupancy of these sites changed over time? Are there any wetlands or large meadows suitable for great gray owl foraging?

HYDROLOGY

ISSUE: Peak Flows, Low Flows, and Flooding

This issue addresses the potential for accentuating peak flows or low flows from federal lands. This may influence winter and spring flooding in the town of Trout Lake.

KEY QUESTIONS:

1. What factors influence peak flows and low flows in the watershed?
2. Where and to what degree do these factors present?
3. How have these factors changed over time?
4. What is the current risk of increased peak flows?
5. How will future management activities affect peak flows?

STREAM CHANNELS

ISSUE: Stream Channels

Stream channels and their morphology are important to understanding watershed issues relating to peak flows, water quality and fish habitat.

KEY QUESTIONS

1. What types of channels are present in the watershed and where do they occur?
2. What are the factors currently influencing channel conditions?
3. How have these factors changed over time?
4. Where are the sensitive channel reaches?

WATER QUALITY

ISSUE: Water Quality

This issue relates to water quality in streams on the National Forest, water quality in subsurface water in the Trout Lake Valley, and potential water quality effects to the White Salmon River.

KEY QUESTIONS:

1. What are the beneficial uses in the watershed and where do they occur?
2. What are the primary water quality parameters important to maintaining those beneficial uses?
3. What processes affect the key parameters of water quality?
4. What is the current water quality?
5. What are the trends in water quality or in those factors that affect water quality?

FISHERIES

ISSUE: Fish Habitat and Populations

Human disturbances such as riparian area harvest, road construction, and stream diversions have altered fish habitat within the Upper White Salmon River Watershed. These disturbances influence water quality and quantity as well as fish population viability.

KEY QUESTIONS:

1. What are the historical and current conditions for fish habitat in the watershed?
2. How have management activities affected fish habitat?
3. How can future management activities improve the existing habitat?
4. What is the current and historical distribution of fish in the watershed?
5. If Condit Dam is removed in the future, what is the anadromous fish potential in this watershed?

HUMAN USES

ISSUE: Cultural Resources

Native Americans have used the White Salmon River Watershed from thousands of years ago to the present. The entire watershed is land ceded by the Yakama Indian Nation and federal land is subject to the Yakama Indian Treaty of 1855.

KEY QUESTIONS:

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

ISSUE: Dispersed Recreation

Dispersed recreation is highly valued public use of National Forests. However, there are landscape features, such as riparian zones, which are easily impacted by human use.

KEY QUESTIONS:

1. What amount and kinds of dispersed recreation is occurring within the watershed?
2. What areas are resilient to dispersed recreational camping?
3. Are there resources being impacted by this activity?

ISSUE: Grazing within the Mt. Adams Cattle Allotment

The Mt. Adams Horse and Cattle Allotment lies within the watershed. Approximately 516 cow/calf units move north from private land onto the National Forest in the summer. The ten-year term permit was last re-issued in 1995. It may be adjusted through the annual operating plan.

KEY QUESTIONS:

1. How are the assumptions on wetland use and protection faring?
2. Are pipelines and water troughs successful in distributing cattle throughout the eastern end of the allotment?

ISSUE: Timber Harvest from National Forest Lands

Scheduled timber harvest is permitted from matrix lands on the National Forest. However, timber harvest can only be considered in the realm of meeting all other ecosystem needs.

KEY QUESTIONS:

1. What is the Probable Sale Quantity (PSQ) from these matrix lands and what has been harvested since 1994?
2. Are there any resource limitations which would prevent attainment of the PSQ?
3. Are there resources that can be improved through stand management which yields a commercial amount of timber?

CHAPTER IV REFERENCE AND CURRENT CONDITIONS

GEOLOGICAL AND PHYSICAL PROCESSES

REFERENCE CONDITIONS

Volcanism, glaciation and erosion have had the most effect on shaping the landscape in the UWSR Watershed. The asymmetry of Mount Adams suggests a complex volcanic history; coalescing volcanic cones built on a broad shield volcano. Extensive glaciation demonstrates that the volcano has been inactive for as much as 10,000 years, except for small eruptions and venting of steam.

The White Salmon River and Cascade Creek flow though volcanic and glacial deposits which constitute some of the youngest deposits in the area. The watershed includes numerous springs that are located along contact zones and fractures within the younger volcanics. These relatively porous volcanic rocks allow rapid lateral and vertical migration of water. Many of these springs flow into the White Salmon River along the gorge reach (below the analysis watershed), and contribute significantly to the total flow of the river. Within the watershed are a numbe of high discharge springs as well. A series of springs located just south of the Forest Boundary and near the White Salmon River are collectively known as Glacier Springs, and provide the source of domestic water for the town of Trout Lake.

Soils in the analysis area are relatively young and volcanogenic in origin. Aiken Lava Bed flowed from a flank eruption between 3,500 and 10,000 years ago. Smith Butte basalts are of late Pleistocene Age and may include som Holocene flows. Pressure ridges, lava channels, flows and flow edges are well preserved.

Soils in the vicinity of the White Salmon River are older in development. There is a mixture of geologic units in the western portion of the analysis area that is bouldery till and lesser outwash deposits, with a formation that is very similar to the Ohanapecosh Formation, which consists of dacitic to basaltic-adisitic breccia, tuff, volcniclastic siltstone, sandstone, and conglomerate materials. There is a significant amount aeolian tephra material in the soil matrix from numerous local and distant sources. Soils strength is generally weak and prone to mass wasting, if slopes are steep and soils are wet.

A notable event in this watershed occurred about 6000 years ago; a large outburst flood initiated off the southwest flank of Mount Adams. The outburst became a debris flow and reached as far as what is now Husum. This debris flow or Lahar, is partly responsible for the broad flat valley floor which comprises the Trout Lake Valley. The combination of steep slopes and weak rock on Mt. Adams will continue to provide mudflows for thousands of years to come.

CURRENT CONDITIONS

MASS WASTING

A relatively small area within the UWSR Watershed has been mapped as unstable or potentially unstable per the Gifford Pinchot National Forest Soil Inventory The bulk of these areas are on the upper slope of Mt. Adams, where past debris flows have occurred. Debris flows are not major processes over geologic time, however, they may constitute a catastrophic event when they occur. For example, Avalanche Glacier yielded a glacier outburst flood August 31, 1997 extending out to

Cascade and Salt Creeks. Mixed with water and rock, ice tumbled and reached the debris flow deposits of a similar event from 1921; its toe reached part of Round the Mountain Trail.

SURFACE EROSION

A quantitative model for erosion rates from roads produced a normalized rate of sediment movement by watershed (see Table 1). As road condition surveys were lacking, Forest-wide averages averages were used for of the models variables.

Table 1. Normalized Rates of Road Erosion by Subwatershed.

Code	Subwatershed Name	Acres	Road Density (Mi/Sq. Mi)	Normalized Erosion Rate (Tons/Sq.Mi./Yr)
C	Upper White Salmon River	4,115	3.7	22
D	Headwaters White Salmon River	4,970	1.4	11
E	Cascade/Salt Creek	9,737	0.2	2
F	Wicky/Morrison Creek	6,791	0.9	17
G	Gotchen/Hole in the Ground Creek	12,744	2.1	23
H	King Mountain (west)	11,065	3.5	26
I	Lower White Salmon River	4,010	4.0	35
J	Buck Creek	4,663	2.3	15
K	Green Canyon Creek	2,881	4.4	37
M	Ninefoot Creek	1,716	3.6	22
Y	Y (no name)	992	4.4	33
Z	Middle White Salmon River	2,824	3.1	29
	UWSR Watershed	**66,509**	**2.3**	**20**

The model is considered to over predict the rates because this watershed has a relatively drier climate, less dissected drainages, and smaller road cuts (owing to comparatively moderate slopes). With that in mind, movement of sediment in this watershed is low. Thus, erosion from roads is clearly not a dominant process in the watershed.

Hillslope erosion is likely not a dominant process as well. Less than 1% of the watershed has soils that are rated for severe erosion potential. These soils are also mapped as potentially unstable.

VEGETATION

REFERENCE CONDITIONS

ECOLOGICAL ZONES

FOREST ZONES

The watershed is dominated by forested plant communities. The most prevalent potential natural vegetation in the forest ecological zones (also referred to as plant series) are grand fir (47%), Pacific silver fir (17%), subalpine fir (9%), and mountain hemlock (6%) (refer to Gifford Pinchot National Forest plant association handbooks). Other plant series present in minor amounts include Engelmann spruce (2%) and lodgepole pine (4%). This ecological variety is a reflection of the breadth of environmental conditions, particularly temperature and moisture gradients. The climate on the east slopes of the Cascade Range combines features of both maritime and continental regimes. Dominant characteristics are the rain shadow effects of the Cascade crest, elevation-related temperature differences, and very low summer precipitation. Elevations within the watershed range from about 1,950 feet in the Trout Lake Valley to 12,300 feet at the summit of Mt. Adams.

The Grand Fir Zone occurs on the warmest and driest sites in the analysis area and are among the driest plant series on the Gifford Pinchot National Forest. These sites are found on south-facing slopes and at lower elevations within the National Forest boundary. Nearly all of the state and private lands in the watershed are within the Grand Fir Zone. The Grand Fir Zone extends from the eastern Forest boundary to Crofton Ridge, mostly at elevations below 4,500 feet on south-facing slopes. Grand Fir Zone plant associations are also found on the south and west slopes of Haystack Butte.

The upper elevation limit of the Grand Fir Zone occurs where greater moisture and cooler temperatures favor the reproduction of Pacific silver fir to the west (Pacific Silver Fir Zone), and mountain hemlock and subalpine fir to the north. The Pacific Silver Fir Zone is found in the western portion of the watershed where precipitation is more abundant. The eastern flanks of Eckhart Point, upper White Salmon River, and Cascade Creek drainages contain plant communities classified within the Pacific Silver Fir Zone. The Mountain Hemlock and Subalpine Fir Zones occurs typically above about 4,500 feet on the south slopes of Mt. Adams, and along the upper elevations of the ridge line spanning from Sleeping Beauty to Dry Meadows. These zones are characterized by deep snowpacks and short growing seasons. The areas classified as lodgepole pine occur within a high elevation plateau which is a severe frost pocket in the Smith Butte vicinity. The Engelmann spruce plant series occurs at high elevations primarily on sites with a high water table.

NON-FOREST ZONES

The are a number of non-forest ecological zones which cover approximately 15% of the watershed. These include talus slopes and rock outcrops, dry and wet meadows, and alpine plant communities on Mt. Adams above the timberline. Prior to being heavily grazed at the end of the 19th century, these non-forest zones were primarily formed by fire. Because of their relative scarcity and species richness, these features are often considered unique or special habitats. Despite being relatively small in total acreage, non-forest zones are the source for much of the overall biodiversity in the watershed. These features typically are slow to change through succession, and some were maintained by frequent disturbances, as in the case of dry meadows which were maintained by fire. Consequently, the non-forested features found today were likely present in historical times, although in greater abundance.

DISTURBANCE - FIRE

FIRE GROUPS

A report was prepared addressing the role of fire on the Mt. Hood and Gifford Pinchot National Forests titled *Fire Ecology of the Mid-Columbia* by Louisa Evers and others in 1994. Several fire groups are identified in this report. The fire groups are based on ecological plant series that have similar fire histories. There are four fire groups present in this watershed: They are Miscellaneous Special Habitats (Group 0); Dry Grand Fir (Group 3); Cool, Dry Lower Subalpine (Group 5); and Warm, and Moist Western Hemlock and Pacific Silver Fir (Group 8).

Miscellaneous Special Habitats (Group 0)
Rock outcrops, talus, meadows, alder glades, riparian communities, and recent volcanic deposits comprise Group 0. These areas have little fuel present, or very discontinuous fuels. Such areas generally don't carry fire except under extreme conditions.

Dry Grand Fir (Group 3)
This fire group includes the gentle slopes on the lower flanks of Mt. Adams, coinciding with the Grand Fir Ecological Zone. Fires are estimated to have burned about every 25-100 years. Prior to fire exclusion, Group 3 probably experienced a fairly even mix of crown fire (stand replacement) and underburning. Most fires probably included both crown fire and underburning. Fire starts would have burned for weeks to a couple of months. Medium sized fires (10-1,000 acres) may have been more common. Under current stand conditions (following about 85 years of fire suppression), fires would tend toward crown fires. Fires today would either tend to stay small (less than 10 acres) because of aggressive initial suppression, or get large (greater than 1,000 acres) during periods of extreme fire weather conditions.

Cool, Dry Lower Subalpine (Group 5)
This fire group is located at the higher elevations of the watershed on the upper forested slopes of Mt. Adams. Prior to fire suppression, this group probably had a stand replacement fire interval of about 200-270 years. However, during the life of the stand, occasional low to moderate intensity ground fires occurred. These lower intensity fires would create canopy gaps, resulting in stands containing a mosaic of age classes and a variety of conifer species. Native Americans may have ignited some fires at high elevations in order to perpetuate huckleberry gathering areas. In the absence of fire, huckleberry-producing early seral communities are replaced by overtopping forest vegetation resulting in much lower berry production.

Warm, Moist Western Hemlock and Pacific Silver Fir (Group 8)
This fire group occurs throughout the mid to upper elevation slopes in the western portion of the watershed not included under the Grand Fir or Subalpine fire groups. Stand replacement fires in the Pacific Silver Fir Zone are estimated to occur at intervals of 90-730 years. Low severity understory burns appear to take place every 40-50 years during the first 150 years of stand development. After that point, a fire may burn every 125-500 years. The understory fires serve to prepare mineral soil seedbeds, producing a mosaic of stand structures and age classes across the landscape. Most fires are believed to have been very small (less than 10 acres), or very large (greater than 1,000 acres) depending on burning conditions.

In summary, the fire return interval outside of the Mt. Adams Wilderness area may be from 30 - 100 years. Stand replacement fires though may have occurred every 100-200 years. In the higher elevations of Mt. Adams, these intervals may be longer. Unusual stand conditions or fire weather result in the stand replacement type of fire. A very rough assumption could be made stating that fires in the 1-10 acre sizes occur 90% of the time in the 30-100 year interval range and fires that are greater than 100 acres occur 10% of the time and fall into the 100-200 year interval.

LIGHTNING TRACK

The watershed lies in the path of a weather pattern that produces lightning. This weather pattern sets up when there is a high pressure to the east of the watershed and a low pressure system moving into the region from the south. Typically this weather pattern produces cumulous clouds that move from a southwest to northeast direction. The area of Eckart Point and Crofton Ridge is in line with the typical lightning track. However, there are many times that this weather pattern creates cumulous build up on the east side of Mt. Adams, which rotates clockwise around the mountain and over the eastern portion of the watershed. This would be the King Mountain and Snipes Mountain area. These storms often occur in June, but can occur as late as August or early September.

HISTORICAL FIRES (PRE-1900)

Prior to settlement, large-scale natural fires periodically burned throughout the watershed. Summer lightning storms moving up from the south in the vicinity of Mt. Adams and King Mountain started fires. In addition, Native Americans may have ignited burns on the southwest side of Mt. Adams. This was done by either leaving their drying logs smoldering after leaving huckleberry fields or by directly setting fire to berry patches at the end of the berry season. The intent was to maintain or re-vitalize huckleberry production (Plummer 1900, French 1957). Plummer in 1899 noted that this area was comprised of 75% ponderosa pine at 3-5 bm per acre. Combined, these vegetative descriptions suggest a large area of lightly stocked pine forest, perhaps maintained by underburns. Plummer also mapped burns (1880-1899), which were likely stand replacing events (refer to Fire History Map). General Land Office survey notes (Clark 1882) also describe where brush fields and burns were encountered during township line surveys in east half of the watershed. Thus, stand replacing burns had also occurred in this area; however, there is insufficient information to accurately map these fires.

FOREST SERAL DISTRIBUTION

SUCCESSIONAL STAGES

Pre-European settlement is the point of reference for vegetation conditions in the UWSR Watershed and Hood-Wind Subbasin. The watershed has a long history of human use which has greatly influenced the vegetation and associated habitats now present. The most important human activity prior to settlement was Native American burning. Since settlement, human influences include fire suppression and timber harvest. Table 2 displays the percent of area by vegetation condition and how conditions have likely changed from about 1800 to the present day.

Table 2. Historical Forest Successional Conditions

Period	Non-Forest	Early Successional	Mid Successional	Late Successional
Range of Natural*	15%	10%-50%	10%-65%	10%-75%
Circa 1900	15%	20%	15%	50%**
Current Conditions	15%	14%	38%	33%

*Derived from the *First Approximation of Ecosystem Health* (USDA-FS 1993)..
**This component was in all probability mostly mature, low stand density ponderosa pine, mapped by Plummer with 5-10 MBF/acre.

Definitions: Non-forest - rock, meadows, agricultural and domestic conversions.
Early Succession - Seedling and saplings.
Mid Succession - Poles and small trees.
Late succession - large trees.

The range of natural condition is adapted from *A First Approximation of Ecosystem Health* (USDA-FS 1993), which is also known as the Regional Ecosystem Assessment Project or REAP. The REAP characterized various ecosystem components in pre-settlement times. The scale of analysis was the subbasin level. The Upper White Salmon watershed lies within the Hood-Wind Subbasin, which also includes Hood River, Wind River, and Little White Salmon River Watersheds (see Map C). The natural range values presented in Table 2 represent the weighted average for the grand fir, Pacific silver fir, and mountain hemlock / subalpine fir zones.

The forests in the late-1800's and earlier were largely ponderosa pine stands that contained single and multi-storied canopies based on the few historical descriptions that are available such as the Government Land Offive (GLO) survey notes. Included in this component were open park-like ponderosa pine stands. Until European settlement, wildfires either started by lightning or by Native Americans were the major cause of disturbance and source for young forests. It is speculated that the historical pattern of Native American burning and land use was drastically altered after 1800 because disease and pestilence decimated the native populations of the Columbia River Basin. After 1880, settlers began to move into the Trout Lake area and lands were harvested and converted from forest land to agriculture uses.

The 1900 figures were derived from survey notes of Fred G. Plummer who surveyed the timber values of the Columbia National Forest and mapped the burns that were obvious at that time. The first commercial logging in the watershed was in 1900. The early commercial logging was done mainly along the lands adjacent to the White Salmon River where logs could be easily skidded to splash dams on the river. Railroad logging operations were conducted between 1942-1946 on the east side of the Mt. Adams Ranger District, removing approximately 50% of the ponderosa pine volume. Timber harvest activities have continued within the watershed to the present. Wildfires and the suppression of wildfires have also played an important role in shaping the vegetation that exists today. Many of these fires were stand replacement fires that contributed to the seedling/sapling component at the turn of the century and which are just becoming late-successional forest today.

The current figures in Table 2 represent the data that resides within the Forest's vegetation data base. The current vegetation is greatly influenced by events that have taken place since the turn of the century. Fire suppression efforts initially began in about 1910 with the establishment of Gotchen Creek Guard Station. The suppression of fires together with the selective and salvage harvest of large mature trees has contributed to the establishment and growth of grand fir into prominence within the watershed. Since 1950, 7,841 acres of regeneration harvest has occurred within the watershed on federal land. These harvests have converted the older mature stands to young conifer plantations.

COMPOSITION AND STRUCTURE

The early-successional stage lasted longer historically than today. With current forest management, stands are re-established more quickly through reforestation efforts, thus shortening the early seral stage. Historical fire events periodically created large openings which in turn may have been great distances from seed sources. Combined with the dense woody shrubs that develop following disturbances (which retards conifer regeneration establishment), stands likely remained in an early seral condition comprised of seedlings and saplings much longer than under current forest practices. In addition, early seral communities created by fire normally had a snag (and subsequent down log) component whereas most of the harvested lands do not contain appreciable amounts of snags.

The late-successional forest stage would have had a large component of old-growth forest, due to the large percentage of acreage represented and long intervals between stand replacing fires. This would be true even within the Grand Fir Zone and fire group 3 where the short fire intervals reflects a greater proportion of underburns. This disturbance pattern would also influence the density and species composition. Late-successional stands in the grand fir ecoclass would have widely spaced large trees, with a greater proportion of the trees comprised of early seral species such as ponderosa pine and Douglas-fir. Vegetative descriptions by Fred Plummer in 1900 match these expectations. Plummer describes the timber as being 75% ponderosa pine on lands that lie within the Grand Fir Zone. Current stand ages and species composition support this description.

Historically, the ponderosa pine in the Grand Fir Zone grew larger and the understory was open, dominated by xerophytic grasses such as Idaho fescue (*Festuca idahoensis*), pinegrass *(Calamagrostis rubescens*), and blue bunch wheatgrass (*Agropyron spicatum*). In particular this describes the eastern half of the watershed. The western half of the watershed may have had a greater shrub component, such as buck brush (*Ceanothus sanguineus*) or other schlerophyllous (firm-leaved) species. The composition and structure of these forests evolved with fire. These open forested stands of the last century could also be considered dry meadows.

Patch sizes in presettlement vegetation communities were quite variable, but large patches tended to dominate the landscape. The large patches could have been early, middle, or late successional forest, at given point as dictated by the last stand replacing fire.

CURRENT CONDITIONS

DISTURBANCE

FIRE

Fire Suppression Efforts
All fires have been actively suppressed since the early 1930's. The current Forest Plan permits a varied suppression response to wildfires. The appropriate suppression response could be control, confine, or contain. Each management allocation in the Forest Plan has a suggested suppression response based on the values at risk. Fire intensity, fuels, and expected spread are then considered to determine what action is actually taken. A fire management plan is required to utilize prescribed natural fire to meet resource objectives. This tool is often suggested for wilderness areas. Currently, the Mt. Adams Wilderness does not have such a fire management plan, thus all fires are suppressed. The Forest's Late Successional Reserve Assessment (1998), which includes the Gotchen LSR, does include a fire management plan, including suggested suppression responses to wildfire.

Due to the fairly flat topography within the watershed, emphasis in the past has been towards using mechanical equipment for fire suppression. This type of suppression action generally impacts other resources such as soil and vegetation. Within the Mt. Adams Wilderness, minimum impact suppression tactics (MIST) have been used. These tactics attempt to employ the appropriate suppression response yet result in the least possible evidence of human interaction. The goal is leave the site as if the fire was controlled through natural means.

Fire History (post 1900)
There appears to have been a number of large fires in the watershed between 1910 and 1924. In that time period there were four fires over 100 acres in size. The specific cause is unknown, however due to the amount of human activity in this area during this time period it is assumed that these fires were most likely caused by some type of human activity. Reports from the turn of the century indicated that the eastern portion of the watershed had open, park-like stands of large diameter ponderosa pine. This would indicate that low intensity fire, most likely underburns, would have occurred on a somewhat regular basis. This would fit the fire return interval of the dry grand fir fire group, fire group 3. However, with the advent of fire suppression in the early 1920 and 30's, natural underburns from lightning and all other fires were no longer acceptable. With this active fire suppression, grand fir has increased in abundance, and the general accumulation of dead fuels has continued unabated.

Records of fire starts during the period from 1930 through 1970 are scarce. Records kept from 1964 through 1970 indicate at least 87 known fire starts on Forest Service land. Fire starts on non - Forest Service lands were not obtained for this report. The following table shows the breakdown by statistical cause.

Table 3. Fire Starts and Causes from 1964-1997.

Statistical Cause	Number of Fires	Percent
Lightning	44	50
Campfires	26	30
Smoking	10	12
Equipment Use	7	8
Total	**87**	**100**

The previous table indicates that half of the fire starts in this watershed are from lightning. The other half were attributed to human causes. Forty-two percent of the fires were the result of campfire and smoking. This can in part be attributed to the high recreational use that this watershed receives. With only two developed campsites in the watershed, most of the camping occurs in dispersed settings without established fire pits. The risk of escaped fire in these areas are much higher than in regular campgrounds.

TIMBER HARVEST

The first harvesting was done by settlers to clear land and provide timber for building materials. The first commercial timber operation occurred in 1900 in the Trout Lake area. Prior to 1950, most timber harvesting on National Forest land consisted of partial cutting and salvage logging. Over the years, much of the high valued ponderosa pine has been selectively harvested. Clearcutting followed by planting was a common practice from the 1950's into the 1980's. Regeneration harvest with mature tree retention of various levels was started in the early 1990’s. The intent of the leave trees and patches is to enable the plantations to achieve late-successional habitat conditions more quickly than in clearcuts where all of the trees are removed. Regeneration harvest levels on National Forest land between 1950 and the present are listed in Table 4.

Table 4. Regeneration Harvest Acres by Decade on Federal Land

Decade	Regeneration Harvest Acres
1950’s	568
1960’s	1,952
1970’s	2,168
1980’s	1,764
1990’s	939
Total	**7,841**

Information on harvest on private and state lands is incomplete but shows high levels of regeneration harvest since the late 1970’s. Much of the recent regeneration harvest activity appears to be associated with the current western spruce budworm outbreak.

RECREATION

Morrison Road, which climbs part of the way up the south side of Mt. Adams was built in 1910. The first climbers took the Snipes Mountain Trail to the top of the mountain. Disturbance from climbing recreation has only been noticed in the last few decades. It has been increasing yearly to the point that the damage exceeds Wilderness thresholds.

INSECTS AND DISEASE

Insects and disease are natural part of the ecosystem having historcially influenced forest composition and structure. As the absence of period fires has increased the density of grand fir and Douglas-fir in the eastern portion of the watershed, insects and disease have become a more visible disturbance agent. The primary insects and diseases affecting forests in the watershed include western white pine blister rust, laminated root disease, Armillaria root disease, and bark beetles, and western spruce budworm. . White pine blister rust, an introduced disease, did not occur historically. Western spruce budworm may have been present historically, but it occurred in low numbers in this watershed.

White Pine Blister Rust

Blister rust is an introduced disease affecting western white pine and whitebark pine. *Ribes* species (currents and gooseberries) are alternate hosts. This disease has caused large-scale mortality of the five-needle pines since its introduction to western North America in the 1910s. White pine occurs as a minor species throughout the watershed. Preventative measures that can be implemented to minimize blister rust impacts include planting genetically resistant western white pine for reforestation and branch pruning during early stand development.

Laminated Root Rot

This disease is found throughout the forested ecosystem and causes mortality to Douglas-fir and true firs. Western hemlock and western larch are moderately resistant; western white pine, ponderosa pine and western redcedar are highly resistant; and hardwood species are immune to the disease. Laminated root rot causes mortality in small areas, from a few trees to up to 2-3 acres in size in this vicinity. Trees weakened by the disease are often attacked by bark beetles. The disease continues to spread by root contact gradually until it encounters areas with immune species or no susceptible root systems.

Armillaria Root Rot

Armillaria is found within the watershed. There appears to be strains of this disease that are species specific. One strain affects mostly Douglas-fir and true firs, while a different strain affects ponderosa pine and true firs. In the White Salmon watershed, the most common strain of *Armillaria* is the one which affects ponderosa pine and grand fir. The disease normally becomes established on trees of low vigor, then spreads by root contacts. Timber harvest can accentuate its spread by creating host sources (stumps and roots) or through detrimental soil compaction which may reduces the vigor of remaining trees. Species that are not affected to a large degree by this disease include western white pine, western larch, and lodgepole pine. The primary strategy to be employed to reduce the effects of Armillaria include maintaining tree vigor and stand diversity.

Bark Beetles

Various species of bark beetles affect different tree species in stands weakened by overstocking or root disease, particularly during a prolonged drought period. Bark beetles that are present in the watershed include the Douglas-fir beetle, fir engraver, western pine beetle, and mountain pine beetle. The resultant mortality frequently cause small gaps with high levels of snags and downed logs. Where undesired, bark beetle impact can be minimized by controlling tree density so as to maintain tree health and vigor.

Western Spruce Budworm

Western spruce budworm defoliates a variety of conifer species but mainly grand fir, Douglas-fir, western larch, and Engleman spruce. The greatest risk to budworm occurs in the Grand Fir zone where fire suppression and increasing stand density has resulted in the predominance of host species with low vigor. There is currently an ongoing outbreak of western spruce budworm in the watershed affecting an area approximately 15,000 acres in size. The first detectable effects were observed from the ground in 1992. The outbreak area was first mapped in the annual Regional aerial surveys in 1994. Effects of the outbreak intensified in 1995 and 1996, then appeared to subside somewhat in 1997. The insect populations appear to have increased within portions of the outbreak area again in 1998. The area most severely affected at present is the south side of Smith Butte and stands immediately to the west. There is no reliable means to predict when the outbreak might end. Outbreaks of 12-13 years are frequent in areas with a long history of past budworm activity such as the Ochoco and Blue Mountain Ranges, and can last as long as 17 years. The most common impact following an outbreak is mortality to intermediate and suppressed crown class trees, with top damage to many of the dominants and codominants. However, in some situations, widespread mortality of all crown classes of true fir and Douglas-fir can occur. In any case, the risk of a large scale stand-replacement fire increases significantly in the aftermath of an outbreak as the dead trees fall over and add to the fuel loading.

CATTLE GRAZING

The initial UWSR Watershed Analysis in 1994 identified a monitoring need to assess sites being impacted by livestock. This would be to determine the degree of current impact and identify needed changes in grazing practices and restoration opportunities.

Parts of several streams in the Mt. Adams Grazing Allotment, including Hole-In-The-Ground, Gotchen and Wicky Creeks, and the spring at Aiken Lava Bed were analyzed in early September, 1998, for grazing disturbances to vegetation. The report is on file at the Mt. Adams Ranger District. Cattle grazing impacts were evident, for example, trampling of stream vegetation leading to bank erosion, exposed bare ground in riparian areas, muddy creeks and riparian areas, high-use creek crossings, and bedding-down in riparian areas were evident. At Aiken Springs, 14 cow/calf pairs were seen escaping the heat, in an area with very little herbaceous vegetation left. Cattle grazing may be keeping aspen groves from expanding as well (more under "Aspen").

Other areas previously identified as heavy livestock use are Snipes Mountain Trail, meadows east of Aiken Lava Bed, upper Gotchen Meadow complex, Bare Meadow, Bugle Sale units, and west of Wicky Creek Shelter (approximately 19 acres T7 N, R10 E, Section 15 nw of sw). One of these areas, upper Gotchen Meadow complex was visited in September 1998. Grazing was evident, but the Aquatic Conservation Strategy was apparently not being violated. Recreation, botany, aquatic resources, and wildlife interface with cattle at these sensitive sites.

FOREST SERAL DISTRIBUTION

SUCCESSIONAL STAGES

All forest successional stages occur in the Upper White Salmon watershed. Per a query of the Forest's vegetation database, the acres of forest in each successional stage by subwatershed are shown in the following table.

Table 5. Current Forest Successional Conditions by Subwatershed.

Subwatershed	Early Successional (Seedling/Sapling)	Mid Successional (Pole)	Mid Successional (Small Tree)	Late Successional (Large Tree)
C	741 Acres	463 Acres	240 Acres	2,537 Acres
D	640	508	1,348	2,263
E	1,599	529	2,703	716
F	504	606	2,274	1,077
G	910	1,289	4,920	3,788
H	2,352	1,334	3,471	3,808
I	598	52	1,276	1,666
J	684	479	1,473	1,973
K	493	185	1,119	1,030
M	399	210	38	999
Y	152	74	207	557
Z	339	458	287	1,727
Watershed Total	**9,411 (14.2%)**	**6,187 (9.3%)**	**19,356 (29.1%)**	**22,141 (33.3%)**

Note: Seedling/Saplings are 0-4.9 " dbh; poles are 5-8.9" dbh; small trees are 9-20.9" dbh, large trees are 21+" dbh.

The vast majority of the early-successional stands originated following timber harvest over the last 20 years. These young stands are dispersed throughout the analysis area. There is also a large area of naturally established early successional forest vegetation on Mt. Adams near the timberline. Pole-sized stands include primarily plantations that have grown to 5-9 inches diameter breast height (dbh). However, there are also stands with mid-successional characteristics at high elevations near the timberline on Mt. Adams. Mid-successional small tree stands (9-21 inches dbh) originated following wildfires earlier this century (1902-1924). Late-successional forests are located throughout the watershed and originated from turn of the century or earlier wildfires.

COMPOSITION AND STRUCTURE

Structure and composition of forested stands within the analysis area are closely correlated with the seral stage and ecological zones in which they occur. Old-growth stands which occur in all ecological zones tend to be the most diverse in both structure and species composition. Late-successional stands tend to be more even-aged.

Within the Grand Fir Zone late-successional forests, species composition is almost exclusively Douglas-fir and grand fir, mostly 80-100 years of age. These stands may have remnant old-growth ponderosa pine (typically 150-400 years old), western larch, or Douglas-fir that were not selectively logged in the 1950's or earlier. Understories are comprised of young conifer regeneration in skid trails or other areas of disturbance. The origin of the main cohort of Douglas-fir and grand fir can be traced back to around 1910 as a result of the initiation of active fire suppression.

Fire occurrence in the Pacific Silver Fir, Mountain Hemlock, and Subalpine Fir Zones, though less common than the Grand Fir None, leads to a mosaic pattern and structural diversity within stands. Late-successional forests contain a variety of species and well-developed vertical canopy structure. The overstory tends to have more old-growth trees commonly 200-300 years old. Gaps have formed in the canopy, with small areas of conifer regeneration and other early-successional vegetation present. Species present in high abundance include western hemlock, Pacific silver fir, mountain hemlock, Douglas-fir and noble fir. Minor species include western white pine, western redcedar, lodgepole pine, Engelmann spruce, subalpine fir, whitebark pine, black cottonwood, and quaking aspen.

With the aggressive suppression of fires, early-successional forests today owe their existence largely to clearcut timber harvests. Species diversity within these stands largely reflect their ecological zone. High numbers of snags and downed logs which would have been present historically in early-successional stands are missing. These stands today advance more quickly into the mid-successional stage of closed canopy, pole sized trees.

Patch sizes associated with timber harvest tend to be smaller and more dispersed than those in pre-settlement conditions. Presently, a large range of patch sizes still exists, but a high frequency of small patches (less than 40 acres) tend to dominate the landscape. Consequently, the patch size of late-successional and old-growth forest has become smaller and fragmented. On federal land, large patches presently remain in the Mt. Adams Wilderness vicinity. Although partial cut, much of the Grand Fir Zone where past thinning has occurred remains as contiguous late-successional forest. More recent regeneration harvests have retained approximately 15% of the original stand to meet direction in the Northwest Forest Plan (see Light Forest on Current Vegetation Map).

UNIQUE HABITATS

The analysis area contains a wide variety of unique communities, most of which are habitats for several threatened, endangered, sensitive, and otherwise unusual plant and animal species. The species associated with many of these unique habitats may be found in the *Wildlife Habitat Relationships, Mt. Hood and Gifford Pinchot National Forests* (Mellen et al. 1995).

FOREST HABITATS

Old-Growth Forest

The watershed contains 12,791 acres of old-growth forest, with most(12,603 acres) on federal land. Old growth forest is comprised of the large tree, multiple story stands that meet the Region Six definitions (at least 10 trees per acre that are 21” dbh and 150 years old). Many of the large trees meeting this definition have been selectively logged from the watershed. Many other large trees, such as ponderosa pine in the grand fir zone, are at risk to insects and disease brought on by grand fir competition.

In addition to the threats on this habitat, old growth remaining in the Upper White Salmon has been greatly altered from historical conditions, primarily due to fire suppression. The predominant species of old-growth trees are ponderosa pine and Douglas fir, both tolerate fire with age. Unlike some eastern Cascade watersheds, ponderosa pine will yeild to grand fir as the climax species in the absence of disturbance in the Upper White Salmon watershed. Historically, the understory was open, dominated by xerophytic grasses such as Idaho fescue (*Festuca idahoensis*), pinegrass *(Calamagrostis rubescens*), and blue bunch wheatgrass (*Agropyron spicatum*). In particular, this would describe the eastern half of the watershed. The western half of the watershed may have had a greater shrub component, such as buck brush (*Ceanothus sanguineus*) or other schlerophyllous (firm-leaved) species.

Old-growth forests are important habitat for a wide variety of fauna and flora, some of which are threatened, endangered, or sensitive. Often it is the structure of the forest, and not the age of the forest which is critical in defining this habitat, which is another reason for concern in the shift from open forests to dense stands of trees that are not fire-tolerant. The plant and animal species dependent on late-successional and old-growth forests include survey and manage species, fringed pinesap, neotropical birds, bald eagles, northern spotted owls, bats (roosting habitat), and many others. Table 6 displays the breakdown of old-growth forest in the watershed by ownership and management allocation.

Table 6. Distribution of Old-Growth Forest in the UWSR Watershed.

Land Ownership / Allocation	Old-Growth Forest Acres	Percent of Ownership / Allocation
Federal land	12,603	25.8 % of federal forest land
Matrix	6,145	12.6 % of federal forest land
All no-harvest allocations	6,458	13.2 % of federal forest land
State and Private Land	188	2.2 % of state and private land
UWSR Watershed Total	**12,791**	**19.2 % of watershed**

This old-growth query was also run for the entire White Salmon River 5th Field Watershed. This would include federal lands only within Upper White Salmon River Watershed, Trout Lake Creek Watershed, and Cave-Bear Creeks Watershed. This query show that old growth forest occupies 29% of the capable lands in the 5th field watershed (see Table 7) Old-growth forest within non matrix allocations and Riparian Reserve totals 15% of the capable lands. There is 774 acres of old-growth forest (0.6% of the capable lands) on potentially unstable soils, currently classed as Riparian Reserves. Based on field review these soils could potentially be found to be stable and reclassified as Matrix. This information is relevant to the LRMP guideline which require a minimum of 15% of 5th field watersheds to maintained as late-successional and old-growth forest, with the preference toward old-growth.

Table 7. Distribution of Old-Growth Forest in the White Salmon River 5th Field Watershed.

Land Allocation	Old-Growth Forest Acres	Percent of Ownership / Allocation
Matrix	16,711	14 % of federal capable land
Non-Matrix plus Riparian Reserves	18,232	15 % of federal capable land
5th Field Total	**34,943**	**29 % of federal capable land**

Riparian Areas

The watershed contains 302 miles of streams and their associated riparian areas. In addition there are approximately 400 acres of wetlands and ponds with their riparian areas. Riparian areas contain elements of both aquatic and terrestrial ecosystems which mutually influence each other. The riparian area transition from cool stream to arid uplands is pronounced and distinctive in this eastern region. Typically, a riparian area will receive high use by wildlife for breeding habitat and movement corridors. The forested Riparian Reserves on Federal land are comprised of the following classes of conifers: 11% early-successional forest, 35% mid-successional, and 41% late-successional, with the remaining 13% as non-forest.

NON-FOREST HABITATS

Dry Meadows

The watershed contains over 12 acres of mapped dry meadows that are located in at the Gotchen Guard Station, Upper Gotchen, and near the top of Smith Butte. In addition, there are other dry meadows located within the watershed that are too small to map (mostly less than 1 acre). Historically this vegetation type occurred on more acres than at present. A dry meadow was inadvertently created at the Bunny Slope off Road 8240 (Section 15 of T 7N, R10E) in the 1930's, which now houses many native grasses, some of which are scarce in other areas (e.g., *Calamagrostis rubescens*). The absence of periodic under burning has permitted conifers to encroach on these meadows, and greatly reduces meadow habitat (see following discussions on Gotchen meadow) .

Aspen Groves

In meadows that are wet to dry and in remnant stands in some coniferous forests, grows quaking aspen (*Populus tremuloides*). It occurs sporadically throughout the watershed where drainage is poor. Widely known as an important Rocky Mountain species, the aspen in this watershed contribute to the diversity of trees on the Forest. Aspen thrive in an environment where competition is kept low through periodic underburning. Existing aspen groves are remnants of pre-settlement times when fires were more frequent and grazing by cattle, elk, and deer were not as great an impact to the aspen. In fact, Kay (1997) attributes the well-documented demise of aspen to the reduced predation (especially by Native Americans) on deer and elk, which have increased their populations exponentially in the past 200 years. Native Americans were responsible for many of the fires as well. The species grows in clones and rarely reproduces sexually, which underscores the risk that grazers pose to the existing aspen genetic base. An inventory of aspen does not exist. Under current conditions, the existing clones will die out as the conifer stands mature to late-successional, as fire continues to be excluded, and/or as grazers nibble away at new shoots.

Wet Meadows

Wet meadows are rare in this watershed, the District, and Forest. These wetlands are important for wildlife habitat and contain unique plant communities. There is a wetland complex to the east of Grand Meadows. Elk heavily utilize this complex, dominated by native sedges (*Carex sitchensis* and *Carex amplifolia*) and grasses (*Calamagrostis canadensis*). A rare plant, intermediate bladderwort (*Utricularia intermedia*) occurs here. There is also a large wetland along Cascade Creek in the Mt. Adams Wilderness, plus a shrubby (*Alnus sinuata*) and forested wetland along the White Salmon River. Wetlands total 397 acres.

Gotchen Meadows

Aspen likely establisshed in open meadow conditions, such as the 30 acres reported near the Gotchen Guard Station in 1930's. Tree ages were examined in this meadow and also in the meadow near Morrison Horse Camp. From the data collected, Gotchen meadow had three times the area of meadow habitat in 1908. Extrapolating into the future, Gotchen meadow will be forested in 50 years. The data collected at Morrison indicated a similar condition. Using these meadows as indicators of succession, the same decline in meadow habitat is anticipated on other meadows in the Upper White Salmon if management of the area stays the same.

Alpine, Talus, and Lava Beds

Rocky talus slopes in a forested setting is a specialized habitat for several plant and animal species such as snakes and amphibians. The larch mountain salamander (a State sensitive species) is known to inhabit talus slopes adjacent to mature forest. There are also often diverse assemblages of mosses and lichens. The current inventory of rocky areas is 8,620 acres.

Rock outcrops and talus slopes are abundant in the alpine communities on Mt. Adams. These areas are sparsely vegetated, as the climatic conditions are extreme and nutrients few. Rocks offer the microtopography to shelter a niche from dessicating wind and sun. The growing season is as short as the melting snowfields allow, and especially harsh in the porous, volcanic soils of the Cascades. Under these conditions, plants may not flower for years as they store energy. The Cascade Mountains act as a chain of islands between which genetic flow is limited. "Cushion" plants, such as some *Polygonum* spp., phlox, and lichens may be all that survive these conditions. In certain sheltered niches, small colonies of taller plants become established and give-way to krumholtz (short and crooked) trees. These areas are also sought by overnighting mountain climbers, and may become heavily damaged. Restoration of heavily used sites may take centuries.

Oregon White Oak

Oregon white oak (*Quercus garryana*) is present in the Upper White Salmon Valley, and on warm, forested ridges, especially those above the White Salmon River. Oak woodlands are identified as a priority habitat by the Washington Department of Fish and Wildlife. Oak provides habitat for the western gray squirrel, California mountain kingsnakes, and for common blue cup (*Githopsis specularioides*), all sensitive species listed by Washington State. Oak woodlands also give rise to unique lichen and mushroom communities. In most cases, oaks are early seral, and unsuccessful competing with conifers. The oaks along Buck Creek are said to be disappearing.

Research Natural Areas

The Smith Butte Proposed RNA consists of 175 acres circling the butte. Its establishment would contribute to research and education the following specific terrestrial elements, represented as plant communities:

grand fir/elk sedge
grand fir/vine maple
`

In addition, it was noted that the proposed RNA includes the only intact grand fir zone forests on the eastern edge of the Gifford Pinchot NF which have not been entered by timer harvest. This site is an important baseline site for a wide area of productive forests of various ownerships which have been heavily disturbed by past management (Topik 1989, letter on file). Near the top of Smith Butte, on the western flank is a pristine grassland meadow of 2.5 acres. Unlike many of the meadows in the watershed, little, if any, cattle grazing has occurred there. Sheep probably grazed there until about the 1940's.

Silviculturist Jim White established 30 long-term vegetation plots on Smith Butte in 1992, just prior to the western spruce budworm outbreak. The information from these plots could be valuable in understanding the effect of this disturbance on the vegetation.

With the budworm infestation, fire risk to these grand fir stands is heightened. Once the Smith Butte RNA is established, a management plan will determine what type of fire management will be appropriate in the RNA.

In 1979, Russ Jolley wrote to Jerry Franklin (then of the PNW Reserch Station) a memo suggesting that Aiken Lava Bed and the forest immediately west of it as a potential RNA. This is a roadless area that has old-gowth Pacific silver fir stands with some large, relic ponderosa pine. It would fulfill the statewide need for a representative lava bed community, as would Big Lava Beds, another potential RNA in the Little White Salmon watershed.

PLANTS OF CONCERN

NOXIOUS WEEDS

Systematic noxious weed surveys of road corridors were conducted in the White Salmon watershed in 1989 and 1995 (on file at the Mt. Adams Ranger District). Spot surveys have been recorded from 1995 to present. As in many watersheds, the weed situation is worsening exponentially. Some of the most tenacious weeds (*Centaurea* spp.) are more abundant in the Upper White Salmon than in other watersheds, however, some of the most common weeds (Scotch broom and St. Johns wort) are less extensive than in some west Cascades drainages. Special habitats, such as lower elevation riparian areas and meadows are susceptible to weed introductions because of the high amount of human activity at these sites. Open habitat suitable for east Cascades xerophytic grasses could also host sun loving weeds. Species in these habitats are often not common and a weed invasion could harm their viability.

Noxious weeds cause considerable damage by suppressing conifer growth, altering native habitat for plants and animals, lessening forage for cattle, being deleterious to some animals, and by helping to increase run-off and soil erosion. Vehicles, cattle, and people are primary means of introduction for noxious weed to an area. Timber sales and road building open habitat available to weeds and should be undertaken cautiously, with awareness of the likelihood of worsening the noxious weed infestations.

There are currently 46 species of plants that have been designated for immediate eradication in the Upper White Salmon watershed (see Appendix B). This is the same list used by the state of Washington.

The noxious weeds which currently occur in the watershed are indicated in Appendix B. More weed species are suspected to exist. A rough estimate for the watershed is 1000 weed-infested acres. Most of these acres are old timber sale units and roadsides.

Invasive Non-native Plants
These are non-native species that occur in the watershed and have the potential to be aggressive, displacing more desirable species. Examples are reed canary grass (*Phragmites communis*), found along roadsides and in wetlands and bird's foot trefoil (*Lotus corniculatus*), which has been widely planted along roadsides and in timber sale units.

THREATENED, ENDANGERED AND SENSITIVE (TES) SPECIES

Four TES plant species are known to occur in the Upper White Salmon watershed. Table 8 and Map K provide details on these species.

Table 8. Region 6 Sensitive Species Known to Occur in Watershed

Species Known to Occur	Region 6 Sensitive	State Sensitive	Habitat
Dense sedge *Carex densa*	Yes	Sensitive	Alpine
Fringed pinesap *Pleuricospora fimbriolata*	Yes	Watch	Late-successional forest
Intermediate bladderwort *Utricularia intermedia*	Yes	Sensitive	Wet meadows
Pale blue-eyed grass *Sysyrinchum sarmentosum*	Yes	Threatened	Wet or dry meadows
Pine broomrape *Orobanche pinorum*	Yes	Watch	Open foreset with oceanspray

Pale blue-eyed grass occurs in both the dry and wet meadow habitats that have been mapped in the watershed. Most of the pale blue-eyed grass populations have been co-existing with grazing for a century, however new evidence suggests that some of these populations have been weakened genetically by eliminating the ability to sexually reproduce. Other than Skamania County, pale blue-eyed grass is known only from Klickitat County, Washington and Clackamas County, Oregon.

Intermediate bladderwort is an aquatic carnivorous plant. It thrives in wet, subalpine meadows such as those near Swampy meadows. A number of recommendations have been made to improve management of this species (Raven 1994).

Dense sedge was first sighted in 1896 by Wilhelm Suksdorf. It has not been rediscovered since that time. A specific location for Suksdorf's sighting was never disclosed. An attempt was made in 1998 to relocate this species on the alpine/subalpine slopes of Mt. Adams. This effort will continue in subsequent years.

Fringed pinesap is a mycotroph, a non-photosynthesizing plant that feeds off of or is symbiotic with soil fungi. A 20-acre Fringed Pinesap Monitoring site exists west of Road 8031 (Section 22 of T7N R10E) near the confluence of Wicky and Morrison Creeks.

Pine broomrape, also a non-photsynthesizing plant, is parasitic to the shrub oceanspray (*Holodiscus discolor*), and the most common of these rare plants in the watershed. These species have recently been downlisted from sensitive as a direct result of so many new population locations on Federal land.

SURVEY AND MANAGE SPECIES

Survey and Manage species are a large group of life forms that receive special listing in the Northwest Forest Plan due to a lack of knowledge on their abundance, live histories, and overall uncertainty of their viability. Only five Survey and Mange botanical species are known to occur in this watershed:

Table 9. Survey and Manage Species Known to Occur in the Watershed

Species	S&M Strategy	Location
Lobaria pulmonaria (nitrogen fixing lichen)	4	SE 1/4, Sec 7, T5N, R10E
Lobaria scrobiculata (nitrogen fixing lichen)	4	SE 1/4, Sec 7, T5N, R10E
Rhizopogon evadens var. *subalpinus* (rare false truffle)	1 & 3	NE 1/4, Sec 34, T6N, R9E
Gastroboletus subalpinus (bolete)	1 & 3	Sec 7, T7N, R10E, (along Salt Creek Trail)
Polyozellous multiplex (blue chantrelle)	1 & 3	Sec 7, T7N, R10E (along Salt Creek Trail)

There are undoubtedly other Survey and Manage species occurring in the watershed; however, no surveys have been done for these species. Habitat for the noble polypore (*Oxyporus noblissimus*) occurs on the old noble fir trees and snags in the Eckhart Point area and west slopes of Mt. Adams. *Usnea longissima* (Strategy 4) is a riparian lichen known from the White Salmon drainage, and while it is suspected further upriver, it has not yet been documented from the Upper White Salmon. Most Survey and Manage species would be suspected from the moister Pacific Silver Fir, and late successional riparian areas in all forest zones. This is because of the West Cascades focus of the Northwest Forest Plan.

DATA GAPS

- Incomplete inventory of small wetlands, which influences hydrologic analyses, habitat assumptions, and the amount of suitable acres available for timber harvest.
- Regular updates of forest successional development, primarily in plantations which have advanced from early to mid-successional. This may affect Aggregate Recovery Percentages, spotted owl habitat analysis, and other analyses that rely on information on stand trees classes and successional development.
- Cursory inventory information on species presence and distribution for unique, TES, and Survey & Manage plants and animals.

HYDROLOGY

REFERENCE CONDITIONS

HYDROGRAPHY

The White Salmon River watershed (NFS 1707010511) lies in the southern Cascades of Washington State. The watershed drains an area of approximately 249,600 acres (390 square miles) reaching from the peak of Mt Adams at approximately 12,276 feet in elevation, to the mouth on the Columbia River at near 100 feet elevation. It is bordered to the northwest by the Lewis River watershed, the west by the Wind and Little White Salmon River watersheds, and to the east by the Klickitat River watershed.

This assessment focuses primarily on the upper portion of the watershed, the ”Upper White Salmon River Watershed”, which includes all lands that drain to the White Salmon River above its confluence with Trout Lake Creek. At approximately 66,509 acres (104 square miles) in size, the analysis watershed represents approximately 27% of the entire White Salmon River (5^{th} field) watershed. Within the analysis watershed are twelve subwatersheds (Map D). Subwatershed size ranges from Subwatershed Y (Cait Creek) at 992 acres to Subwatershed G (Gotchen Creek/Hole in the Ground Creek) which is approximately 12,744 acres (Table 16). The watershed has a dendritic drainage pattern, with the mainstem of the Upper White Salmon River flowing generally from north to south where it meets Trout Lake Creek, a major tributary to the White Salmon River.

Table 16. Subwatershed Names, Codes, and Area in the UWSR Watershed.

Subwatershed Name	Subwatershed Code	Acres
Upper White Salmon River	11C	4,115
Headwaters White Salmon River	11D	4,970
Cascade/Salt Creek	11E	9,737
Wicky/Morrison Creek	11F	6,791
Gotchen/Hole in the Ground Creek	11G	12,744
King Mt.	11H	11,065
Lower White Salmon River	11I	4,010
Buck Creek	11J	4,663
Green Canyon Creek	11K	2,881
Ninefoot Creek	11M	1,716
Cait Creek	11Y	992
Middle White Salmon River	11Z	2,824
UWSR Watershed	**11**	**66,509**

The mainstem of the Upper White Salmon River is approximately 23 miles long from its headwaters on Mt. Adams to its confluence with Trout Lake Creek near the town of Trout Lake. The river is fed by the White Salmon and Avalanche Glaciers which lie above 7,000 feet elevation on Mt. Adams, and is a relatively high gradient system throughout most of the analysis watershed. With the exceptions of Ninefoot Creek and Green Canyon Creek which enter the White Salmon River from the west, all of the major tributaries drain the south slopes of Mt. Adams and enter the mainstem from the northeast, or mountain side. Channels in the eastern portion of the watershed (i.e. Gotchen, Hole in the Ground) tend to be dry at the lower elevations throughout much of the year, while those in the north and central portion (i.e. Cascade Creek, Headwaters WSR) are more directly fed by the glaciers and have substantial flow throughout the entire year.

CLIMATE

The watershed lies in the climatic transition zone just east of the crest of the Cascade Mountains. As such, there is a strong moisture gradient going from the west side to the east. Similarly, because of the elevational difference from the lower end of the watershed to the upper elevations on Mt. Adams, there is a moisture gradient from north to south. Precipitation ranges from over 140 inches at the upper elevations of Mt. Adams to less than 40 inches in the southeast portion of the watershed.

Climate in the analysis watershed is typified by cold wet winters and warm dry summers. Air temperatures at the Mt. Adams Ranger Station near the lower end of the watershed range from an average maximum of 36°F in January to 82°F in July (Figure 4). Approximately 85% of the watershed's precipitation is delivered from October through March, with the majority of that falling as snow during the middle winter months. Typically, much of the watershed is under snow cover throughout a majority of the winter and early spring months.

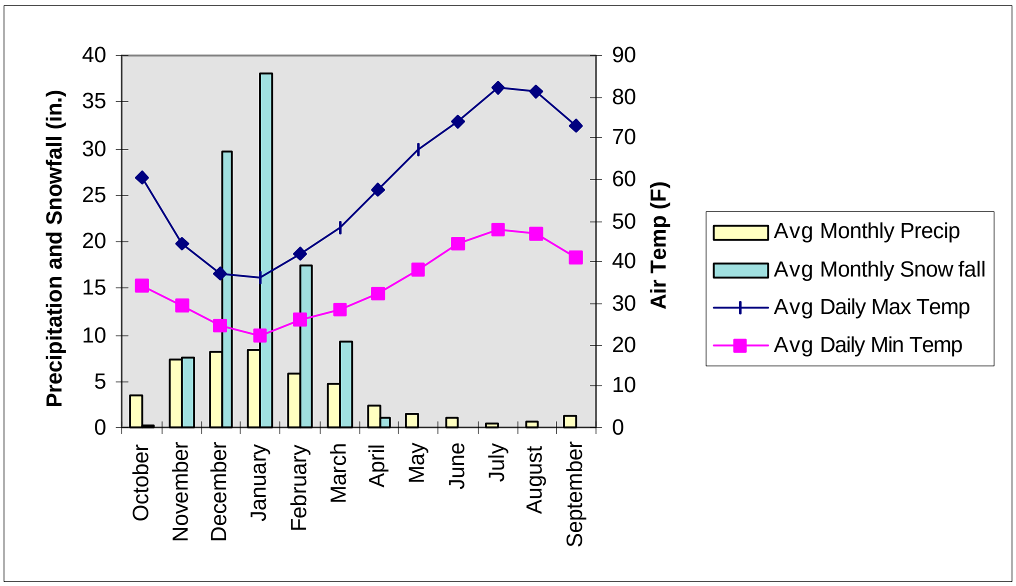

Figure 4. Average Monthly Precipitation and Snowfall, and Average Daily Maximum and Minimum Air Temperatures, Mt Adams Ranger Station (1948-1994).

Elevation is an important factor affecting the hydrology of the watershed because of its influence on air temperature, and the form that precipitation occurs. Lower elevations that experience precipitation almost exclusively as rainfall show runoff response very closely tied to precipitation intensity. Because the UWSR watershed lies at relatively high elevation, none of the watershed falls in this "rain dominated" category. Higher elevations that receive snowfall can have delayed runoff response as snow accumulates, but can also have subsequent runoff levels enhanced by melting snow, particularly when it occurs with rainfall or during spring melt conditions. Summer discharge can also be affected by elevation in that late season snowpacks can provide runoff later in the year. Much of the UWSR watershed is at these higher elevations, referred to as the "snow dominated" zone.

Middle elevations that frequently experience sequences of rainfall and periods of snowfall and snowmelt are referred to as the "rain-on-snow" zone. In these elevations, snowpacks commonly develop and then completely or partially melt out several times during the course of the year. During rainfall, depending on the depth and quality of the existing snowpack, the amount of rain, and air temperature during the rainfall, snowpacks can act as either sponges for incoming rainfall, storing and freezing the rain into the snowpack, or as sources of enhanced runoff volumes from snowmelt during rainfall. Because of the significant effects forest cover has on snow accumulation and melt, these elevations may be the most sensitive to changes in hydrologic function resulting from vegetation removal. Lower elevations of the analysis watershed fall into this “rain-on-snow” zone.

Figure 5 identifies the proportion of the UWSR watershed in different precipitation zones. These zones were defined by the Washington State Department of Natural Resources, and simply reflect the most common form of runoff-producing climatic process occurring in that portion of the watershed.

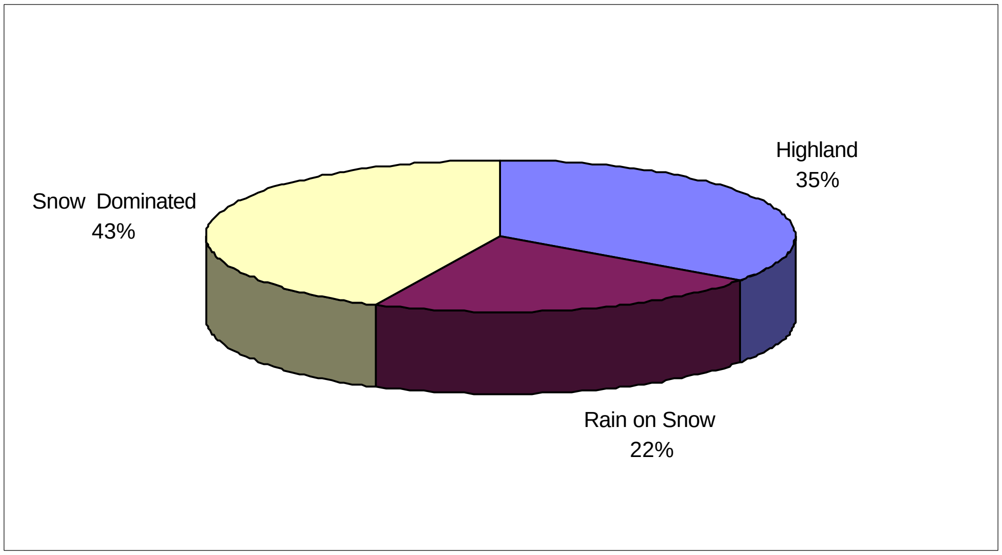

Figure 5. Proportion of the UWSR Watershed in Three Precipitation Zones.

The “rain-on-snow” elevation zone comprises approximately one fifth of the watershed, including all of the lower elevations in the analysis area. The highest elevations in the watershed on Mt. Adams are in the “highland” zone, which represents just over one third of the watershed and the area between these two elevations zones is in the “snow dominated” zone. It is quite possible that the actual proportion of this watershed in the effective rain on snow zone is even less than is shown in the figure, due to the local effect that Mt. Adams has on reducing air temperatures in the watershed. This highlights the importance of snow and snowmelt processes on the hydrology of this watershed. Implications are that runoff processes here are driven more by rain-on-snow and snowmelt processes than on rainfall alone.

LOW FLOWS

Summer flows in the watershed are largely maintained by glaciers, high elevation snowmelt and springs. Ninefoot and Green Canyon Creeks do not have glacial influence, but are fed by subsurface recharge and water stored in wetlands and wet meadow systems. Streams in the northern and middle portion of the analysis watershed, including the mainstem White Salmon River, Cascade Creek, Salt Creek, and the Wicky/Morrison system all have more direct influence of the glaciers and high elevation snowmelt from Mt. Adams. These streams maintain substantial flow throughout the summer months. The entire eastern portion of the watershed including the Gotchen/Hole in the Ground systems and the King Mt. subwatershed do not have the strong influence of runoff from the higher elevations on Mt. Adams. Spring systems and high elevation meadows contribute to discharge in summer months, but most surface channels in this portion of the watershed are dry in summer months throughout their lower reaches. It is presumed that rapid infiltration through the porous sands and underlying basalts, combined with the gentle slopes on this portion of the watershed are responsible in large part for the lack of surface flow in these channels.

Variability in summer low flows during the reference period occurred through differences in annual and seasonal precipitation and climatic conditions, and in response to large-scale vegetative disturbances such as fire. Following large scale fires, annual discharge including summer low flows increased as a result of the loss of forest vegetation. Advances or retreats of glaciers on the mountain affected low flows in the watershed, particularly in streams in the central and northern portions of the watershed.

PEAK STREAMFLOWS

The annual hydrograph for the UWSR measured near the mouth of the analysis watershed shows peaks occurring both in winter and spring months (Figure H-4). The largest floods at this site generally occur between November and February when peak discharge is driven primarily by rain-on-snow. High flows occurring during these times commonly result from warm, wet frontal systems coming from the Pacific Ocean. These systems bring rainfall, warm temperatures, and high winds, and are capable of melting a large volume of snow in addition to the rainfall they deliver.

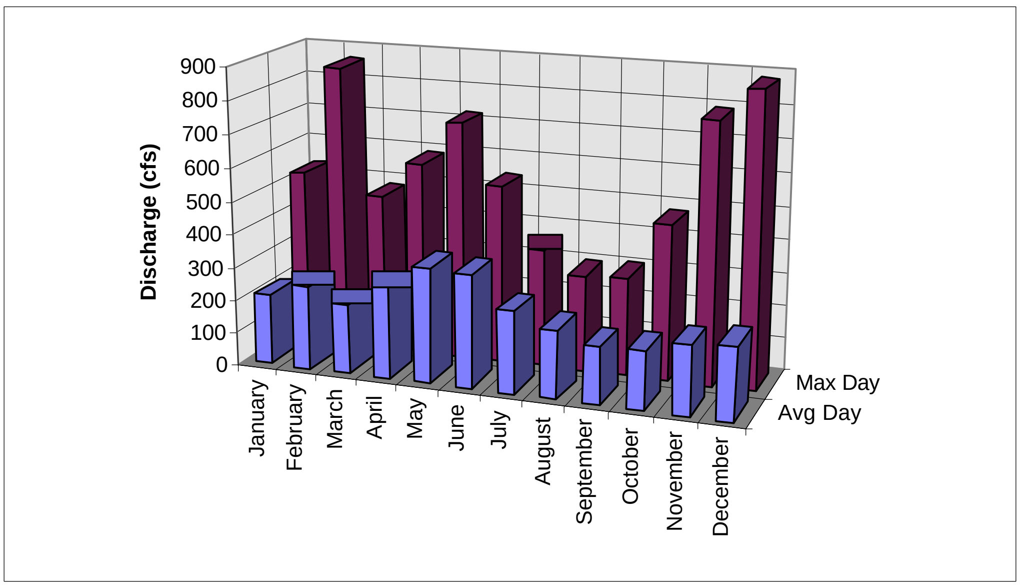

Figure 6. Average and Maximum Daily Discharge on the White Salmon River Above Trout Lake Creek (1959-1969).

While winter months can produce the largest flood events, it can also be a time of particularly low flow in these high elevation streams. This results from differences in the snowpack depth and condition, and the type of weather events that occur. A relatively warm, "ripe" snowpack can quickly yield melt water as runoff, but a deep, cold snowpack is capable of absorbing a large volume of precipitation without releasing water at all. During extremely cold, dry periods in the winter, streamflow can drop substantially in the higher elevation streams as snow accumulates and snowpacks fail to produce runoff. This can result in some of the lowest flows of the year. Because of the storage of water in snowpacks at higher elevations through the winter, runoff during spring snowmelt conditions is substantial, and in fact it is during this time of year that average runoff is greatest. This is shown in Figure H-4 by the "average day" peaks in April, May and June.

DISTURBANCE PROCESSES

Major geologic events associated with Mt. Adams and other volcanic vents in the area may have caused the greatest local impacts in this watershed, but are infrequent relative to other disturbance processes. Fire affected large portions of the landscape, and was a relatively frequent disturbance process affecting vegetation.

Due to the combination of scale, intensity and frequency of wildfire, this was probably the most common disturbance process that affected vegetation, and thus snow accumulation, snowmelt, and water runoff in the reference period.

Loss of forest cover resulting from large wildfires allowed increased snow accumulation and increased volumes of runoff during subsequent rain-on-snow floods. As the proportion of any subwatershed affected by fire was increased, the potential for higher peak streamflows was greater due to the increased runoff that occurred from burned over areas during rain-on-snow driven floods. Fire frequency assessments in the region have found that return intervals for stand replacing fires in the area including the analysis watershed would range from 10's to several 100's of years for fires covering anywhere from a few acres to thousands of acres in extreme cases (USFS, 1993). Under these conditions, entire subwatersheds would have at times been completely burned. At the same time, other subwatersheds would have been largely or entirely skipped over by fire for decades or even hundreds of years.

In an 1899 survey of southwest Washington, Plummer found that approximately 26% of the White Salmon River (fifth field) watershed was in "burned areas", and approximately 84% was "timbered" (Plummer, 1900). Plummer's surveys of other nearby watersheds found "burned areas" comprising 7% of the Little White Salmon River watershed at that time, and 16% of the Wind River watershed. Although these conditions represent only a snapshot in time, they provide some context for the magnitude and range of areas burned in the past by wildfire, and the relative proportion of these large watersheds in early seral condition at the turn of the century.

The significance of the fire analyses to hydrologic response is that at any given time under reference conditions, there were likely large areas of the landscape that were in a burned condition, and which were experiencing increased peak streamflows. Nearby subwatersheds that were covered in mature forest were at the same time experiencing average or below average sized peak flows. Partially burned subwatersheds functioned somewhere between the burned and fully mature watersheds. The result of this would have been higher variability in the timing and magnitude of streamflows from subwatersheds in the analysis watershed during reference conditions.

Although changes in peak streamflows could be relatively large following extensive fires, the effect of the increased peak flow levels on stream channels may have been somewhat less than would be expected today under similar vegetative conditions. This is because streams historically had higher levels of in-channel woody debris and more large standing trees along streambanks than under current conditions. Fire may in fact have provided a mechanism for introducing additional woody debris to the stream when riparian areas were burned. In general, channels under reference conditions had a higher degree of roughness, in-channel structure, and bank integrity than under current conditions, and so would have been more resilient and better able to handle changes in flow regimes.

CURRENT CONDITIONS

The primary trend in factors affecting peak and low flows in this watershed has been the shift from a fire dominated system to one where timber harvest, road construction, farming and residential development have become the dominant disturbance processes.

LOW FLOW

Low flows are complex and variable within the watershed. Streams on the east side of the analysis watershed (Gotchen Creek, Hole in the Ground Creek) are totally dry throughout much of their lengths during summer months. Perennial flow at the upper ends of some east side streams diminishes in a downstream direction through a combination of diversions, extractions, and infiltration. The fate of water from this portion of the watershed is unknown, but it may be in part this water that re-emerges as springs along the White Salmon River.

On the northern and central portion of the watershed, streams such as the headwaters White Salmon River and Cascade Creek are more directly fed by glaciers and snowmelt. Daily mean discharge on these streams is typically at an annual low in the fall, with extreme minimums occurring later in the winter when air temperatures have dropped and little water is being released from glaciers and snowpacks. Even during average summer low flow periods, these glacially-fed streams maintain relatively high discharge levels due to the continued contribution of glacial and snow melt. It is this continued source of late season water inputs, combined with the spring systems lower in the watershed, that is in large part responsible for maintaining summer flows in the White Salmon River. Table 17 compares low flow discharges at three gauging stations in the White Salmon watershed and one station in a nearby drainage (the Wind River) to show the relative importance of the analysis watershed in producing streamflow during annual low flow months.

Table 17. Comparison of Average Streamflow Discharge During Low Flow Months at Selected Gauging Stations in and adjacent to the White Salmon River Watershed.

Gauging Station	**Month of Low Flow (Avg)**	**Daily Mean Discharge (cfs)**	**Drainage Area (mi^2)**	**Avg Discharge per Square Mile**
WSR below Cascade Cr*	Oct	98	32	3.0 cfs/mi^2
WSR above TLC*	Sept	174	60	2.9 cfs/mi^2
WSR nr Underwood**	Oct	623	385	1.6 cfs/mi^2
Wind River nr Carson**	Sept	236	225	1.0 cfs/mi^2

* Within the analysis watershed.
** Outside the analysis watershed, near the mouth of the White Salmon River (fifth field) watershed.
*** Outside the analysis watershed, a nearby watershed to the west of the White Salmon River watershed.

Low flow discharge per contributing land area (drainage area) in the White Salmon River below Cascade Creek is more than double the rate in the lower White Salmon River, and over three times the rate that is found in the lower Wind River, and adjacent watershed. Water withdrawals elsewhere in the White Salmon River watershed and storage behind Condit Dam would affect actual discharges, but probably would not change the general relationships shown in Table 17. The relatively high discharge from the analysis watershed is important to maintaining sufficient flow for recreation on the lower White Salmon River, but also for maintaining water quality.

Summer streamflow levels are important because water quantity is very closely tied with water quality. A decrease in water quantity during the low flow period of the year can have negative implications to water quality parameters such as water temperature and dissolved oxygen, two parameters that are important to fish survival. In addition, a decrease in water quantity directly affects the amount of available fish habitat, which can be limiting during late summer months in some streams. In some cases, low flows can limit the ability of fish to access streams or to move around within the stream system.

Activities that would potentially affect summer low flows include direct withdrawals of water from streams or groundwater, loss of water retention capacity in wetlands or other storage areas, and changes in vegetative cover that would affect evapotranspiration processes. In addition, glacial advance or retreat can affect low flows by putting more or less of the glacier at lower elevations where it is exposed to increased rates of melting. The large ice and rock slide from Avalanche Glacier in 1997 may have caused increased low flows during the past couple of years by moving a huge volume of ice from higher elevations on Mt. Adams to lower elevations where it is more rapidly melted.

PEAK FLOWS

Streamflow levels have been measured at a number of locations in the White Salmon River watershed over the past several decades. Most of the gauge stations were operated for short time periods and then abandoned. The longest and still operating gauge station is on the White Salmon River near Underwood. This station has been operational since 1915 and is located near the mouth of the White Salmon River (fifth field) watershed, just below Condit Dam. Within the analysis watershed, the White Salmon River was also gauged for a period of 22 years from 1957 through 1978 at a station below the confluence with Cascade Creek (i.e. within the upper portion of the analysis watershed). Another gauge was operated on the White Salmon River above Trout Lake Creek for the eleven year period of 1959 through 1969. The gauge on the White Salmon River above Trout Lake Creek was located very near the mouth of the analysis watershed, so is most representative of total discharge from that watershed.

The largest flood on record at the gauge station on the White Salmon River near Underwood occurred in February of 1996. This flood was calculated to be approximately 45,200 cubic feet per second (cfs), approximately three times the size of the next largest event recorded at that site. Much of the volume experienced at that gauge was a result of the failure of flashboards on the dam at Northwestern Lake, and the subsequent deluge of water as the lake quickly drained down to the level of the top of the dam. Immediately prior to the failure of the flashboards, measured discharge at that station was in the neighborhood of 15,000 cfs, which is approximately the discharge of the next largest flood measured at that station (Figure 7).

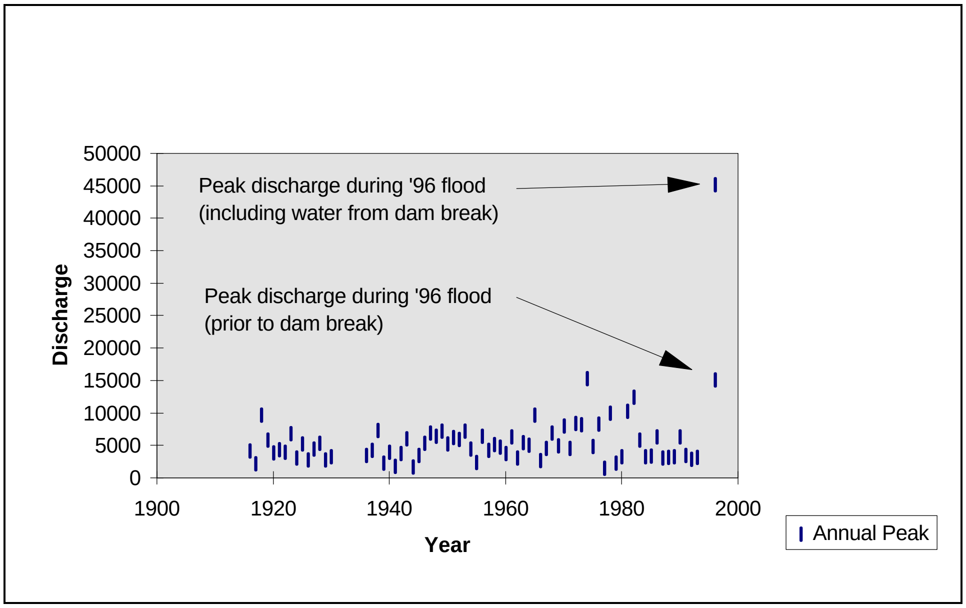

Figure 7. Annual Maximum Peak Flows on the White Salmon River near Underwood (1916-1998).

Other recent large floods on the White Salmon River occurred in January, 1974 (15,300 cfs); February, 1982 (12,400 cfs); December, 1980 (10,300 cfs); and December, 1977 (9,980 cfs). As can be seen in Figure 7, some of the largest measured events occurred from the mid-1960's through the early 1980's at this station. Of the largest 20 annual peak floods at this station, nine of them occurred in December, six occurred in January, and five occurred in February. That all twenty of the largest annual flood peaks occurred during these three months is significant, because it is during these months that there is presumably snow cover over substantial portions of the watershed, and soils are fully charged with moisture from early winter and fall rains. The '96 flood was typical of the kinds of conditions that cause the largest flooding in systems like the White Salmon River. A heavy snowfall was followed by deep freezing and a subsequent warm, wet frontal system that remained in the area over a period of days. The resulting snowmelt combined with runoff from heavy rains caused major flooding throughout the region during that event.

Streamflows were measured for a much shorter period of time at gauging stations in the upper watershed, but the results provide insights to the relationship of peak flows in the upper watershed (i.e. within the analysis watershed), and those occurring on the lower White Salmon River (i.e. near Underwood). Figure 8 displays annual peak flows for four gauging stations within the analysis watershed for a 20-year period when there was some overlap of discharge data. The stations are:

1) White Salmon River below Cascade Creek (WSR bl Cscd).
This station is within the analysis watershed. It is located on the White Salmon River just below the confluence with Cascade Creek, so reflects discharge primarily from the Headwaters (11D), Upper WSR (11C), and Cascade/Salt Creek (11E) subwatersheds.

2) White Salmon River above Trout Lake Creek (WSR ab TLC).
This station is within the analysis watershed as well. It is located on the White Salmon River just upstream of the confluence with Trout Lake Creek, so reflects discharge from essentially the entire analysis watershed.

3) White Salmon River near Trout Lake (WSR nr TL).
This station is below the analysis watershed. It is located on the White Salmon River just below the confluence with Trout Lake Creek, so reflects the combined discharge of the entire analysis watershed and discharge from the Trout Lake Creek and Cave/Bear Creek watersheds.

4) White Salmon River near Underwood (WSR nr Undwd).
This station is well below the analysis watershed. It is located on the White Salmon River near the mouth of the river and just below Condit Dam. As such it reflects discharge from nearly the entire White Salmon River watershed.

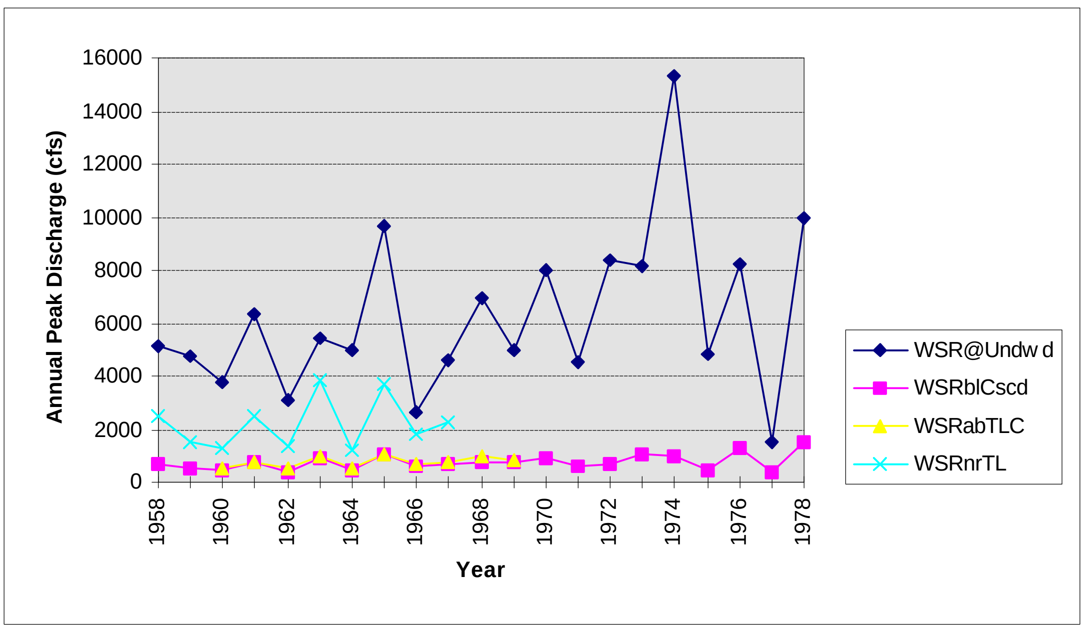

Figure 8. Annual Peak Discharge at Four Stations in the White Salmon River Watershed (1958-1978).

The two stations within the analysis watershed (WSR bl Cscd, and WSR ab TLC) show very close correlation throughout the period of overlap. With nine matched events to compare during the period of 1960-1970, discharge at the WSR below Cascade Creek was 75-99% of the discharge measured at the WSR above TLC station. Drainage area contributing to discharge at the WSR below Cascade Creek station is approximately 54% of the drainage area contributing to discharge at the WSR above TLC station. The proportionally higher discharge per unit of drainage area from the upper drainage (represented by WSR bel Cscd) probably represents higher precipitation rates due to elevation and the fact that this drainage area is west of the much of the drainage area for the WSR above TLC station.

There is insufficient data to determine whether the upper drainage area is contributing a greater proportion during the winter floods or the spring melt conditions, and the actual difference in discharge at these two stations is so small as to be within the range of expected measurement error. However, it is interesting to note that during the largest matched event, which occurred on December 23, 1964, and presumably was a rain-on-snow event, the upper drainage contributed a full 99% of the discharge measured at the lower of these two sites. This suggests that although the upper drainage is located entirely above 3,000 feet elevation and includes lands as high as 12,000 feet elevation, it is still responding during rain-on-snow conditions.

Comparing discharge from the WSR bel Cscd site with discharge measured at the WSR nr Underwood station, there were six years when the annual peak discharge occurred during the same event at these two stations (i.e. matched events). Five of these six events were during rain-on-snow type conditions, and for the six events, discharge from the WSR bel Cscd represented from 6% to 23% of the total peak discharge at the WSR nr Underwood. The 6% contribution occurred during one of the largest floods measured on the Whtei Salmon River over the period of record, a rain-on-snow event occurring January 15, 1974. The 23% occurred during a spring snowmelt peak occurring on May 6, 1966. This would tend to support that the relative importance of the analysis watershed in terms of providing discharge to the White Salmon River is greater for the spring snowmelt floods than those driven by rain-on-snow, and probably greater for the smaller peak flows than for the really large events. For comparison, drainage area of the WSR bel Cscd site represents approximately 5% of the contributing drainage area of the WSR nr Underwood station.

Fewer years of data overlap exist for the WSR ab TLC station and WSR nr Underwood station. There are three matched events between these stations, with the WSR ab TLC representing 11-27% of the discharge measured at the WSR nr Underwood station. The WSR ab TLC station represents approximately 16% of the drainage area contributing to discharge at the WSR nr Underwood station. Summarizing the information provided here, peak discharge measured at the White Salmon River near Underwood station is only a rough predictor of peak discharge at stations in the upper (i.e. analysis) watershed. In fact in many years, the annual peak flow on the lower White Salmon River occurs at different times and in response to different events than the annual peak flows in the upper watershed. In general, for the matched events examined here, the analysis watershed generally appears to produce at least its share of discharge during peak flows relative to its drainage area.

DISTURBANCE PROCESSES

Peak and low streamflows in the watershed are a function of climatic processes combined with physical conditions at the watershed and subwatershed scale that control the routing of water from the atmosphere to the ground, and from hillslopes into stream channels. Seral class of vegetation and extent of roading in the watershed are two factors that can affect the timing and magnitude of peak and low streamflows by altering the routing of water from the atmosphere to stream channels.

VEGETATION

Vegetation in the watershed plays a strong role in determining the timing and magnitude of water available for runoff during periods of rainfall and snowmelt. Generally, as the proportion of a watershed in early seral vegetation is increased, the potential for the timing or magnitude of peak flows to be altered is increased. Forest cover is a key factor affecting the hydrology of systems where rain-on-snow occurs because as forest cover is removed, snow accumulation can increase in the open areas. Rates of snowmelt are higher in the open areas as well because during rain-on-snow, the transfer of heat from the air to the snowpack is increased due to the increased windspeed and air turbulence over the snowpack. As incrementally more of the watershed is put into an open or early seral condition (i.e. by wildfire or timber harvest), the increased water available for runoff from these hydrologically unrecovered areas can combine to increase the size of resulting streamflows.

Currently approximately 86% of the watershed is in some form of forest vegetation. Approximately 13% of the land area is in early seral vegetation, and an additional 1% is in administrative, rural and residential uses. Administrative, rural and residential uses would function most similarly to early seral vegetation in terms of snow accumulation and snowmelt during rain-on-snow (Figure 9). Early seral vegetation is defined here as a combination of the grass/forb, shrub/seedling, and open sapling/pole vegetation classes. These hydrologically unrecovered stands may produce higher levels of water available for runoff during rain-on-snow conditions, and can contribute to changes in both the timing and magnitude of peak streamflows.

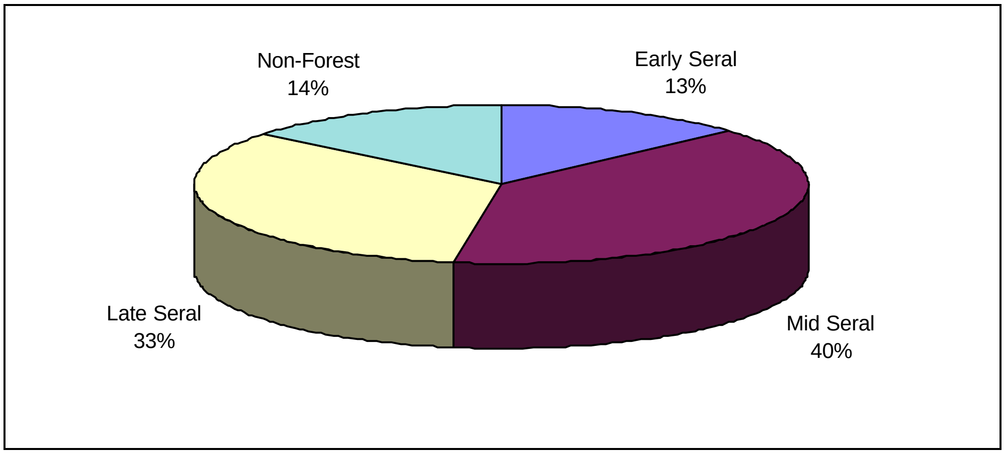

Figure 9. Vegetation Seral Classes in the UWSR Watershed.

The Aggregate Recovery Percentage (ARP) is a tool used to index the proportion of a watershed in a hydrologically "mature" condition. Hydrologically mature stands in general include any fully stocked stand with average tree sizes larger than the pole size class. These larger trees have greater capacity to intercept and retain snow in the forest canopy, and are more effective at limiting snowmelt during rain-on-snow by impeding wind movement across the snowpack. An ARP of near 100 indicates that nearly all of the forest vegetation in the watershed is in hydrologically mature condition, whereas an ARP of 0 would indicate that all forest vegetation in the watershed is hydrologically immature. As the ARP for a watershed decreases, the risk of increased peak flows becomes greater. Table 18 presents the ARP values for each subwatershed in the Upper White Salmon River watershed.

Table 18. Subwatershed Aggregate Recovery Percent (ARP) and Percent Rain-on-Snow (ROS).

Subwatershed Name	Code	Acres	ARP	%ROS
Upper White Salmon River	11C	4,115	76	33
Headwaters White Salmon River	11D	4,970	91	0
Cascade/Salt Creek	11E	9,737	98	9
Wicky/Morrison Creek	11F	6,791	99	7
Gotchen/Hole in the Ground Creek	11G	12,744	94	36
King Mt.	11H	11,065	70	48
Lower White Salmon River	11I	4,010	80	92
Buck Creek	11J	4,663	77	26
Green Canyon Creek	11K	2,881	79	95
Ninefoot Creek	11M	1,716	71	13
Cait Creek	11Y	992	79	90
Middle White Salmon River	11Z	2,824	75	95
UWSR Watershed	**11**	**66,509**	**85**	**36**

Current ARP levels range from 70 in the King Mountain subwatershed to 99 in the Wicky/Morrison subwatershed. The ARP for the entire analysis watershed is 85. Based on current ARP levels, the King Mountain, Ninefoot Creek, Middle White Salmon, and Upper White Salmon River subwatersheds are at greatest risk of changed snow accumulation and melt dynamics as a result of past timber harvest.

Because ARP values are used to help assess the effects of vegetation cover on peak flows resulting from rain-on-snow driven floods, the elevations of the subwatershed are also important in assessing the risk of increased peak flows. Those subwatersheds with a relatively high percent of their area in rain-on-snow elevations, and with a relatively low ARP would be at greater risk of having peak flows increased as a result of past timber harvest. Table 18 shows the percent of each subwatershed in the high probability rain-on-snow elevations (%ROS), which are generally considered to be from 1,500 to 3,500 feet in this watershed. Much of the Upper White Salmon River watershed falls into this and higher elevation zones where snow accumulation and snowmelt are dominant hydrologic processes. Based on the proportion of each subwatershed in the ROS zone, the Green Canyon Creek, Middle White Salmon River, Cait Creek, and Lower White Salmon River subwatersheds have the greatest potential for altered peak flows associated with rain-on-snow runoff.

ROADS

Roads are another important feature on the landscape that can affect the hydrologic functioning of a watershed. By impeding water infiltration, intercepting subsurface water and converting it to surface flow in roadside ditches, roads can accelerate the rate at which water moves from hillslopes into streams. As the number of roads or road density is increased in a watershed, the potential for this localized effect on hillslope hydrology to affect watershed hydrology by changing the rate or timing of streamflows is increased. Table 19 displays the current road mileage and road densities for each subwatershed.

Table 19. Road miles and Density by Subwatershed.

Subwatershed Name	Code	Road Miles	Road Density
Upper White Salmon River	11C	24.0	3.7
Headwaters White Salmon River	11D	11.2	1.4
Cascade/Salt Creek	11E	2.8	0.2
Wicky/Morrison Creek	11F	10.0	0.9
Gotchen/Hole in the Ground Creek	11G	41.9	2.1
King Mt.	11H	60.0	3.5
Lower White Salmon River	11I	25.0	4.0
Buck Creek	11J	16.7	2.3
Green Canyon Creek	11K	19.8	4.4
Ninefoot Creek	11M	9.7	3.6
Cait Creek	11Y	6.9	4.4
Middle White Salmon River	11Z	13.8	3.1
UWSR Watershed	**11**	**241.8**	**2.3**

In general, subwatersheds with road densities in excess of 3.0 miles per square mile of watershed area are considered "high" on the Gifford Pinchot National Forest. Green Canyon Creek, Cait Creek, and the Lower White Salmon River have exceptionally high road densities at four miles or more per square mile of drainage area. This level of roading would be of particular concern when it occurs in subwatersheds which also have relatively low ARP's, and have relatively high proportions in the ROS elevations. The Wicky/Morrison and Cascade/Salt Creek subwatersheds have quite low road densities which probably results from lying mostly within the Mt. Adams Wilderness.

Another way of looking at the effect of roads on the hydrology of the watershed is through the change roads cause in watershed drainage density. Roadside drainage ditches that drain to either perennial, intermittent, or ephemeral channels in effect function as channels during runoff, and increase the effective drainage density of a watershed. This increases the rate at which water is moved from the hillslopes into surface stream channels, allowing water to concentrate in channels much faster, and potentially resulting in changes in the magnitude or timing of peak streamflows.

During runoff periods, as additional miles of road begin to capture and route water directly to streams through roadside ditches, the effective surface drainage network in a watershed can be substantially increased. Table 20 displays the natural drainage network density for each subwatershed, and the percent that the natural drainage density may be increased during runoff periods as a result of the current level of roading in the watershed. The values presented in this table were determined by assuming that during runoff events, approximately 57% of the roads in the watershed function as extensions of stream channels by routing water directly from hillslopes to streams (following Wemple, 1993). Because there are a number of variables that affect how much of the road system actually functions as channel extensions, these numbers are presented only to provide a relative comparison of the potential effects of roads between subwatersheds.

Table 20. Natural Drainage Density and Percent Drainage Denstiy is Increased by Roads.

Subwatershed Name	Code	Stream Miles	Natural Drainage Density (mi/mi^2)	Current Drainage Density (mi/mi^2)	Increase in Drainage Density (%)
Upper White Salmon River	11C	20.32	3.2	5.3	67
Headwaters White Salmon River	11D	26.97	3.5	4.3	24
Cascade/Salt Creek	11E	47.66	3.1	3.2	3
Wicky/Morrison Creek	11F	44.24	4.2	4.7	13

Gotchen/Hole in the Ground Creek	11G	52.73	2.6	3.8	45
King Mt.	11H	38.01	2.2	4.2	90
Lower White Salmon River	11I	18.56	3.0	5.2	77
Buck Creek	11J	15.62	2.1	3.5	61
Green Canyon Creek	11K	12.49	2.8	5.3	91
Ninefoot Creek	11M	9.07	3.4	5.4	61
Cait Creek	11Y	4.68	3.0	5.5	84
Middle White Salmon River	11Z	11.67	2.6	4.4	67
UWSR Watershed	**11**	**302.02**	**2.9**	**4.2**	**46**

Drainage density in some subwatersheds has been dramatically changed due to road systems. In the King Mountain, Green Canyon Creek, and Cait Creek subwatersheds, natural drainage densities have been nearly doubled. The large increase in drainage density in King Mountain is due in part to the naturally low drainage density there combined with a relatively high road density. For Green Canyon and Cait Creeks, the large increase in drainage density is due to exceptionally high road densities (4.4 miles per square mile).

The degree to which any particular road intercepts subsurface flows and re-routes this water to streams via roadside ditches is dependent upon a number of variables including the soil type and depth, subsurface geology, hydrology, slope, and position of the road on the hillslope. Roads located along ridgetops are probably less important to changes in hydrologic flow paths because these roads have no cutslope and no drainage area above them. Roads in mid-slope positions have relatively larger drainage areas above them, and may have long distances below them through which water would normally have flowed via subsurface pathways. When they are intercepting subsurface water, these roads may have the greatest effect on changing the timing of water delivery from hillslopes into stream channels. Roads in lower hillslope positions are probably the most likely to intercept subsurface flows, because these landscape positions are where subsurface water builds up and often intersects the ground surface during precipitation or snowmelt periods. Roads in the analysis watershed are found in all landscape positions, though there are probably more in mid-slope and ridge top positions than in valley bottoms.

OTHER WATERSHED DISTURBANCES

Land converted from forestland to other vegetation types or other uses may also be an important factor in assessing the degree to which watershed hydrology has been changed in this watershed. Land uses including residential and commercial development compact soils and cover the ground surface with impervious material, causing water to run overland instead of seeping into the ground and flowing more slowly through subsurface pathways. By accelerating the movement of water to stream channels, this can affect the timing and magnitude of peak flows. Less than 1% of this watershed is in the residential, administrative, or rural land use classes, and most of this is concentrated in the lower subwatersheds.

RISK OF INCREASED PEAK FLOWS

Based on the vegetation age classes present, the elevations of the subwatershed, and the degree of roading that has occurred, a relative risk rating was used to identify those subwatersheds with the highest potential for increased peak streamflows. The risk rating indicates relative differences between subwatersheds, rating each subwatershed as “high”, “medium” or “low” risk for increased peak flows. Figure 10 presents the results of this risk rating.

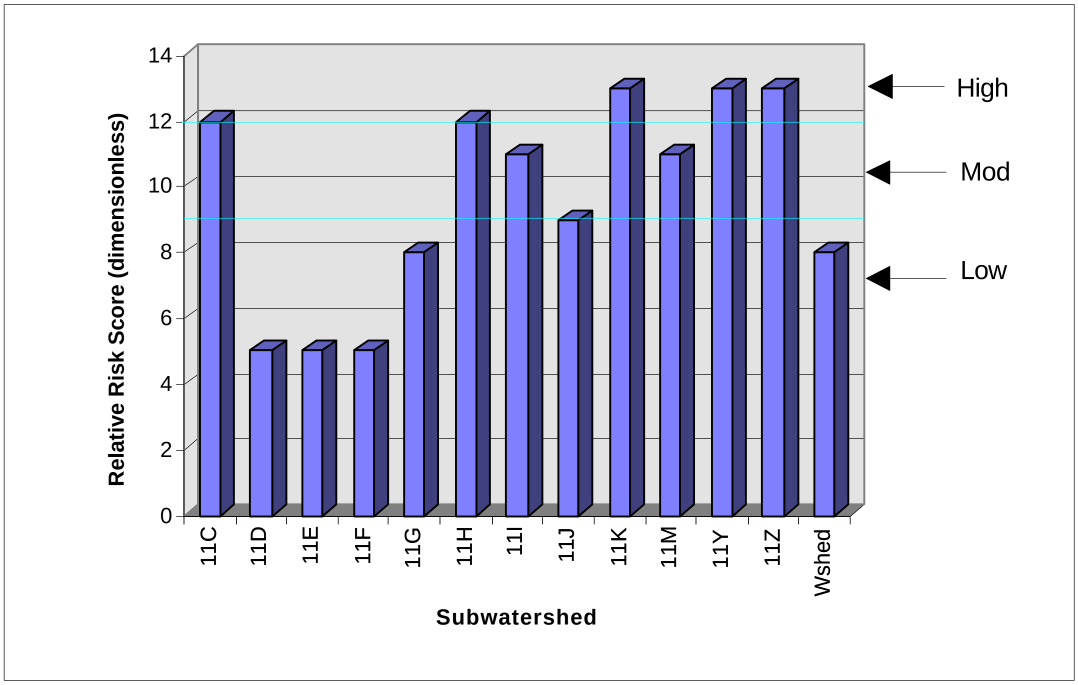

Figure 10. Relative Risk of Increased Peak Flows by Subwatershed and for the UWSR Watershed.

Based on this rating, the Upper White Salmon (11C), King Mt (11H), Green Canyon (11K), Cait Creek (11Y), and Middle White Salmon River (11Z) subwatersheds are at a relatively high risk of increased peak streamflows based on their current road density and vegetative condition. The Lower White Salmon River (11I), Buck Creek (11J), and Ninefoot Creek (11M) subwatersheds are at a moderate risk, and remaining subwatersheds as well as the entire UWSR watershed are in the low risk category.

PREDICTED CHANGES IN PEAK STREAMFLOWS

To further investigate potential changes in peak streamflows resulting from past forest harvest alone (i.e. not including the effects of roads), streamflows were modeled under current vegetative conditions and compared against streamflows modeled under fully forested (i.e. pre-harvest) conditions. The model used for this is a tool developed for watershed analysis by the Washington State Department of Natural Resources. The model calculates differences in snow accumulation and melt based on changes in vegetative conditions in the watershed. Based on the amount of snow accumulation and calculated rates of snowmelt, the model predicts a volume of water available for runoff for a range of flood recurrence intervals. Differences in water available for runoff are then converted to streamflow to show differences in predicted flow under different vegetative conditions. This model does not in any way address routing of the water from hillslopes into stream channels, so the effect of roads on peak flows is not taken into account. Table 21 displays the estimated discharges for each subwatershed over a range of recurrence intervals. Discharge calculations use regional regression equations developed by the USGS (Cummans et. al, 1975).

Table 21. Estimated Peak Discharge Levels for a Range of Recurrence Intervals.

Subwatershed		**Estimated Peak Discharges* (cfs) and Recurrence Interval**					
Name	**Code**	**2-Yr**	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Upper White Salmon River	11C	338	435	546	692	760	833
Headwaters White Salmon River	11D	246	298	408	589	637	703
Cascade/Salt Creek	11E	**	**	**	**	**	**

Wicky/Morrison Creek	11F	**	**	**	**	**	**
Gotchen/Hole in the Ground Creek	11G	460	612	865	992	1162	1251
King Mt.	11H	397	503	633	759	853	914
Lower White Salmon River	11I	188	235	294	343	380	410
Buck Creek	11J	338	418	600	667	779	826
Green Canyon Creek	11K	188	236	315	352	404	428
Ninefoot Creek	11M	138	167	225	282	312	313
(no name)	11Y	80	103	141	152	178	187
Middle White Salmon River	11Z	205	253	346	388	442	472

*Estimates made from USGS regional regression equations.
**Estimates not made. These subwatersheds are primarily located in the Highlands precipitation class.

The model was run for each subwatershed in the watershed. Peak flows were calculated for the flood with a two-year recurrence interval under current conditions and under fully forested conditions. The two-year event is used because the higher frequency events show the greatest relative change in magnitude as a result of changes in forest cover, and because these events are considered to be the most important events from a stream channel and fish habitat perspective. Streamflows modeled under current conditions are compared against those modeled under fully forested conditions to show the magnitude of difference in streamflows under the two vegetative conditions. Figure 11 presents the results of this modeling effort.

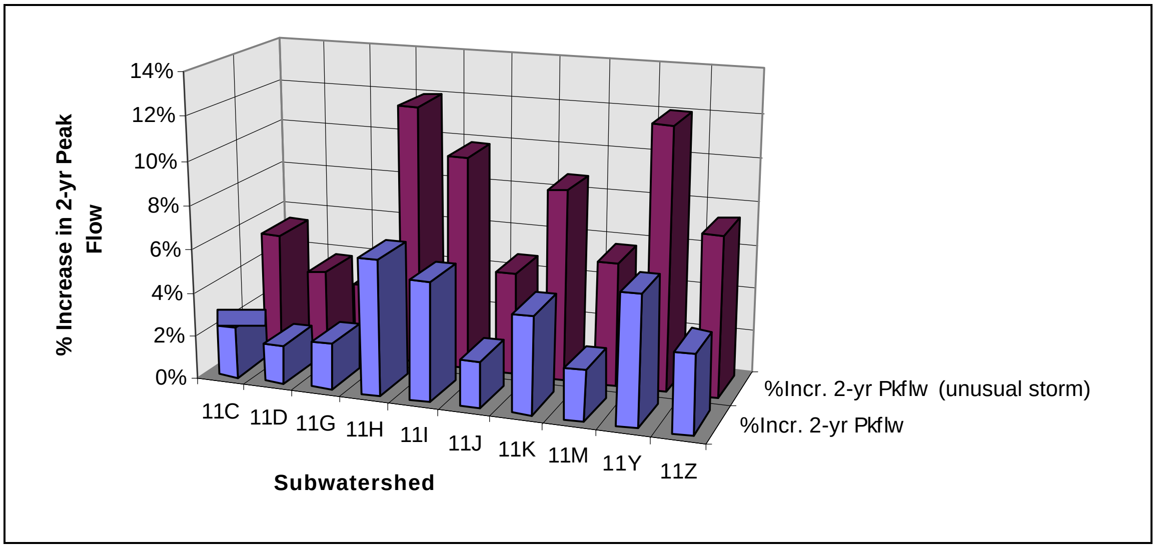

Figure 11. Predicted Peak Flow Increases Under Current Vegetative Conditions for Two Storm Intensities.

For subwatersheds in this analysis watershed, the two year flood is predicted to have increased by from 2 to 6 percent under “average” storm conditions, and from 4 to 12% under “unusual” storm conditions. The King Mt (11H) and Cait Creek (11Y) subwatersheds showed the greatest increases at 6% each. The State of Washington defines a 10% change as the threshold for concern. Streams showing less than a 10% increase in discharge under the State’s interpretation are given a “low” risk rating.

DATA GAPS

Current streamflow data for any stream in the watershed

CHANNEL CONDITIONS

REFERENCE CONDITIONS

Stream channels in the Upper White Salmon River watershed are strongly influenced by past volcanism and mass wasting processes associated with Mt. Adams and other volcanic vents in the watershed. Landslides, debris avalanches and lahars from Mt Adams have filled, scoured, and altered stream courses in this watershed for thousands of years. More recent landslides at upper elevations of the watershed have strongly influenced the upper reaches of Cascade and Salt Creek, but are relatively minor disturbances in comparison with past debris avalanches and lahars. The Cascade and Salt Creek systems appear to have sustained more than there share of the large debris avalanches and lahars in the past. The mountain slope is relatively steep in this area, and the processes of glaciation along with past mass wasting have deeply eroded this portion of the mountain.

Examples of past slides that impacted this watershed include a 5 million cubic yard rockfall that occurred from Avalanche Glacier in 1921. This debris avalanche travelled several miles down the Salt Creek valley, and contained or acquired sufficient water to partly transform into small lahars. Approximately 6,000 years ago, an avalanche of some 90 million cubic yards of debris initiated the largest known lahar to impact this watershed. The lahar inundated the Trout Lake lowland and continued down the White Salmon River valley at least as far as Husum (Scott and others, 1995). These events are clearly of a magnitude that would have totally altered, buried, re-routed, and re-shaped stream channels directly in the path of the avalanche or lahar. Deposits from these events form the substrate through which a number of streams in the watershed are currently cutting.

More frequent but lower impact disturbance processes also affected riparian areas and stream channels in the watershed, including fire, flooding, wind and ice storms, as well as disease or insect outbreaks. Subsequent to large-scale or intense fires, woody debris and sediment inputs to the stream system were increased. Trees burned in the riparian area were blown over or fell into the stream, debris flows from burned over hillslopes moved sediment and wood downslope to stream channels, and surface soil erosion increased in areas where duff and ground cover was consumed. Woody debris recruited into stream channels following such fires likely played an important role in stabilizing the channel during subsequent high streamflow events. Large wood in the system also provided channel roughness, instream hydraulic variability, helped armor streambanks, and provided locations for intermediate sediment storage throughout the channel network.

CURRENT CONDITIONS

Although there have been no recent volcanic eruptions, mass wasting from the upper slopes of Mt. Adams continues to play a disturbance role in stream channels at upper elevations of the watershed. In 1997, a large mass of ice and rock slid from Avalanche Glacier and continued down the upper reaches of Cascade and Salt Creeks. Although this event only impacted a relatively small section of two streams in the watershed, it serves as a reminder that mass wasting processes are still ongoing, and can have significant effects on affected portions of the watershed.

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

Livestock grazing including cows and sheep has been ongoing in the watershed for the past 100 years or more (see Cultural section of this report). The current allotment that includes this watershed is used only by cattle. Direct effects of these animals on riparian condition can include physical trampling and breaking down of channel banks, effects to water quality, and changes in vegetative structure, density and composition. In extreme cases, major changes in channel morphology and in streamflow can follow as well. Since there has been no systematic monitoring of livestock use in riparian areas of the watershed, it is unknown the degree to which livestock have affected riparian conditions. However, anecdotal evidence indicates that while there are specific areas of concentrated use that show negative impacts of cattle use, there has not been widespread damage to stream channels attributable to grazing.

CHANNEL TYPES

Channel gradients are a primary element used in channel typing, and a key factor in assessing channel response to disturbance such as high flows, bank disturbance, and riparian vegetation removal. Very high gradient channels can be source areas for sediment production and delivery to lower stream reaches. Primary disturbance processes in these channels include avalanches, debris torrents, and other mass wasting. Due to their gradient, these high gradient channels also route systems are In contrast to these types of channels are the lower gradient reaches where the capacity for sediment transport is exceeded by the amount of sediment supplied from upstream. These lower gradient stream reaches are where channel response to changes in sediment supply or stream discharge can be most evident. These channels generally are bounded by material that has been deposited over time by the stream. This alluvial material is much less resistant to erosion and bank cutting than the large boulder and bedrock substrates common in the upper stream reaches, and thus movement of the channel, or changes in channel geometry can occur more frequently in these channel types through fluvial processes. Also, because these are lower energy systems, response to disturbance can occur relatively quickly, but recovery from disturbance can take long periods of time.

Channel typing is done as a means of distinguishing between channels of different morphology or grouping channels of similar characteristics. The purpose of channel typing is in part to help predict channel processes and response to disturbance. The Rosgen channel typing system is used on the Forest to classify channels based on gradient, substrate and form. Because channels within a channel type have roughly similar morphology, gradient, substrate and plan form, they are likely to behave similarly in response to disturbance. Channels in this watershed were typed to major channel type (i.e. A-G) largely from topographic maps and air photos, with field validation done at selected points. Those sites where field visits were conducted were classified as to channel substrate as well (i.e. 1-5). Figure 12 shows the proportion of the stream network in this watershed that is in each major Rosgen channel type.

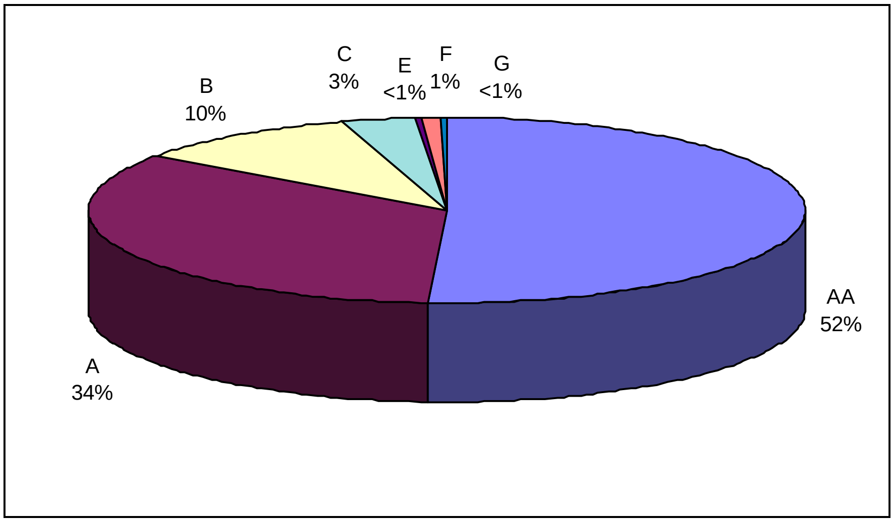

Figure 12. Rosgen Channel Types in the UWSR (Percents are calculated based on the total miles of stream in the watershed.)

Due to its location on the slopes of Mt. Adams, the watershed is dominated by higher gradient channel types. Nearly 96% of the streams in the watershed are in either Rosgen A, Aa+, or B channels, all of which are over 2% gradient, and are sediment transport dominated systems. Over one half of the stream miles in the watershed are in the highest gradient stream types, the Aa+. A majority of these are on the upper slopes of Mt. Adams (Figure SC-2), and in many cases lie above tree line. These channels along with the Rosgen A channels are often locations of sediment introduction through mass wasting processes on upper slopes. Rosgen A channels constitute another one third of the watershed. These are typically step/pool channels that have gradients of 4-10%. Although these are often very stable channels due to the controlling influence of bedrock and boulders, the finer grained A channels (i.e. A4, A5) can be sensitive to disturbance. Rosgen B channels have moderate gradients of 2-4%. These are very stable channels that are dominated by sediment transport. Rosgen B channels comprise about 10% of the stream miles in the watershed.

Rosgen C channels are located where gradients drop below 2%. These are alluvial channels, and while sediment is moved through them, can be areas of long term sediment storage as well. The C channels are often where the stream shows the greatest response to upstream changes in discharge, sediment, or wood supply. Because they rely on vegetation for bank protection and stability, removal of trees from the riparian area—both standing and down trees—can destabilize these channels. Once destabilized, the normal processes of channel migration and bank cutting can be greatly accelerated, particularly during high peak flows. Rosgen C channels are not particularly prevalent in this watershed, due to a combination of relatively high gradient and narrow valley bottoms. The Upper White Salmon River subwatershed (11C) has the largest share of C channels in the watershed.

Rosgen E channels in this watershed are found in wet meadow systems. These channels have low gradient, and high sinuosity, and are highly efficient at transporting sediment due to their low width-to-depth ratio. In an undisturbed condition, they are not sensitive to changes in peak flows because high flows quickly exceed the channels capacity, and can spread out and dissipate energy in floodplains. These channels rely on vegetation for bank stability, and when vegetation is removed or banks are destabilized, these channels can widen, downcut, and become sediment sources, as well as potentially lowering local subsurface water elevations.

Rosgen F channels are low gradient, entrenched streams that have a high potential for introducing sediment from steep surrounding banks. In this watershed, they are found exclusively at the lower end of the watershed on the mainstem of the White Salmon River. The river in these areas has cut down through old mudflow deposits and has created a relatively wide channel with steep sidewalls composed of erodable material. This channel type represents about one percent of the stream miles in the analysis watershed. Table 22 summarizes the Rosgen channel types by subwatershed.

Table 22. Miles of Rosgen Channel Type by Subwatershed.

Subwatershed	A	AA	B	C	E	F	G
11C	0.9	10.9	2.3	6.1	0.3		
11D	8.5	14.3	1.7				
11E	1.2	39.7	3.9	1.4			
11F	9.2	29.0	5.9				
11G	25.0	20.6	5.1				
11H	28.5	9.5					
11I	6.2	6.8	0.9	1.4		2.2	1.0
11J	9.5	4.5	1.6				
11K	3.4	4.2	3.9		1.0		
11M	5.1	3.9	0.0				
11Y	2.0	2.4	0.2				
11Z	1.9	4.5	4.9	0.3			
UWSR Watershed	**101.4**	**150.5**	**30.3**	**9.2**	**1.3**	**2.2**	**1.0**

CHANNEL CONDITIONS

Channel conditions are affected by a range of factors including upslope activities, conditions and activities in the riparian areas, as well as instream. Roads constructed across stream channels represent locations where the channel is typically constricted, fixed in position, and often where fill has been placed in the channel. Road crossings also create a discontinuity in riparian vegetation, and can function as sediment retention areas (i.e. above culvert inlets), and as sediment sources (i.e. through fill slope erosion, road surface erosion, and gullying below culvert outlets. During floods, these points on the channel become hazards, in that they often do not pass large woody debris or even sediment. The number of road crossings by subwatershed can be an indication of the number of channel discontinuities and the relative hazard during high flows. The number of road crossings per subwatershed is presented in the Water Quality section of this report, Table WQ-6. In general, roads and road crossings functioned well in this watershed during the 1996 flood. The hazard factor associated with culvert sites is considered relatively low in this watershed as compared to other watersheds, largely because of the relatively gentle slope of the watershed, and the fact that much of the upper, steeper portion of the watershed is in Wilderness, so has no roads.

Riparian vegetation directly affects the amount of large woody debris in stream channels, and plays a key role in channel stability through its subsurface rooting and bank protection. The loss of riparian vegetation, and in particular large trees, can have a large effect on channel structure and response to other disturbances such as high streamflow. Instream large woody debris is important for structural stability of some channels, and also acts to slow water velocities, trap sediment, and provide habitat complexity for fish. Standing green trees are critical to stream systems where root masses of the riparian trees constitute a large share of the channel bank stability (i.e. Rosgen C channels). In these systems, removal of trees from the streambanks can substantially reduce the cohesiveness of bank material. Subsequent high flows can more easily erode banks, change channel shape and form, and accelerate stream migration and sediment production from streambanks.

Seral class of forest vegetation in the riparian area is another indication of the stability and health of the stream system. A large proportion of the riparian area in late successional forest indicates a channel with a high potential for large woody debris recruitment. Conversely, a riparian area with a high proportion of early seral vegetation might indicate areas that have been logged, and where there are fewer large trees remaining along the stream. Because root systems of large trees can be extensive and can play a large role in streambank stability, a lack of standing large trees in the riparian area can also indicate areas where channels are less robust to physical disturbances such as high peak flows. Table 23 shows the percent of the Riparian Reserves in each subwatershed that are in early and late seral vegetation.

Table 23. Percent Early and Late Seral Vegetation in Riparian Reserves.

Subwatershed Name	Subwatershed Number	Percent RR in Early Seral*	Percent RR in Late Seral**
Upper White Salmon River	11C	7	72
Headwaters White Salmon River	11D	3	55
Cascade/Salt Creek	11E	20	10
Wicky/Morrison Creek	11F	9	26
Gotchen/Hole in the Ground Creek	11G	7	30
King Mt.	11H	17	31
Lower White Salmon River	11I	13	23
Buck Creek	11J	13	47
Green Canyon Creek	11K	21	36
Ninefoot Creek	11M	23	63
(no name)	11Y	12	57
Middle White Salmon River	11Z	4	84
UWSR Watershed	**11**	**12**	**38**

* Range of Natural (from REAP) 5-30%
** Range of Natural (from REAP) 23-92%

The proportion of early and late seral vegetation in Riparian Reserves in the watershed is within the "range of natural" conditions as defined in the Regional Ecosystem Assessment Process (REAP) for these riparian areas (USFS, 1993). The watershed is below the midpoint for the "range of natural" in terms of both early and late seral vegetation, implying that there is slightly more mid seral vegetation now than under "average" conditions during the reference period. The subwatershed with the highest proportion of late seral vegetation in the riparian area is the Middle White Salmon River at 84%. This subwatershed is entirely outside of the Wilderness. The Cascade/Salt Creek subwatershed is largely in Wilderness, yet it has the lowest proportion of its riparian area in late seral vegetation at 10%. The lack of late seral vegetation in the Cascade/Salt Creek subwatershed is largely due to the high elevations, short growing season, and the fact that a large part of the lower riparian areas in this subwatershed are in wet meadow/mesic conditions. In addition, over one quarter of the riparian area in this subwatershed is above tree line, so has no forest vegetation. Were the vegetation classes to be grouped based on age instead of size class of the trees, it is possible that the Cascade/Salt Creek subwatershed would show as having more late seral vegetation. Because of the short growing season and difficult growing conditions at this elevation, many trees that are old enough to be called "late seral" are actually in the "small tree" or even "pole" size classes. It appears that these higher elevation stream channels did not develop with the number and size of large trees that were found in streams at lower elevations as a result of this.

CHANNEL SENSITIVITY

Channels most vulnerable to heating in general include the Rosgen C, E, and F channels. Vulnerability of the C and F channels stems from the relatively high width-to-depth ratios in those streams, offering a large surface area of potential exposure to radiation. Rosgen E channels can be areas of stream heating or cooling, depending on the condition of the channels, the presence of shrubs or trees along the banks, and extent to which the stream is gaining water from the meadow through subsurface pathways.

There are limited reaches of C channel in the watershed, and those that exist are primarily on the mainstem of the White Salmon River, as well has short reaches in Cascade Creek and Stagman Creek. As mentioned in the Water Quality section of this report, because of the relatively high volume of flow during the summer months from glacial melt, risk of temperature problems with these streams is relatively low. Rosgen F channels in this watershed are found exclusively on the mainstem, and for the same reason just stated, are probably not likely to experience particularly high water temperatures. Rosgen E channels represent a very small portion of the channel network in this watershed (less than one percent), but can be areas of stream heating, particularly when the banks are laid back or degraded. In this watershed, they are found in high elevation meadow systems such as the Upper Gotchen Meadows (unmapped), in upper Green Canyon Creek, and in the west fork of Stagman Creek. Although the E channels have a relatively low width-to-depth ratio, they flow through meadow systems, and commonly have no tree or shrub cover over the channel. Because of the high sinuosity through these meadows, water in the channels has a large (potential) exposure time to solar radiation, which can cause heating.

Vulnerability to impacts of grazing is similarly greatest for the Rosgen C, E, and F channels, but may also include the A channels that have finer substrate and bank material (e.g. A4, A5). Although the A channels are relatively steep and generally would be prohibitive to cattle, the banks are generally not particularly cohesive or stable, and can be sloughed back by direct trampling. Areas of potential concern from a grazing standpoint would be the E channels in high elevation meadows, and the C and F channels where livestock may congregate or use for extended periods of time. Road crossings on any of these channels represent locations that should be monitored.

Stream reaches most sensitive to changes in peak streamflows would be the Rosgen C and F channels, and possibly also the A4 and A5 channels. The concern with increased peak flows would be the increased depth and frequency of channel bed scour, and the increased potential for accelerated channel bank erosion. Rosgen E channels generally do tend to not contain high flows, and when they are well vegetated, are not particularly sensitive to high streamflows. Rosgen C and F channels are more prone to bank erosion, during high flows, particularly when riparian forests have been cut and large woody material has been removed.

WATER QUALITY

REFERENCE CONDITIONS

WATER TEMPERATURE

Stream water temperatures are closely tied to the intensity and duration of direct solar incidence on the stream and volume of stream discharge. In the analysis watershed, annual water temperature maximums typically occur in the summer months of July, August and September, as streamflows reach their annual minimum levels and air temperatures reach annual peaks. Figure 13 shows this pattern using temperature data collected in 1977. Although actual temperatures during the reference period may well have differed from 1977 levels, the relative timing of peak temperatures during the year has not changed. Year-to-year variation in maximum stream temperature occurs in response to changes in low flow discharge, changes in peak levels and duration of ambient air temperature maximums, and changes in riparian shade. Changes in channel morphology as a result of debris torrents, aggradation, or other means can accentuate changes in water temperature by exposing a greater or lesser stream surface area to insolation and direct heat exchange at the water surface.

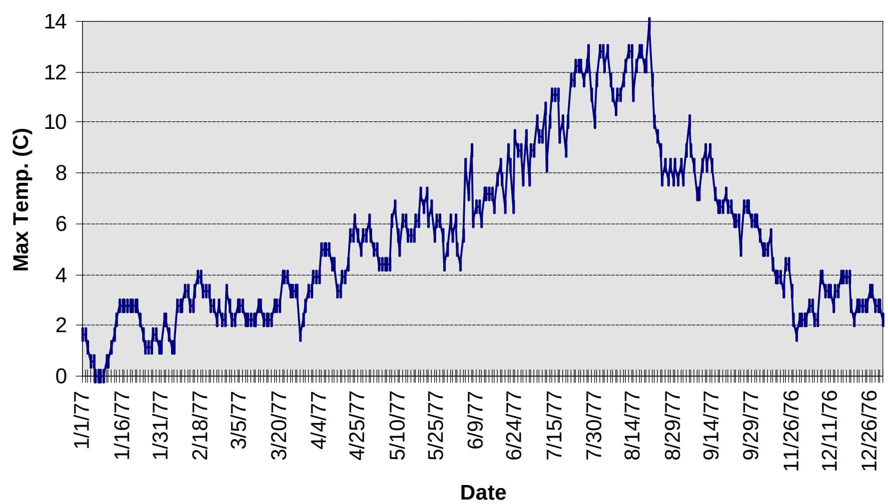

Figure 13. Maximum Daily Water Temperatures on the White Salmon River Baseline Station (Subwatershed 11I) During 1976 and 1977.

Changes in riparian canopy cover are the most dominant cause of change in water temperatures aside from larger scale meteorologic factors such as air temperature and precipitation. The primary factors affecting riparian canopy cover under reference conditions were fire, insect and disease outbreaks, and debris torrents or large scale flooding that removed riparian vegetation. As the proportion of the riparian area in early seral condition increased, the potential for elevated maximum water temperatures increased. The *First Approximation of Ecosystem Health* (USDA-FS 1993), also referred to as the Regional Ecological Assessment Project (REAP), concluded that early seral vegetation comprised anywhere from 5 to 30% of riparian areas under historical (pre-settlement) conditions for watersheds in the Hood-Wind Subbasin. The REAP also defined the “range of natural” water temperatures in this area to be 7-20 °C.

TURBIDITY

Turbidity levels in streams are an indication of the amount of fine material in suspension in the water column. Streams often show a high correlation of turbidity levels with stream discharge levels because the capability of both entraining sediment and maintaining that sediment in suspension is closely tied to stream discharge. In this watershed, high streamflows occur both in winter months during heavy rains or rain-on-snow conditions, as well as in spring when warmer temperatures begin to melt higher elevation snowpacks and glaciers. (see Hydrology section of this report). Turbidity levels under reference conditions would similarly have winter peaks coinciding with major runoff events, but would also have remained elevated in spring through summer months as a results of glacial processes. During particularly cold, dry periods in winter, turbidities in this watershed may reach annual lows as a result of reduced snowmelt and runoff.

In addition to the effects of changing streamflow levels and glacial inputs, turbidity levels during the reference period were linked closely to large scale disturbances including fire, mass wasting and flooding. Sediment inputs from surface soil erosion were negligible under fully forested conditions, but would have increased for a short period following fire, particularly in the case of high intensity burns that damaged soil conditions. Although the watershed is considered relatively stable in terms of mass wasting, following large scale or intense fires, the potential for mass wasting would have increased for a period of time. In addition, Mt. Adams is known to have had a number of large scale landslides, debris flows, and lahars which would have caused increased turbidity levels for some time following these events. These types of events were relatively infrequent, but may have affected turbidity levels for extended periods following the event as streams re-carved channels in the deposits and the unvegetated deposits were eroded.

CURRENT CONDITIONS

WATERS WITHIN THE UPPER WHITE SALMON RIVER WATERSHED

Streams within the National Forest are classed by the Northwest Forest Plan (NFP) as either “perennial fish-bearing”, “perennial non fish-bearing”, or “intermittent”. Perennial streams are those that flow water year-round. Intermittent streams are those that only have flow during some part of the year. Some intermittent streams flow only during rainfall or high flow conditions, and others may flow for most of the year, but run dry for a short period of time in the late summer. Table 24 lists the miles of stream in the watershed, and the acres of lakes, ponds and wetlands. For purposes of this analysis, stream classes provided in the NFP were applied to all streams in the watershed regardless of land ownership.

Table 24. Aquatic Resources in the UWSR Watershed.

Aquatic Resources	Miles/Acres
Perennial Fish-Bearing Streams	34.6 mi.
Perennial Non Fish-Bearing Streams	72.6 mi.
Intermittent Streams	190.2 mi.
Lakes/Ponds	2 ac.
Wet Meadows	397 ac.

BENEFICIAL USES AND KEY WATER QUALITY PARAMETERS

All streams and lakes within the Upper White Salmon River watershed are rated by the Washington State Department of Ecology (WSDOE) as either Class AA (extraordinary), Class A (excellent), or Lake Class.

Stream segments on National Forest lands are rated as Class AA, as are all streams that feed lakes within the watershed. Specific water quality criteria have been established by WSDOE for each of these classes in conformance with the present and potential uses of the water. The purpose for these criteria and the state water quality standards is to ensure that water quality is maintained at levels that continue to support beneficial uses of those waters. The Upper White Salmon River watershed has a number of important beneficial uses that drive the need for water quality protection. Table 25 identifies the beneficial uses that occur in the watershed, the subwatersheds they are located in, and the primary water quality parameters of concern. The table is not inclusive of all water quality parameters that may affect the identified beneficial use, but identifies the dominant parameters of concern.

Table 25. Beneficial Uses and Primary Water Quality Parameters of Concern.

Beneficial Use	Subwatershed	Primary Parameters of Concern
Community and Domestic Water Supply	I	Fecal Coliform, Turbidity
Resident Fish	C,D,E,F,I,J,K, M,Y,Z	Temperature, Turbidity
Wild and Scenic River	C,D,E,I,Z	Fecal Coliform, Turbidity

<u>BENEFICIAL USE: COMMUNITY AND DOMESTIC WATER SUPPLY</u>

Although much of the town of Trout Lake lies within the Cave/Bear watershed, most of the residents get their drinking water from the Glacier Springs Water District, which uses a water source in the UWSR watershed. The Water District has approximately 320 subscribers in the community. Water used by the Glacier Springs Water District is of excellent quality according to District staff, and currently is neither chlorinated nor filtered. A number of private landowners in the valley have their own water sources as well. These sources are for domestic use, irrigation and stock watering, and come from either groundwater, springs, or from surface channels. Activities that could pose a threat to the water quality of these sources include waste material from livestock, wildlife, septic systems, and recreational users of the watershed. Timber harvest, road and landing construction, and other land use activities could also potentially affect turbidities in the surface water sources.

<u>BENEFICIAL USE: RESIDENT FISHERIES</u>

The UWSR watershed has a resident fishery that includes rainbow trout and brook trout. The primary water quality threats to these fish would be temperature increases (and resultant decreases in dissolved oxygen), and increases in sediment. Loss of streamside shade from timber harvest, grazing, or road construction, and sediment introduction from these same sources are the most likely pathways for affecting the fish through changes in water quality. Continued sediment input from areas of excessive streambank cutting, from existing road systems, and from recreation areas and other developed sites is also a concern.

<u>BENEFICIAL USE: WILD AND SCENIC RIVER</u>

The lower, middle, and upper reaches of the White Salmon River are all either designated or proposed for Wild and Scenic River designation. Because of this designation and the amount of recreation taking place in the White Salmon River, water quality of the river and its tributaries is important. The UWSR watershed is approximately 66,509 acres in size, representing approximately 27% of the entire drainage area for the White Salmon River. In addition, the entire reach of the White Salmon River within the analysis watershed as well as Cascade Creek are currently proposed for Wild and Scenic River designation.

WATER TEMPERATURE

Maximum summer water temperatures have been recorded intermittently since 1976 at the Forest Service baseline water quality monitoring station on the White Salmon River (located in Subwatershed 11I). Over the 15 years of monitoring, annual peak temperatures average 11.6°C and occur primarily in August, but also in July and September (Table 26). The state water quality standard for maximum water temperature has not been exceeded during the entire period of monitoring.

Table 26. Maximum Water Temperatures at the White Salmon River Baseline Monitoring Station for the Period of Record.

Year	Max Temp ºC	Month of Max	Data Source	Instrument Used
1977	14	Aug	FS-Storet	Peabody/Ryan?
1978	11	Jun (truncated record)	FS-Storet	Peabody/Ryan?
1980	11	Jul/Aug	FS-Storet	Peabody/Ryan?
1981	12	Aug	FS-Storet	Peabody/Ryan?
1982	10	Aug	FS-Storet	Peabody/Ryan?
1983	10	Jul/Aug/Sep	FS-Storet	Peabody/Ryan?
1985	12	Aug	FS-Storet	Peabody/Ryan?
1986	10	Aug	FS-Storet	Peabody/Ryan?
1991	12	Aug	FS-Files	Unidata
1992	13	Aug	FS-Files	Taylor Max/Min
1995	13	Aug	FS-Files	Unidata
1996	11	Aug	FS-Files	Unidata
1997	12	Aug	FS-Files	Unidata

It is somewhat unique on the south end of the Gifford Pinchot National Forest to have a stream of this size that has not exceeded the state standard for water temperature. The likely causes for the relatively cool summer temperatures here include the following: 1) the entire watershed is at relatively higher elevations than others on the District; 2) geomorphically, the watershed lacks large, wide alluviated valleys; 3) glacial inputs and high elevation snowmelt form the basis of late summer flows in much of the western and the central portion of the watershed; 4) streams draining this portion of the watershed have relatively high gradients and low width-to-depth ratios; 5) much of the riparian forest canopy is still functioning for shade in this portion of the watershed; and 6) most of the streams on the east side of the watershed are totally dry during the summer months, so do not have surface waters that could be exposed to the sun. Water from this eastern portion of the analysis watershed may in fact be reaching the White Salmon River through spring systems along the river corridor, and as this water is traveling largely through subsurface pathways, it may actually be a cooling source to the White Salmon River.

Water temperature monitoring was also conducted in both Green Canyon and Ninefoot Creek in the early 1990's. The first effort occurred in 1992 when max/min thermometers were placed in three locations in Green Canyon Creek and monitored for one season. Results indicated a general cooling in Green Canyon Creek from the upper stations to the station below the canyon portion of the stream. The 1992 water year was one of the warmest and lowest water summers recently experienced on the south end of the Gifford Pinchot National Forest, and during that summer, water temperatures in Green Canyon Creek reached 17°C (62°F) at all three stations monitored. Maximum temperatures in the White Salmon River near the confluence of Green Canyon Creek were 13°C (56°F) during this same period.

Taylor max/min thermometers were used for this monitoring effort. Although the accuracy of these instruments is sometimes not high due to both instrument and operator errors, the consistently higher temperatures in Green Canyon Creek as compared to the White Salmon River during this summer indicated that follow-up monitoring of Green Canyon Creek was merited. Since that time, Green Canyon was monitored for temperature in 1995 and 1996 and reached maximum temperatures of 13°C and 12°C respectively for those two years. Monitoring of water temperatures in Ninefoot Creek was conducted during 1995, 1996, and 1997. Maximum recorded temperatures during those three years were: 14°C, 11°C, and 11°C respectively.

For tributary streams lacking any water quality data, seral condition of riparian vegetation can be used to indicate specific areas of the watershed that may have temperature concerns due to a lack of shade. Riparian areas dominated by early seral vegetation may not be fully shaded by these young forest stands, and so may have higher direct insolation on the stream, and higher water temperatures as a result. For purposes of this analysis, early seral vegetation includes the vegetation classes: grass/forb, shrub/seedling, open sapling/pole, and light forest. Currently, approximately 12% of the Riparian Reserves in the analysis watershed are in these vegetation classes. This is within the “range of natural” conditions described in the REAP report (USFS, 1993). Although each of the tributaries also has early seral conditions within the “range of natural” described in the REAP report, Cascade/Salt Creek (11E), Green Canyon Creek (11K), and Ninefoot Creek (11M) have relatively high proportions of their Riparian Reserves in early seral vegetation (Table 27).

Table 27. Percent of the Riparian Area Currently in Early Seral Vegetation Types.

Subwatershed Name	Code	Percent RR in Early Seral
Upper White Salmon River	11C	7%
Headwaters White Salmon River	11D	3%
Cascade/Salt Creek	11E	20%
Wicky/Morrison Creek	11F	9%
Gotchen/Hole in the Ground Creek	11G	7%
King Mt.	11H	17%
Lower White Salmon River	11I	13%
Buck Creek	11J	13%
Green Canyon Creek	11K	21%
Ninefoot Creek	11M	23%
Cait Creek	11Y	12%
Middle White Salmon River	11Z	4%
UWSR Watershed	**11**	**12%**

Because most of the Cascade Creek/Salt Creek system is in Wilderness, the relatively high proportion of Riparian Reserves in early seral vegetation in that subwatershed appears to be a natural condition. Ninefoot and Green Canyon Creeks also have relatively high proportions of their Riparian Reserves in early seral vegetation, but in these cases, the early seral vegetation results from past harvest of riparian forests. In addition to the current seral condition of their riparian areas, Ninefoot Creek and Green Canyon Creeks may have a higher potential for increased water temperatures due to the fact that these streams are not directly influenced by glacial runoff and high elevation snowmelt from Mt. Adams as are all of the other major tributaries in the analysis watershed. As reported above however, monitoring to date indicates that temperature is not a major problem in these two streams.

COLIFORM

Fecal coliform monitoring in the analysis watershed has been limited in scope and sporadic over the past two decades. Most of the data on fecal coliform was collected at the Forest Service baseline water quality monitoring station in subwatershed 11I. The most consistent efforts were made in the early 1990’s by the Forest Service and Underwood Conservation District (UCD). In 1992, samples were collected monthly throughout the period that cattle were on the Mt. Adams Cattle Allotment. Peak coliform levels were reached in August of that year, and measured 40 colonies/100ml (Table 28). This is within the state water quality standard for fecal coliform, which is 50 colonies/100ml for class AA streams. The UCD continued quarterly monitoring at that station through the following year, and found coliform levels up to 45 colonies/100 ml in May, 1993. This peak occurred prior to cattle entering the Mt. Adams Allotment, suggesting that other sources are responsible for the coliform levels found there.

Table 28. Fecal Coliform Monitoring at the White Salmon River Baseline Monitoring Station.

Date of Sample	Fecal Coliform/100ml	Data Source
10/4/76	23	FS-Storet
5/31/77	30	FS-Storet
7/5/77	36	FS-Storet
10/2/78	30	FS-Storet
12/5/78	30	FS-Storet
11/5/79	2	FS-Storet
10/6/80	30	FS-Files
7/6/81	9	FS-Files
6/24/92	2	FS-Files
7/14/92	20	FS-Files
8/17/92	40	FS-Files
9/15/92	2	FS-Files
10/5/92	18	UCD
1/11/93	18	UCD
3/29/93	18	UCD
5/31/93	45	UCD
7/19/93	18	UCD
1/3/94	18	UCD

All of the coliform monitoring reported above occurred at the Forest Service baseline station on the White Salmon River. This station is located over one mile downstream of the National Forest boundary. Although the large majority of its drainage area is on National Forest lands, there is privately owned land surrounding the monitoring site which may influence water quality readings taken at that station.

In addition to the data presented above, Cascade Creek was monitored for fecal coliform in 1993 by the UCD. Their findings showed 18 colonies/100 ml at each of the four sampling periods. Based on these combined results, it would appear that there is not a significant problem with fecal coliform in either Cascade Creek or the White Salmon River where it leaves the National Forest. However, the results do indicate that there is an increase in coliform from levels occurring in Cascade Creek to levels measured at the White Salmon River baseline station in the lower portion of the analysis watershed. Moreover, because the White Salmon River has a relatively high discharge (i.e. large dilution factor) during the months of most intense recreational use and cattle use of the watershed, there may be localized areas within the watershed where coliform concentrations are higher.

TURBIDITY

Limited turbidity monitoring has been done within the analysis watershed. Forest Service measurements of turbidity from grab samples taken at the baseline station on the White Salmon River (near the mouth of the analysis watershed) occurred infrequently over the period of late 1975 through late 1980. The Underwood Conservation District in cooperation with the Forest Service reinitiated turbidity monitoring at that station in 1992, and continued collecting grab samples on a quarterly basis through early 1994. Results of this monitoring are presented as average monthly turbidities in Figure 13. With the exception of one very high turbidity reading taken during a December flood, average turbidity during the period of monitoring peaked in the summer months at this station, with a maximum value of 46 occurring in July of

1993. The lowest recorded values occurred during the winter months and early spring with the lowest value (<1 NTU) occurring in January, 1977.

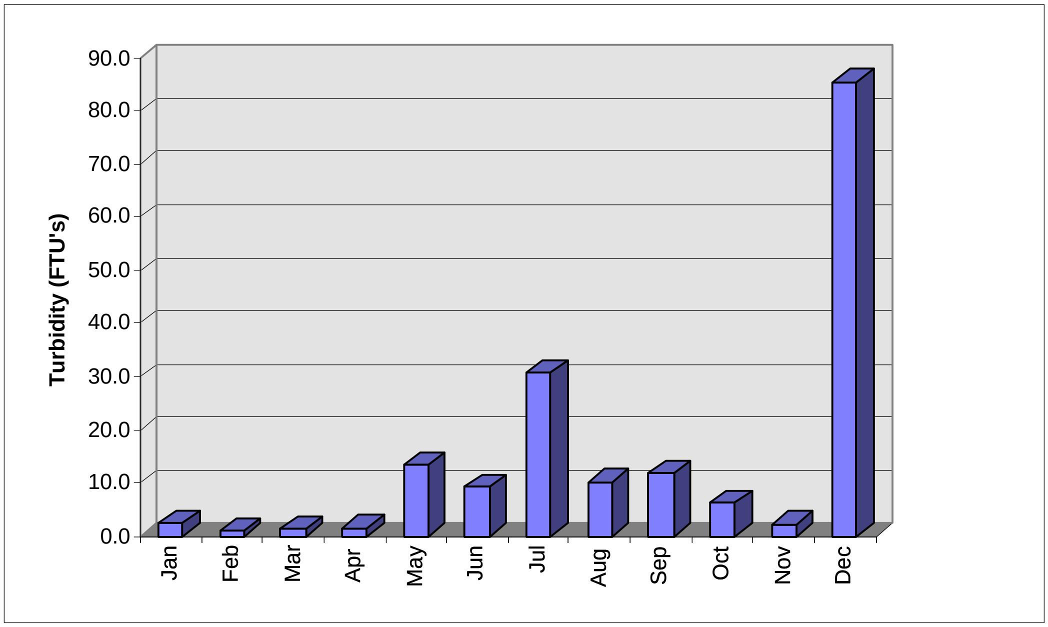

Figure 13. Average Turbidity at the White Salmon River Baseline Monitoring Station Based on Intermittent Grab Samples Taken During the Period 1975-1992.

(Note: The bars in this graph represent a mix of individual and average turbidities. For some months, there was only one sample collected, and in months that had more than one sample, the readings were averaged. The number of readings per month ranges from one in February, to ten in both July and August. December's average is based on four readings. If the one high value for December (336 FTU's) is taken out, the average value for December would be approximately 2 FTU's, essentially the same as both November and January.)

The late spring and summer peaks shown in Figure 13 are due to a combination of high flows associated with spring snowmelt and glacial processes that continue to provide fine glacial flour through the summer months, even as stream discharge is declining. Winter peaks are associated with rain or rain-on-snow events that flush sediments into streams and elevate stream discharge levels. The particularly large peak shown in Figure WQ-2 for the month of December is a result of one particularly high turbidity reading taken during a winter flood. Because this graph is based on very limited data that was not collected systematically, it is not expected to represent actual average turbidity levels. It is provided here only to show very general patterns of turbidity over the course of a year.

Results of turbidity monitoring done elsewhere in the White Salmon River watershed (outside of the analysis watershed) provides additional perspective for how turbidity levels in the analysis watershed compare to those around it. Figure 14 summarizes two years of data collection at major tributaries to the White Salmon River (WSR), and at four locations on the mainstem of the WSR. One station on the mainstem of the WSR lies within the analysis watershed, it is called the "Upper WSR" station.

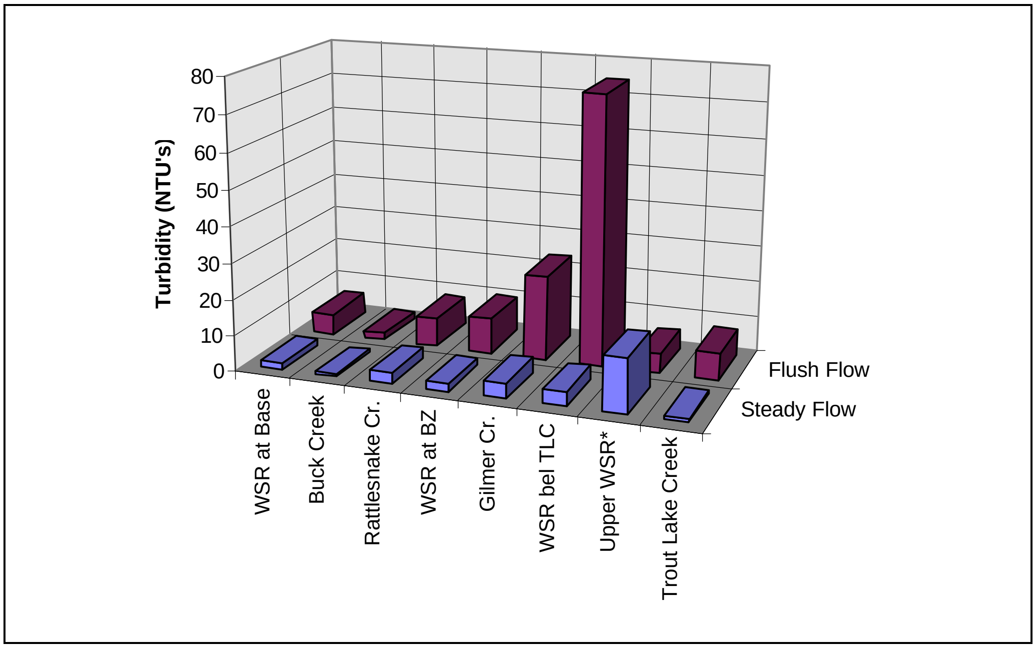

Figure 14. Average Turbidity Levels at a Number of Sampling Stations in the White Salmon River During Steady and Flush Flow Conditions (1992-1994).

* Upper WSR is the station lying within the analysis watershed.

During "steady flow" conditions, turbidity levels in the analysis watershed are substantially higher than in any other subwatershed, or any other location on the mainstem of the White Salmon River. However, during "flush" flows, turbidity levels actually decrease in the analysis watershed while increasing at all other stations in the watershed. During "flush" flows, average turbidity in the analysis watershed becomes one of the lowest levels in the entire watershed. "Flush" flow measurements were taken during periods of increased runoff. During these times, the discharge in the analysis watershed is less dominated by glacial runoff, so the turbidity from glacial flour is in effect diluted by the increased runoff from rainfall and snowmelt occurring in other parts of the analysis watershed. It also indicates that this runoff from elsewhere in the analysis watershed has lower turbidity than the water coming from the glacially fed streams, and even lower than many (most) of the other tributaries in the larger White Salmon River watershed.

Aside from glacial sources, turbidity is affected by sediment introduction from harvest units, roads, and other developed areas, as well as from streambank cutting and bank or slope failures. Upslope mass wasting potential is relatively low in this watershed compared with other watersheds on the Forest (see Mass Wasting section of this report), so this is likely a relatively small part of the source for turbidity over the long term.

More chronic, though lower intensity inputs of sediment in the watershed may be a result of sediment contributions from roads, harvest units, other areas where surface vegetation and soils have been disturbed, and from streambank cutting. Locations where roads cross streams are one of the primary avenues for sediment from the road prism to be delivered to a stream network. Figure 29 shows the number of road crossings per subwatershed, and the density of road crossings (number of road crossings per square mile of watershed area) by subwatershed.

Table 29. Road Crossings on Streams, and Road Crossing Density by Subwatershed.

Subwatershed Name	**Code**	**Road Xings (number)**	**Road Xing Density (number/sq. mile)**
Upper White Salmon River	11C	40	6.2
Headwaters White Salmon River	11D	16	2.1
Cascade/Salt Creek	11E	2	0.1
Wicky/Morrison Creek	11F	13	1.2
Gotchen/Hole in the Ground Creek	11G	57	2.9
King Mt.	11H	44	2.5
Lower White Salmon River	11I	10	1.6
Buck Creek	11J	19	2.6
Green Canyon Creek	11K	32	7.1
Ninefoot Creek	11M	9	3.4
(no name)	11Y	13	8.4
Middle White Salmon River	11Z	9	2.0
UWSR Watershed	**11**	**264**	**2.5**

This watershed has the lowest road crossing density of any other watershed analysis area on the Mt. Adams Ranger District. It is less than half the density found in the Wind River and Little White Salmon River watersheds, and less than the other two eastside watersheds, Trout Lake Creek and Cave/Bear Creek. This reflects the relatively gentle topography of the watershed and lack of surface stream channels on the eastern side of the watershed. Total road densities in this watershed are actually at least as high as they are in other District watersheds.

Although remobilization of sediments stored in streambeds, on bars, and in streambanks can be another important component in the total sediment load carried by a stream, the magnitude of this factor is largely a function of the stream channel type and condition. This watershed is dominated by Rosgen AA, A and B channel types (see Stream Channel section of this report). Because these channel types are sediment transport-dominated systems, they typically do not store a great deal of fine sediment, and therefore are probably not a large source of stored instream sediment. Lower gradient C channels, and degraded E channels may be a greater source for turbidity associated with in-channel stored sediments, but these types of channels are quite limited in this watershed.

FISHERIES

REFERENCE CONDITIONS

ANADROMOUS FISH POPULATIONS

Condit Hydrologic Dam is located on the White Salmon River 3.3 miles upstream from the Columbia River confluence. An impassable concrete dam is present at this site and was completed in 1911. In 1913 a fish ladder was included in the Condit project and was washed out that same year. This dam has blocked upstream migration of salmonids since 1913. Prior to dam construction, anadromous fish species found in the river included: fall chinook salmon *(Oncorhynchus tshawytscha*), sea-run cutthroat trout (*O. clarki*), winter and summer steelhead (*O. mykiss*), coho salmon (*O. kisutch*), and chum salmon (*O. keta*). These anadromous fish could migrate at least to Husum Falls on the White Salmon river (river mile 7.6) and steelhead (*Oncorhynchus mykiss*) migrated to river mile 16.2 where a falls barrier exists. This falls is 16.5 feet high at it's lowest point and 21 feet at it's highest point. The upper drainage above this falls which includes this entire analysis area, contained no anadromous fish according to studies of the area (FERC, 1991). However, affidavits from local residents say steelhead where found as far up as Trout Lake Creek (river mile 25.8) before the dam was built. It therefore remains uncertain if steelhead ever inhabited the White Salmon River above river mile 16.2 or streams in this watershed analysis area, or if they will inhabit the upper watershed in the future if this dam is modified or removed.

RESIDENT FISH POPULATIONS

Documentation of historic resident native fish species inhabitancy in the White Salmon River is also lacking. Washington State Fish and Game records (1930's) show the upper White Salmon River's natural fish population to be rainbow trout (*O. mykiss*) and cutthroat trout (*Salmo clarki*). It is unknown exactly what "natural" refers to in these records, but it most likely indicated that these were the native fish populations.

FISH HABITAT

STREAM CONDITIONS

Specific data on historical stream channel conditions in the basin such as the number of pools/mile or amount of large woody debris (LWD) does not exist. Due to this data gap comparisons are made to the Range of Natural Conditions (RNC) as determined for the Hood-Wind subbasin in the Regional Ecosystem Assessment Report (REAP) (USDA-FS 1993). The natural range for pools in the Hood-Wind subbasin are 40-60 pools per mile, and stream temperatures ranged from 7-20° C (Table 30). Comparisons were also made to the Columbia River Anadromous Fish Policy Implementation Guide (PIG) Desired Future Conditions (DFC's) (USDA-FS 1991), which are thought to be close to the "natural" unmanaged conditions. These DFC's are a core of minimum numeric values which describe fully functioning aquatic systems in fish bearing streams of the Pacific Northwest. The PIG standards are: 80 pieces of large woody debris (LWD) per mile, width to depth ratios less than 10, and stream temperatures less than 16° C (Table 30). The DFC for the number of pools per mile varies by stream as it is based on stream width.

Table 30. Local Habitat Conditions in Relatively Unmanaged Stream Reaches as Compared to the Hood-Wind Subbasin Range of Natural Conditions (RNC) and the Columbia River Basin Policy Implementation Guide (PIG) Standards.

Elements	Trapper Creek	Falls Creek	Green Canyon	WSR RM 37.8-38.6	WSR RM 41.6-42.5	Range of Values (by Rosgen type)	Hood-Wind RNC	PIG standards
Subwatershed	09D	09C, 09P	11K	11C	11D			
Location Watershed	Wind River	Wind River	White Salmon	White Salmon	White Salmon			
Survey Length (mi.)	5.57	11.72	1.13	0.78	0.93			
Rosgen stream type*	B	B	B	A	A			
# Large Pools per Mile (PIG standard)	12.7 (58)	30.37 (45)	33.6 (124)	7.7 (40)	18.4 (63)	**A**: 7.7-18.4 **B**: 12.7-33.6	40-60	based on stream width (40-124)
# LWD per Mile (24" dbh, 50'long)	32	15.19	66.3	6.41	4.32	**A**: 4.3-6.4 **B**: 15.2-66.3	NA	>80
Width to Depth Ratio	7.3/1	no data	8.0/1	14.6 /1	11.6/1	**A**: 11.6-14.6 **B**: 7.3-8.0	NA	<10
Subwatershed Conditions*								
ARP value	97	80	79	76	91			
Road Density	0.5	2.2	4.4	3.7	1.4			
% Rain on Snow Zone	73%	69%	95%	33%	0%			

*See hydrology section for description of Rosgen types, ARP value, Road Density, and % area in Rain On Snow.

Due to the variability of stream systems, a range of DFC values or reference condition values should be determined for each particular watershed area. An attempt was made to determine local reference conditions in this watershed by surveying habitat conditions in riparian reaches of fish bearing streams found on the district with little to no riparian area timber harvest. The streams surveyed occur in similar Rosgen stream types as those which occur in the analysis area (Table 30). None of these areas are considered truly "pristine", as the upland subwatershed conditions have been altered due to timber harvest and road building. These changed upland conditions have most likely affected peak flow conditions in these steams, resulting in changes to stream channels. True pristine streams do exist on the district in designated Wilderness areas, but these are in high gradient, non fish bearing streams and were therefore not used in this comparison. The percent of timber harvest, number of roads per mile, and percent of area in the Rain-On-Snow (ROS) zone all influence peak streamflow (Table 30). Trapper Creek and the Upper White Salmon River are considered very close to historical natural conditions as they have very high Aggregate Recovery Percentage (ARP) values, indicating most of the subwatershed has not been harvested, and low road densities (Table 30). The relationship of these attributes and their effects on altering stream flow is described in the hydrology section of this report.

These local reference conditions have been further refined by tying them to Rosgen stream type, as stream types differ in the number of pools/mile, width/depth ratio, and number of pieces of large woody debris (see stream channel section for full description of Rosgen stream types). The DFC values in these local "natural" areas were found to be generally lower than the PIG DFC values for the number of pools and large woody debris. There is a wide range in values for each element (Table 30), and this range is considered to be much more representative of historical conditions found in the watershed than the general REAP RNC or PIG values. It is uncertain why the local conditions are so different from the REAP and PIG DFC values, but it appears that streams in this analysis area must have different characteristics than those used in these analyses. Additional sampling along fish bearing streams in "pristine" areas is needed to further verify these values and truly define DFC's for the Upper White Salmon River watershed. However, this is a start of defining these conditions, and an indicator that the PIG standards are not representative of habitat conditions which we historically had in this watershed nor should we necessarily be striving to reach.

MIGRATION BARRIERS

There are several areas of probable historic and current barriers to upstream migration on the mainstem White Salmon River below the analysis watershed. These include: Husum Falls (a 6-12 foot falls at river mile 7.6), a 15 foot falls at river mile 12.4, a series of four falls, 6, 8 ,12, and 21 feet high between river mile 16 and 16.3, and three 8 foot falls between river mile 20.5 and 21.5. The largest barrier is the 21 foot falls at river mile 16.2. Other barriers in the analysis area include a twenty foot waterfall at the mouth of Wicky Creek followed by a 15-20% stream gradient, a 15 foot waterfall at the mouth of Cait Creek, and a 12-15% gradient at the mouth of Buck Creek.

LAKE CONDITIONS

No historical data on fish bearing lakes was found.

CURRENT CONDITIONS

ANADROMOUS FISH POPULATIONS

No anadromous fish inhabit the upper White Salmon River watershed. Fish currently inhabiting the lower White Salmon River below Condit dam include coho, fall and spring chinook, and summer and winter steelhead. The current coho salmon population below Condit dam is believed to be low and predominantly hatchery strays from the Willard and Little White Salmon River hatcheries (NPPC, 1994). Small numbers of pink salmon are also reported to use the lower river.   Nehlsen *et al*. (1991) indicate that the remaining native anadromous stocks in the lower river below the dam are at a high risk of extinction or are functionally extinct. Summer and winter steelhead are annually stocked (30-40,000 fish) in the river below Condit dam.

In 1989 PacifiCorp Electric Operations applied to the Federal Energy Regulation Commission (FERC) for a new license to continue operation of the Condit hydroelectric project. In 1996 the final Environmental Impact Statement on this project was completed and a preferred alternative identified. This alternative included a fish ladder for upstream fish passage and a fixed screen system to pass migrants downstream. PacifiCorp then notified the FERC that a new license issued in compliance with the Environmental Impact Statement would render the Project uneconomic to operate (Beck, 1998). Since that time PacifiCorp and other cooperators have been working to develop a least-cost plan for dam removal.   The preferred approach at this time includes blasting a tunnel through the dam at it's base, emptying the reservoir and allowing river erosion to remove 1.57 million cubic yards (of the 2 million cubic yards total) of sediment deposited upstream of the dam. The dam will be removed using blasting techniques after the reservoir has been emptied. At the time of this analysis PacifiCorp is engaged in discussions with state and federal agencies, Native American Tribes, and environmental and other groups to determine whether removal of Condit Dam can be achieved in an economically and environmentally feasible manner (Beck, 1998).

RESIDENT FISH POPULATIONS

There are a total of approximately 32 miles of fish bearing streams in the analysis area. Resident fish populations currently inhabiting the upper White Salmon River watershed include rainbow trout (*O. mykiss*) and eastern brook trout *(Salvelinus fontinalis*). Rainbow trout inhabit the White Salmon River up to river mile 42.5 where the stream becomes a barrier due to steep gradient and low flow. Brook trout are present in the lower valley area of the mainstem White Salmon River, but none have been found in any tributaries. Rainbow trout inhabit the following tributaries: Ninefoot Creek (Subwatershed 11M), Green Canyon Creek (11K), Cascade Creek (11E), and Stagman Creek (11C) (Map P). Records show that rainbow trout inhabited Wicky Creek in the 1940's and 1950's, but none have been found in electrofishing surveys in the recent past. Several sites were sampled in Wicky and Morrison Creeks in the summer of 1998 and no fish were found. Morrison Creek and lower Wicky Creek may still be fishbearing as these streams are very difficult to adequately sample due to high velocity streamflow creating low visibility. A waterfall barrier exists at the mouth of Wicky Creek which eliminates repopulating of this stream by trout from the White Salmon River. The streams in the eastern side of the watershed, Gotchen Creek, Hole in the Ground, and their tributaries are non-fish bearing, intermittent streams.

Rainbow trout and cutthroat trout are believed to be native species in the watershed, and brook trout are an introduced species. Stocking of rainbow trout began in the White Salmon River at least as early as 1934, and in Cascade Creek in 1942 (Table 31). These are the Forest Service and Washington Department of Fish and Wildlife's earliest records found, yet stocking may have occurred before these dates.

Table 31. Fish Bearing Streams in the UWSR Watershed.

Stream	Fish Species Present	Presently Stocked	Date First Stocked *	First Species Stocked	Natural Population
Upper White Salmon River	rainbow and brook trout	No	1934	rainbow	rainbow cutthroat
Green Canyon	rainbow	No	none known	NA	unknown
Ninefoot Creek	rainbow	No	none known	NA	rainbow
Trib. A	rainbow	No	none known	NA	unknown
Wicky Creek	rainbow (1940- 1953)	No	none known	NA	rainbow
Cascade Creek	rainbow	No	1942	rainbow	unknown

* Earliest documentation found.

Rainbow trout spawn in this watershed in the spring and the eggs hatch in approximately fifty days when water temperatures are rising (Hunter, 1991). This spawning time is just after peak flows in the streams on the west side of the White Salmon River (Green Canyon and Ninefoot Creek), where the highest annual flows typically occur between November and February. However, streams on the eastern side of the White Salmon River and the headwater's of the river itself are fed by high elevation snowmelt and runoff from glacial melt, resulting in high spring flows. Very high velocity flows during spring may make trout spawning difficult and/or wash out deposited eggs, resulting in reduced trout survival. This timing of peak flows may be a factor in the low numbers or absence of fish in streams on the eastern side of the river including Wicky, Morrison, Cascade, Cait, and Buck Creeks. Other factors which contribute to poor habitat conditions in these streams include very little spawning gravel substrate, waterfall and gradient migration barriers, and very cold water which limits productivity.

Brook trout are found only in the lower mainstem of the White Salmon River within this analysis area. Brook trout spawn in October and emerge from the gravel in March-April. Bull trout (*Salvelinus confluentus*) are also a member of the char genus and therefore have the same life history as brook trout. High spring flows from glacial melt may also be a limiting factor for these species as emergence time is during the time of peak flows, resulting in few slow water refuge areas. The largest events of the year, the Rain on Snow floods, which typically occur between November and February, may scour out redds further limiting char production .

Currently there are no known populations of bull trout in the UWSR watershed, nor were any known historically. In the lower White Salmon River two sightings of bull trout were reported above Condit dam at Northwestern Lake, both by WDFW biologists. One fish (10.75 inches long) was captured in a gill net set in the spring of 1986 in Northwestern Lake, and the other (12 inches) was checked on the opening day creel census in April 1989 (Weinhiemer, 1996). Bull trout have been found in the river below the dam, but these are believed to be strays from the Hood River in Oregon. If any bull trout populations do exist above Condit dam they are native and maintained by wild production.

In 1993 bull trout presence/absence surveys were conducted in the watershed as a cooperative project between the Forest Service and WDFW. Electrofishing and day snorkeling sampling sites included: the White Salmon River above the Cascade Creek confluence, Cascade Creek, Ninefoot Creek, and Morrison Creek. Two tributaries to Northwestern Lake (off Forest Service land) were also electrofished and included Spring Creek, and Buck Creek. No bull trout were found in any stream during this sampling effort. The sections sampled on Forest Service land are considered to be the areas with the highest probability of finding bull trout within the upper White Salmon River. Surveys occurred during spawning time (Aug. 31-Oct. 20), and stream temperatures were between 5-8.5ºC on Forest Service land streams, and 8-10ºC degrees on the Northwestern Lake tributaries. There are no records which indicate that bull trout ever inhabited the analysis area although bull trout habitat is present in the mainstem White Salmon River, Green Canyon Creek, Ninefoot Creek, Cascade Creek, Cait Creek, Buck Creek, Morrison Creek, and Wicky Creek. Barriers are present at the mouths of many of these streams as mentioned previously. If bull trout were present in the White Salmon River and migrated below the falls at river mile 16, they would be unable to ascend the falls.

Trout Lake, located on Trout Lake Creek which is the major tributary to the White Salmon River, has been extensively stocked by WDFW with both legal and fingerling sized brook and rainbow trout. These stocked fish are free to move into the White Salmon River. The lake was stocked almost annually from 1960 to 1991. Rainbow trout were the predominant species stocked and were last planted in Trout Lake in 1993. The White Salmon River has also been directly stocked with rainbow trout. Records are sketchy for this area, but in the 1970’s there were several plants. The upper river is no longer stocked, nor is Trout Lake Creek. However 10-40,000 fingerling rainbow trout are currently stocked annually in Northwestern Lake.

An electrophoretic study of rainbow trout in the White Salmon River drainage was conducted during the summer of 1990 by the Washington Department of Fish and Wildlife and Pacific Power and Light (Phelps, 1990). The objectives of the study were to determine the reproductive success and possible inbreeding of hatchery stocked rainbow trout with native populations. Rainbow trout were collected from four locations in the White Salmon River and included: the White Salmon River between Husum and Northwestern Lake, Buck Creek (tributary to Northwestern Lake), Rattlesnake Creek, the White Salmon River above Cascade Creek, and Trout Lake Creek. All five of the samples showed wild rainbow trout populations to be genetically distinct from each other and from Washington State hatchery rainbow trout strains. The study concluded that hatchery supplementation of rainbow trout in the drainage has not caused a loss of distinct wild populations.

Records show cutthroat trout inhabited the White Salmon River in the 1930’s. Population surveys in recent years have not found cutthroat in any stream in the drainage, although surveys have not been comprehensive. Displacement of cutthroat by rainbow and brook trout may have occurred in the past and may still be occurring.

MIGRATION BARRIERS

All road culverts on fish bearing streams in the analysis area have been inventoried for fish passage and the only one that presents a barrier is the Road 23 culvert crossing Ninefoot Creek. In 1990 a parasitic copepod was found in high numbers on the rainbow trout sampled below the culvert on Ninefoot Creek and in the White Salmon River adjacent to the mouth of Ninefoot Creek. This parasite was not present on fish inhabiting Ninefoot Creek above the culvert. For this reason passage at the Road 23 culvert was not recommended in the past in order to protect the rainbow trout population above the culvert from infestation of this parasite. Trout populations in this stream need to be sampled again to determine if this parasite is present today, and if it is still only present in the stream below the culvert. It is recommended that this culvert be made passable to fish if there is an absence of the parasite or if anadromous fish inhabit the analysis area in the future. Unscreened water diversions are present in the White Salmon River below this analysis area which pose as barriers when the diversions are shut off and fish become trapped in the de-watered ditches.

FISH HABITAT

Potential anadromous fish habitat in the analysis area include: the White Salmon River (16 miles), Cascade Creek (2 miles), Stagman Creek (0.5 miles), Green Canyon Creek (4 miles), Buck Creek (O.5 miles), Ninefoot Creek (6 miles). Sufficent habitat is present in Wicky, Morrison, and Cait Creek but these areas are inaccessible to migrating fish species due to waterfall barriers.

STREAM CONDITION

Habitat conditions for each stream are based on stream surveys conducted in the watershed in the 1990's. The White Salmon River, Ninefoot Creek, Green Canyon Creek, and Morrison Creek were surveyed with the Region 6 Hankin and Reeves survey methodology. Comparisons to the PIG desired future conditions for habitat elements shows these streams do not meet PIG DFC criteria but most do meet the locally defined DFC's
(Table 32).

Table 32. Stream Survey Data Compared to Local Reference Conditions, the PIG DFC Values, and the Hood-Wind Subbasin RNC.

Survey Criteria	White Salmon River	Morrison Creek	Green Canyon Creek	Ninefoot Creek	East Fork Ninefoot	Middle Fork Ninefoot
Stream Length Surveyed (mi.)	6.4	3	2.58	2.6	0.8	0.5
Rosgen Stream Type	A, B	A, B	A, B (small amt. of E)	A, B	A, B	A, B
Average Number of Large Pools/mi.	2.2	13	41	8.8	0	0
Local DFC Range Rosgen: A: 7.7 - 18.4 B: 12.7 -33.6	below	meets	exceeds	meets	below	below
PIG Rating	.04% - poor	19% - poor	45% - fair	8.8%-poor	0%-poor	0%-poor
Hood-Wind RNC	below	below	meets	below	below	below
Width to Depth Ratio	6	13.9	7.5	14.3	no data.	no data.
Local DFC Range Rosgen A: 11.6 -14.6 B: 7.3 - 8.0	exceeds	meets	exceeds	meets		
PIG Rating	good	poor	good	poor		
Hood-Wind RNC	NA					
Average Large Woody Debris/mi. (24”dbh, 50’long)	.08	6.3	.23	42.2	16.8	6
Local DFC Range Rosgen A: 4.3 - 6.4 B: 15.2 - 66.3	below	meets	below	meets	meets	meets
PIG Rating	poor	poor	poor	fair	poor	poor
Hood-Wind RNC	NA					
Maximum Water Temperature	13.5	6.5	17.5	7.5	7.9	10
PIG Rating	good	good	poor	good	good	good
Hood-Wind RNC	meets	below	meets	meets	meets	meets

Historically the White Salmon River and Morrison Creek most likely never met the PIG DFC’s for large pools and large woody debris due to their high velocity flows from glacial run-off. Currently these two streams do not even meet the local DFC conditions for number of large pools and woody debris. This is due to the high gradient, high velocity of these streams creating mainly riffle/cascade habitat and flushing most LWD downstream. There also is very little LWD recruitment from streambanks into most streams in the analysis area as they are A and B Rosgen stream types which have little to no channel meandering and bank cutting, and therefore low tree recruitment. Low numbers of large woody debris are present in most streams surveyed, yet these numbers do not adequately represent the total amount of wood as small pieces exist which are not of a size class included in the tally (<24" dbh, 50' long). In the upper reaches of these streams where the stream becomes smaller, small woody debris is instumental in channel formation and fisheries habitat. Habitat conditions in Green Canyon and Ninefoot Creeks are not optimal conditions for fish, but good populations of rainbow trout are found in these drainages.

Several other streams in the analysis area were surveyed in 1992 and 1993 using a revised Department of Ecology (DOE) methodology as part of the White Salmon River Assessment cooperative project with Underwood Conservation District. The DOE survey is solely a judgment call and no actual counts or measurements are taken. These surveys rated the following parameters: diversity of fish habitat, streambank stability, overhead canopy, vegetative bank cover, abundance of large woody debris and channel capacity. The streams surveyed with this method include: Hole in the Ground, Wicky Creek, Stagman Creek (RM 38.4), Buck Creek, and Cascade Creek. Cascade Creek and Stagman Creek were the only streams where the majority of reaches fell into poor categories. Cascade Creek was rated as having little fish habitat diversity, instream cover, overhead canopy cover, vegetative bank cover, and overhanging streambank vegetation. Stagman Creek was rated as having poor fisheries habitat, overhead canopy, and vegetative bank cover. However, both Cascade and Stagman Creek have no riparian area harvest and these conditions are close to natural conditions in these streams. Some upland timber harvest has occurred along Stagman Creek, but none has occurred in the Cascade Creek subwatershed. All other streams surveyed were adequate in almost all parameters with the exception of large woody debris. In all streams abundance of woody debris was low (DOE criteria for LWD is over 6 inch dbh and 20 feet long). Large woody debris abundance was particularly low in Hole in the Ground, Wicky Creek, Cait Creek, and Buck Creek. Riparian harvest conditions in these streams are 33% early seral in the riparian area of Gotchen/Hole in the Ground, 9% in Wicky/Morrison, 12% in Cait Creek, and 13% in Buck Creek. Of these, only the riparian area of Hole in the Ground (a non fish bearing, intermittent stream) seems to be significantly altered from natural conditions due to timber harvest. Cattle damage to streambanks was noted by surveyors in Hole in the Ground (RM 2.7-3.7) and Morrison Creek (RM 0.38-1.38). Gotchen Creek is the only stream in the analysis area with no survey data of any kind as it is difficult to locate in several sections where it flows underground.

Water temperatures in streams in the analysis area are very cold for the majority of streams (table 3). The only fishbearing stream with temperatures known to have exceeded the state standard is Green Canyon Creek (see water quality section for more discussion of stream temperatures). The highest temperature in Green Canyon during monitoring was 17.5 degrees which may lead to increased stress and disease on the trout in the stream. This high temperature was only found in 1992 which was an extremely dry and warm water year.

Rosgen channel types in fish bearing streams are depicted on Map R and discussed in detail in the previous section on Stream Channels. The Rosgen C and E channels are in the lower gradient reaches, and are therefore the good fish production areas in this watershed. These stream types are more sensitive in terms of response to changes in stream flow and inputs of sediment and wood, and typically have higher width-to-depth ratios, which leaves them more prone to solar heating. The Rosgen C type fish bearing streams in this analysis area include small sections of Stagman Creek, Cascade Creek, and the lower White Salmon River. Rosgen E channel types flow through meadow systems. These channels are heavily dependent on streambank vegetation for stability and are more sensitive to loss of bank vegetation by animal grazing. The E channel types are found in Stagman Creek and Green Canyon Creeks. The majority of fish bearing streams in this analysis area are Rosgen types A and B which are very stable, bedrock and boulder dominated systems.

LAKE CONDITIONS

The only fish bearing lake in this watershed is Looking Glass Lake which is located on the south side of Mt. Adams in the Mt. Adams Wilderness area. A naturally sustaining brook trout population is found in this lake. As brook trout are a non native species in the western United States, this species was introduced at some time into the lake but time of first stocking is uncertain. WDFW personnel indicate that it has not been stocked in at least 15 years. A 60 foot waterfall barrier is present on the lake's outlet stream, a tributary to

Cascade Creek. Outmigration of brook trout from the lake has occurred as they have been found in this stream below the waterfall. Lake tributary streams contain good spawning habitat.

Looking Glass Lake was surveyed in 1993. All sampled water quality parameters in Looking Glass Lake were within acceptable limits for salmonid production (Scott, 1993). This lake had a high sulfur content (17.55 mg/l) due to it's proximity to the Mt. Adams volcano (Table 33). The high alkalinity value in this lake (table 4) shows a high buffering capacity of acid rain deposition.

Table 33. Lake Survey Data for Looking Glass Lake (1993).

Lake Name	**Elev.**	**Water Temp. surf./bottom**	**Max. depth (feet)**	**Ave. depth (feet)**	**pH**	**Diss. Oxygen surf./bottom**	**Conductivity m/mhos/cm**	**Alkalinity mg/l**
Looking Glass	5580	7.5/4.5 Celsius	18	6.96	7	11.8/12.2	169.8	436.37

DATA GAPS

- Further refinement of local desired future stream habitat conditions.
- Historical fish species distribution.
- Comprehensive fish sampling in Wicky, Morrison, and Buck Creeks
- Effects of low flows on fish populations (due to diversions or natural conditions).
- Comprehensive population sampling to determine if cutthroat trout are still present in the watershed.
- Channel stability surveys on all streams including non fish bearing streams.
- Population sampling in Green Canyon Creek for parasitic copepod infestation levels.

HUMAN USES

REFERENCE CONDITIONS

The White Salmon River Watershed encompasses an area that has seen thousands of years of human use. Many of the roads used for travel in the area today are located along routes used by early sheep and cattle men, trappers, Columbia National Forest rangers, and by the Indians who have lived in this area for centuries. Most of the formal inventory for heritage resources has taken place in areas proposed for timber harvest. Other information comes from oral and written histories and from incidental sources. The following represents a summary of the known cultural features in the watershed, beginning with the earliest documented human use of the Cascades.

PREHISTORIC USE

For approximately the past 3500 years (Chatters 1989) Indian people in this area practiced a collector-type subsistence strategy which involved primary dependence on the seasonal salmon runs on the Columbia River and its tributaries, including the White Salmon River. People moved across the landscape from spring through fall, taking advantage of a variety of plant and animal resources as they became available. This strategy involved the ability to mobilize in order to arrive at a place on the landscape at a time when the desired resource was at an optimal state for harvesting. During the winter month villages were occupied along the major tributaries of the Columbia, and people subsisted primarily on dried foods collected during the previous seasons. Several of these winter villages were located in the lower part of the White Salmon River drainage. The ability to remain in these semi-permanent villages was dependent on the ability to accumulate stored resources for winter use.

During recent years a number of sites on the Gifford Pinchot National Forest have been the subject of archaeological investigations. Several of these sites, including the Vine, Squirrel, Lost, Pointless, Fallen Arches Cave, and Ice Cave sites, are located within the larger White Salmon River drainage, and are all within 5 miles of the boundary for this watershed analysis. Information from these excavated sites helps to provide a context for understanding sites located within this watershed boundary.

Within the watershed boundary itself, a number of prehistoric sites have been documented. These include an obsidian dart point recovered in the vicinity of Smith Butte, a chert lanceolate point found in the vicinity of Haystack Butte, a jasper core found along a drainage below Crofton Ridge, a prehistoric camp along a meadow below Haystack Butte, a prehistoric camp near the headwaters of the White Salmon River, a prehistoric camp in a meadow on the east side, and a prehistoric camp along the ridge near the headwaters of Ninefoot Creek. The projectile point recovered near Smith Butte is a corner-notched obsidian dart point. It is assumed that this object was intended for used hafted to a foreshaft, in an atlatl and dart weapon system. The point is similar to types used in the Columbia Plateau from about 2500 to 1500 years B.P. The large chert lanceolate point found along the slopes of Haystack Butte is more difficult to classify, since it may have been used as a knife, or it could have served as the tip of a thrusting spear. The most logical explanation for the presence of these two isolated points is that they were lost during use. The large jasper core found below Crofton Ridge is indicative of quarrying activities, which is consistent with evidence found throughout the White Salmon drainage for local tool stone procurement.

The remaining camp sites appear to be low density lithic scatters, situated in a variety of environmental settings. Their locations and assemblages are consistent with a model of seasonal transhumance by small hunting and gathering groups, who move into the higher elevations out of low elevation winter residences, following resource availability. The variety of resources utilized is probably reflected in the variety of environmental settings in which the sites are found. Debitage and utilized flakes are the most common type of artifact recovered at these sites, with the exception of a quartzite abrader and a flaked cobble found at the site near the headwaters of Ninefoot Creek.

Overall these sites suggest a broadly similar pattern of human use within this portion of the Gifford Pinchot National Forest, which in itself is similar to that seen throughout the central Cascades at this time period. This pattern is one of repeated seasonal occupation by small groups, beginning approximately 7000 years ago and continuing into the historic period. A disruption in occupation may have occurred in parts of the southern Washington Cascades, due to the effects of the ca. 3500 B.P. eruption of Mount St. Helens, which deposited a thick layer of tephra (Ye and Yn) over parts of the area. It has been suggested that this Smith Creek eruptive period (set Y) of Mount St. Helens was devastating enough to have led to abandonment of the area and a hiatus in human occupation throughout the southern Washington Cascades, between approximately 3500 and 2000 B.P. (Lewarch and Benson 1991, McClure 1992). Occupations dating to 2000 B.P. and later in the southern Washington Cascades are generally limited use locations, exhibiting a low diversity of tool types. It is only the earliest components from the Vine and Squirrel sites, dating to before 5000 B.P., that contain a wide variety of heavy task tools, while the remainder of the assemblages are characterized by debitage, cores, and a limited variety of chipped stone tools.

HISTORIC NATIVE AMERICAN SUBSISTENCE AND LAND USE PATTERNS

The people who occupied this area during historic and late prehistoric times included the Sahaptin-speaking Klickitat, Yakama, Kamiltpah, Wyam and Tenino Indians, as well as the Chinookan-speaking Wishram and Wasco Indians. Their settlement pattern involved winter residence in semi-permanent villages located in sheltered locations along either a major river or tributary, and seasonal camping at root digging grounds, fishing stations, and hunting and berrying locales (Ray 1939). The seasonal salmon runs along the Columbia and its major tributaries formed the emphasis of their subsistence economy, but people took advantage of a wide variety of plant and animal resources throughout the year. After about A.D. 1730, this collecting strategy was succeeded in some parts of the Plateau by an increasing dependence on hunting with equestrian mobility (Schalk and Cleveland 1983).

BERRY PICKING

A variety of warm season resources were available within the watershed, including huckleberries, strawberries, raspberries, blackberries, gooseberries, currants, salmon berries, chokecherries, service berries, elderberries, hazelnuts, black lichen, white bark pine nuts, and animals such as deer, elk, bear and grouse. Huckleberries are notable in that they were available in quantities suitable for collection as a stored food, and they could be dried to a raisin-like state. There are several references in the ethnographic literature to huckleberry collection and processing in the area around Mt. Adams. According to Curtis (1911:5-6), no fewer than eighteen kinds of berries were commonly used as food by the Yakama, and huckleberries were considered the most important. The Yakama and Klickitat gathered them in quantity on the slopes of Mt. Adams. The berries were picked, dried, packed in bags and brought back to villages for winter consumption. Murdock (1980: 131) states that certain bands of the Tenino went to the Mt. Adams area in summer to gather berries and pine nuts, hunt deer and elk, and lay in a supply of dried berries and smoked meat for winter. He describes a connecting trail through Klickitat territory heading to Mt. Adams, used by the Wyam and John Day subtribes of the Tenino.

Huckleberries grow best in high elevation areas that have been burned over by forest fires (Minore et al. 1979). Ecologically these huckleberry fields are seral, being temporary stages in the natural succession from treeless burn to climax forest (Minore 1972). The maximum amount of berries is produced a few years after establishment of the field, with production gradually declining as other shrubs and trees begin to dominate the site. Without the intervention of fire, the huckleberries are eventually crowded out by competing vegetation.

Since about 1910 modern fire protection and control techniques have severely curtailed the role of fire in influencing the ecology of forest landscapes. Prior to this time it is likely that Indians purposefully maintained large burns either by leaving their drying logs smoldering after leaving the berry fields or by directly setting fire to berry patches at the end of the berry season.

Plummer (1900), in an early report for the United States Geological Survey, discussed the various causes of forest fires in what is now the Gifford Pinchot National Forest, including an 1898 fire on the southern and southwestern slopes of Mt. Adams, within the watershed boundary. He wrote that "Indians also start fires for the purpose of promoting the growth of huckleberries, blackberries and raspberries, and also to drive game." (1900:135). According to French (1957) the Indians in this area considered trees to be like weeds overrunning their huckleberry fields. The solution to this problem was to start fires under controlled conditions. French reports that a "common technique for increasing the probability that a fire would indeed occur was to leave the log burning that had served as the reflector during the course of the heat drying of huckleberries" (1957:3). Recent interviews with elderly Yakama informants corroborate this, providing descriptions of how one or two men were chosen specifically for the task of staying behind to burn the fields. These men were chosen for their knowledge, because not only did they have to burn the fields, they also had to call on the rain and thunder to put the fire out. The informants stressed that this was not done every year, but only when needed. Accepting that local Indians most likely used fire as a tool for enhancing huckleberry production, it is also likely that the locations of huckleberry fields would simply shift as naturally-occurring fires opened up new areas, and older burns reforested.

In August of 1878 Francis Marion Streamer joined a group of Yakama Indians traveling to huckleberry fields on Mt. Adams, and he describes the expedition in some detail (Briley 1986). They entered the valley of the White Salmon River from the Glenwood area (then called Camas Prairie), most likely following the trail shown on the 1890 GLO Plat map, labeled "Trail from Camas Prairie to White Salmon River". They then proceeded approximately 9 miles northwest, to camp near a spring along a creek that Streamer referred to as Clear Creek, "in a beautiful cluster of firs, pines and alders". It is likely that this camp was located within the watershed boundary, somewhere between the upper reaches of Wicky Creek and Cascade Creek. Streamer describes over 100 Indian "tents" within a radius of two miles of their camp, which suggests that this was along the main route of travel to what were then the huckleberry fields. It also suggests a pattern similar to that seen in the more recently used huckleberry fields in the Indian Heaven area, where each family group had their own camp that they returned to year after year, in close proximity to the camps of other families. Streamer describes activities he observed at the camp, including the weaving of tule mats and baskets, as well as the construction and use of a sweat lodge.

The berry fields to which they were heading were located on the northwest slopes of Mt. Adams, near a lake. Streamer's description of the camp provides one of the better indications that we have as to the intensity of human (and equestrian) use of these huckleberry fields. When they reached "Ollala Camp", Streamer noted "There are now over one thousand ponies and nearly 200 Indians - and there will be as many more before the week..." He described these Indians as being from the Yakima area, as well as from areas along the Columbia River stretching from Bonneville to Roosevelt. To give some idea of the quantities of berries picked, Streamer describes how his group alone dried 10 bushels of huckleberries (approx. 90 gallons), and that they planned on selling these along with fresh berries at the Dalles. He commented that the larger group heading to the Dalles had nearly a half ton of dried and fresh berries. These quantities are all the more impressive in consideration of Hunn's estimate that drying the berries reduces the water content and thus the weight by 70% (1990:132).

In September of 1890, C. E. Rusk made a circuit of Mt. Adams along with his mother Josie and his twelve year-old sister Leah. They camped with a group of Indians at a "huckleberry patch" on the northwest side of Mt. Adams, probably close to Streamer's "Ollala Camp". Rusk states:

> The huckleberry patches northwest of Mt. Adams and along the slopes of the Cascade Range draw hundreds of Indians each summer...The squaws devoted their time assiduously to picking and drying the luscious berries; but their lords and masters spent most of the their waking hours in gambling, horse-racing, and hunting. (Rusk 1978:49)

Although Rusk was traveling in the opposite direction to Streamer, the trail that Rusk followed around the mountain on the west side is probably the same trail followed by Streamer's group as they were heading to the huckleberry fields. Based on a map of Rusk's route, within the watershed boundary this trail appears to be located between one-half and one mile below the present Round-the-Mountain Trail. Rusk discusses the origin of the trail they followed, stating "All of the trails on Mt. Adams, at that time, were Indian trails,...".

Another source which gives names and general locations for Indian camps utilized during the historic period in the Mt. Adams area is Click Relander, a Yakima Valley resident who interviewed Yakama informants in the 1950's (Relander 1959). In interviews with three elderly Yakama men in 1959, Relander documented the names and general locations of four camps and huckleberry fields on the western slopes of Mt. Adams, "where most of the berries were gathered in the old days". Although the exact locations of these camps have not been verified, one may have been located on Stagman Ridge. This camp was called *Sum Sum*, which means a hill with a sharp back, which comes to a ridge, and it was reportedly located on the southwest slope of Mt. Adams. Most of Stagman Ridge burned in an 1898 fire, so that by the early 1900's this area could have been a productive huckleberry field. Another piece of evidence that points to Stagman Ridge as the location of a former huckleberry field is the presence of a large number of peeled cedar trees at the base of the ridge, along the periphery of the 1898 burn. Over 300 peeled western redcedar trees have been documented in this area, and both ethnographic sources and interviews with informants indicate that the bark slabs removed from these trees were primarily used to make folded bark baskets in which to carry huckleberries. Once again, Streamer provides an apt description of their use:

> The Indians make baskets out of cedar bark, long and winding...The Indian baskets will hold a half bushel...Yesterday the Chief and I went about five miles to the dark Cedar Swamp...peeled the bark off and carried it home to make baskets out of it in tub shape. These buckets will hold about 20 quarts of berries for market (Streamer 1878, as quoted in Briley 1986).

PEELED CEDAR

The association of peeled cedar sites with former huckleberry fields and camps has been documented in other parts of the District, most notably in the Red Mountain area in the southern part of the Indian Heaven Wilderness, in the Sawtooth Berry Fields, and on Little Huckleberry Mountain. Use of these areas as huckleberry fields has been documented archaeologically, through ethnographic sources, and through the recollections of living Indian people. Peeling dates from these peeled cedar sites correspond to the dates of use of these particular huckleberry fields. It is possible that peeled cedar sites without obvious associations are located near former huckleberry fields which have since reforested.

Within the watershed boundary a total of 637 peeled cedar trees have been documented, in 29 clusters or sites. Peeling dates have been determined through tree ring counts in three of these sites, and the nine peeling dates ranged from A.D. 1807 to A.D. 1854, with a mean date of A.D. 1835. The peeled trees appear to cluster along at least three major travel corridors, one being the west side of the main stem of the White Salmon River, the second being the headwaters of the White Salmon, and the third being Wicky and Buck Creeks. The peeling dates are all from sites along the main stem of the White Salmon, and probably indicate use of the ridgelines above Haystack Butte and Eckhart Point during the early to mid-1800's. Access was probably up the west side of the White Salmon River, from the Trout Lake Valley.

The peeled cedars located along the headwaters of the White Salmon River, along the base of Stagman Ridge, have been referred to above. They cluster so closely to the edge of the 1898 fire that it seems likely they are associated with huckleberry camps that are located higher up on Stagman Ridge, within the Mt. Adams Wilderness. Again, access was most likely up the White Salmon River, but it is also possible that people accessed the area from above, following the route used by Rusk and Streamer. People may have simply followed drainages down to the edge of the fire, in order to peel cedar bark. The peeled cedars located along Buck Creek and Wicky Creek could be located along travel routes leading to another lobe of this 1898 fire, which burned McDonald Ridge and Lower Butte. Or, depending on their age, they could be associated with the travel route followed by Streamer in 1878, heading northwest out of the Trout Lake Valley.

Based on analysis of peeling dates from peeled cedars in the southern part of the Indian Heaven area, it appears that the average duration of use of a huckleberry field in that area was between approximately 40 and 70 years (Mack 1996:32). When evaluating this data, however, one must keep in mind that huckleberry fields could also be abandoned long before they became unproductive, if more productive or more easily accessible fields opened up elsewhere. This is particularly true for the period around A.D. 1930 - 1940, when many traditional huckleberry fields were abandoned in favor of areas which were accessible to automobiles, such as the Sawtooth Berry Fields and Potato Hill.

Other species of peeled trees have been documented within the watershed boundary, but we have far less information on their use. A single example of a peeled silver fir tree has been documented in the northwestern portion of the watershed, in the vicinity of a human burial and an historic camp. It's association is not known. An example of a peeled white pine tree is located in the western portion of the watershed, along an historic trail. White pine bark is known to have medicinal uses.

PINE NUTS

In an 1899 report for the U. S. Geological Survey, Plummer noted that the seeds of the white bark pine (Pinus albicaulis), or what he referred to as “Mountain pine”, produced seeds which were edible, and he stated that the trees were sometimes cut down to secure them. On one ridge of Mt. Adams he observed about 100 trees which were felled for this purpose (Plummer 1899:100).

TRAILS

A number of historic travel routes exist within the watershed boundary, several of which have already been discussed. Ernie Childs, a local resident who worked on the Mt. Adams District from 1921 to 1972, described another trail used by Indians, which crossed through the northwest corner of the watershed:

> ...there's another old Indian trail that crossed the White Salmon River above Williams Creek that went around the hill and stayed higher than the road and went to the Council Lake country...this trail out through here they dragged their stuff through on poles and it was deep. This old trail up here when I first traveled it, you couldn't put a pack horse in it with a pack on. The pack would drag, it was worn so deep. They were dragging their poles...The Indian trail...came out in a pass just at Takhlakh Meadows (from taped interview with Virginia Yancey, 1980).

This trail was located in the general vicinity of the Pacific Crest Trail, and probably joined into the trail around the west side of the mountain, followed by Streamer and Rusk.

OTHER SITES

Other types of sites which have been documented within the watershed boundary include talus pit features and human burials. A single talus pit feature has been recorded in the southwestern corner of the watershed, although a number of others have been recorded in other parts of the District. The function of these features is not known, although examination of ethnographic literature and interviews with Indian informants indicate some possibilities. The pits may have functioned as part of the aboriginal spirit quest, in which young children were sent off to special places to seek their guardian spirit power. It is reported in several sources that stone piling was often a part of this quest, both as an aid in keeping awake and also as proof that the young person did indeed stay at the prescribed place. Food was also cached in talus pits, in order to provide protection from varmints. Talus pits may also have functioned as hunting blinds.

Three human burials have been documented in the northwestern portion of the watershed boundary. At least one of these is likely an Indian burial, since it contained glass beads retailed ca. 1836 by the Hudson's Bay Company, for the Indian trade. A second burial was described by Ernie Childs as being a military burial, although the apparent reason that people assumed it was a military burial was because in the 1930's an artillery-type rifle barrel had apparently been found in the vicinity by a Forest Service employee. Numerous peeled cedar trees have been recorded in this area, and it is in the general vicinity of the "old Indian trail" referred to by Ernie Childs, as well as near Grand Meadows, where Mr. Childs claimed the Indians formerly grazed their horses. It is also in the vicinity of the area where Mr. Childs claims a military stockade was constructed in the 1850's, during the "Indian Wars". According to Mr. Childs, this stockade was constructed in order to restrain what were perceived as "hostile" Indians. The stockade will be discussed in more detail below, under Historic Land Use.

SUMMARY

The ethnographic pattern indicated for the southern part of the Gifford Pinchot National Forest is one of warm season use. The collection and processing of various plant foods were the primary focus of activities, along with opportunistic use of game animals and fish. Within the watershed boundary, huckleberries were intensively utilized, both as an over-winter staple and as an item of trade. It is likely that Indians utilized fire as a tool to "manage" huckleberry fields, in order to enhance their productivity. The distribution and density of peeled cedar sites are one indicator of the location and intensity of use of former huckleberry fields, as well as indicating general routes of travel. Based on a variety of historic sources, it is likely that the intensity of human use of certain parts of the watershed was much greater in the past than it is today. This is particularly true for areas that are in what is now the Mt. Adams Wilderness.

HISTORIC LAND USE DURING THE PERIOD OF FOREST SERVICE ADMINISTRATION

EARLY SETTLEMENT

The Peter Stoller family were the first non-Indian settlers in the trout Lake valley in 1879. In 1889 the Trout Lake Irrigation Company was formed by William and Frank Coate and Rufus Byrkett, who homesteaded just outside of the watershed boundary. The first large ditch in the valley originated in the White Salmon River, wad was followed by a number of others. Between 1890 and 1900 five ditches were built from the White Salmon River. Large crops of red clover were grown with the aid of irrigation. Rye, red clover and Lincoln grass were the main crops raised for hay, but wheat and oats were also grown.

In a 1909 report for the U. S. Geological Survey, Stevens noted that in the upper portion of the valley irrigation is practiced extensively. The water for the ditches is diverted from both Trout Creek and the White Salmon River. These ditches are small but numerous and they have an abundant supply of water. Lumbering was considered the principal industry of this territory. The Wind River Lumber Company constructed three splash dams on the White Salmon River by means of which logs are floated from the upper portion of the drainage area to the mouth of the river, where they are gathered and transported in rafts to the mills on the Lower Columbia.

Stevens noted six diversions for irrigation ditches within the watershed boundary in 1909, on both sides of the river. These ditches ranged in capacity from 2 to 10 feet per second. These ditches were all for the purpose of irrigating farmland within the valley. These included the Wagnitz, Thomas, Coate and Duncan, Coate Brothers, Dutch, and Pearson ditches.

Closer to the Forest boundary, the Mat Yuth homestead was located along what is now Forest Road 23. It is shown on the 1913 GLO Plat map.

GRAZING

The earliest grazing of domestic livestock in the Mt. Adams area was the grazing of horses brought in by the Indians, which could potentially date to the mid-1700's. Horses aside, grazing activities on the southern slopes of Mt. Adams began in 1886. This was most likely a direct result of “the great conflagration of 1885”, which according to the 1886 field notes for the survey of T7N, R11 E, burned three-quarters of the merchantable timber in the township. The survey notes state that “Large areas where stood the dense forests and very thick undergrowth of August 1885 are now overgrown with rank weeds and grass from 2 to 6 ft. in hight (sic).” Sheep were the first livestock brought in to the area, with cattle following near the turn of the century. The first band of sheep reportedly belonged to Charlie and Alexander McAllister and William Smith, who were originally from New Zealand, but in the early 1880's were in the sheep business in the John Day Valley. Smith Butte was named for William Smith. They brought a band of 5000 sheep to the area between King Mountain and Bird Creek in 1886. According to an interview with Charlie McAllister in 1939, the range was excellent, with the timber quite open. In 1886 they took a new partner, Michael King from New Zealand, for whom King Mountain was named. He brought the second band of sheep to the area. The Gotchen (or Gotzen) family of Grass Valley, Oregon was the third family to bring sheep to the area, in 1887. They used the Gotchen Creek drainage, which was named for them. John O'Leary added a fourth band in 1888, which was also trailed from Grass Valley. Regulation of grazing by the Forest Service did not begin until 1908.

The following is taken from a document entitled "Grazing on the Gifford Pinchot", probably written in the early 1970's. This report states that by the 1890's, sheep from the eastern side of the Cascades were being trailed to the mountains for free summer feed by the tens of thousands. At this time the range was unadministered, and overuse was common. The completion of railroads connecting the West to population centers in the Midwest and East enhanced this use around the turn-of-the-century. Estimates of numbers of sheep on Mt. Adams in 1900 ranged from 100,000 to 150,000 (Ladiges 1978:31). Grazing continued to increase until the Forest Service established an administrative presence in the area, beginning around 1908.

With the infusion of cattle into summer grazing lands, "range wars" ensued between the sheep herders and cattlemen. This was exacerbated by both the overwhelmingly large numbers of sheep, and by the fact that many of the sheep were from Oregon, while the cattle were all from local Glenwood ranches. Ladiges (1978: 31-34, 130) relates several accounts of physical assaults and "burn-outs" during the period between 1890 and 1910 in the Glenwood (then Camas Prairie) area. Several of Ladiges' more colorful stories provide a picture of these times, when

> Settlers in Camas Prairie were quick to see that something must be done to stem the tide of the grass eating woolly horde, or there would be no forage for their cattle...One sheepman had a charge of buckshot planted in his anatomy by a cattleman. A camp tender had the top an ear clipped off with a Winchester bullet. A...sheepherder was shot in the hip, when he attempted to resist activity of night riders. A packer for an Oregon flockmaster was tied to a tree and give a rather severe "whipping post" lashing, because he unwisely attempted to draw a gun on a committee of settlers...Mysterious burning of buildings and hay stacks was openly charged to resentful sheepfold interests (1978:31).

It was the establishment of the Columbia National Forest in 1908 and the subsequent creation of separate sheep and cattle grazing allotments administered by the Mt. Adams Ranger District which put the first limits on grazing activities and eventually began to ease these tensions.

By the 1920's Mt. Adams lambs were being sold by the trainload under that name on the Omaha and Kansas City markets. Rail handling facilities for Mt. Adams lambs were built at Lyle, Washington, and covered 13 acres. The reduction in sheep grazing by the 1930's was due to a number of factors, including reduced demand nationwide for mutton, lamb, and wool. But another important factor was Forest Service administration, which both directly and indirectly affected the grazing of sheep on the Forest. The emphasis on fire control indirectly affected grazing by reducing the availability of forage. An apparent recognition of the impacts caused by sheep grazing led to stricter regulation of the sheep bands and withdrawal of some areas from grazing. Although largely anecdotal, information from taped interviews with Ernie Childs provide interesting insights into that period.

Aside from working for the Forest Service, Mr. Childs also ran cattle on the Forest for many years. Sheep still dominated the summer grazing ranges in 1926, with numbers totaling 75,000, in comparison with just 1500 head of cattle. In speaking of the early years of cattle grazing on the District, around 1912 to 1918, Mr. Childs stated that the area was then so badly overrun with sheep that when the sheep moved they appeared to be walking through a smog of dust. According to Mr. Childs, "That was one reason why there was a change in the District Ranger". Apparently Harvey Welty, who was ranger at Mt. Adams District from 1923 to 1933, was considered a "sheepman". The cattlemen apparently protested that the sheep were "tromping the country to pieces", and subsequently Welty was transferred and K.C. Langfield was brought in "from cattle country. He was a cattleman." Ranger Langfield was reported to be a "stickler", who regularly inspected sheep camps and sheep allotments and made the sheepherders move their camp and bed grounds every night. Prior to that, according to Mr. Childs, the sheep were accustomed to bed every night in the same place and water in the same water for weeks. This is corroborated in a 1911 Grazing Report for the Columbia National Forest, written by then Forest Supervisor H. O. Stabler, which stated that:

> In the early use of this country as a sheep range, the sheepmen had a habit of camping for several weeks at one place where water and horse feed were handy. This caused the range to be tramped out for quite a distance in all directions from the camp and the bed grounds were worn out so that it has taken years for the grass to get started again. During the past few years the Forest officers have been doing all they could to prevent the using of these old camps...(Stabler 1911:2-3).

Ranger Langfield also drastically reduced the size of the sheep allotments, converting some areas from sheep to cattle range.

According to Mr. Childs, the first cattle allotment on the District was the Trout Lake Allotment in 1912, which went from the Forest boundary to the Trail Peak area and west to Peterson Prairie, and the second was the Glenwood Allotment in 1914, which went from the southeast boundary of the District to Hole-in-the-Ground Creek. The Mt. Adams Cattle Association was organized in 1916, listing 26 charter members (Ladiges 1978:140). District records indicated that Association members obtained grazing permits on the Mt. Adams Cattle Allotment in 1917. The grazing season on the allotment generally lasted four to five months, extending from early June to October. A range rider was hired for the summer months to monitor the grazing areas, restock salt logs, and mend fences. The range rider was joined by the rest of the Association members for the fall roundup. These activities, centered at Cow Camp, would generally last ten to seventeen days.

Although there are a number of sites within the watershed boundary which relate to grazing, one site type provides a uniquely human perspective. Twelve clusters of carved aspens, have been documented within the area, all of which contain trees inscribed with names and dates which precede the establishment of the Columbia National Forest. The earliest dates associated with the sites range from A.D. 1875 (ten years prior to the first documented grazing activities) to 1906. Of the 113 carved trees which have been documented, nine exhibit dates ranging from A.D. 1875 to 1895, and an additional 30 trees are inscribed with dates ranging from A.D. 1900 to 1910. Research of local historical documents has established the identities of six men whose names appear, in varying numbers, at eight of the twelve sites. All are associated with cattle or sheep grazing. Their occupations range from "homesteader and stockman" to Assistant Manager of the Toppenish Livestock Company. Nine names occur at more than one site, indicating widespread use of the range at an early date. Although the sites are located over a broad area, all are located within one-half mile of former stock driveways.

The name of Link Jordan is inscribed into trees at five different sites, with dates ranging from A.D. 1887 to 1895. Lincoln Jordan was born in 1872 at Bickleton, Washington, and made his living "raising sheep and following the grazing" (May 1982: 256). The name of O. P. Kreps, Sr. is inscribed into a tree, along with a date of 1912. Kreps was one of the founding members of the Mt. Adams Cattle Association in 1916, and was one of the original permittees on the Mt. Adams Cattle Allotment. The date of 1912 corresponds with the date given by Ernie Childs for the earliest cattle permittees on the District, indicating that Kreps may have also grazed on the Trout Lake Allotment. The oldest grazing records in District files date to 1917, so information from sources such as this often provide the only clues we have to this earlier period. The names of Ben Snipes, an early cattleman, Andrew and G. C. Bunnell, brothers who grazed sheep from Stagman Ridge to Bird Creek until 1914, Miles Nicholas Mulligan, a "stockman" from the Klickitat Valley, are all recognized today from names on maps such as Snipes Mountain, Bunnell Butte and Mulligan Meadows. But when these same names are seen today inscribed in aspen trees along stock driveways, a vital link is made to the overall picture of historic open range grazing activities on the Forest.

A uniquely human perspective on the tensions between early sheepmen and cattlemen, as well as those caused by the initiation of Forest Service regulations on grazing can also be found in these carved aspen sites. Although in many cases not printable, some of these trees bear rather descriptive epithets directed against particular individuals. In one site, the name of Harvey Lickel, an early "Ranger" stationed at the Gotchen Creek Guard Station between 1910 and 1918, is colorfully taken in vain. The name of Will McGrath appears at two different sites, along with a date of 1903. At one of these sites his name has been modified, so that each letter provides the first or second letter of a profanity. Although most of these words are still perceived as profanities today, the choice of "Muttenhead" for the letter M probably indicates that Mr. McGrath was a sheepherder, and also portrays the concept that profanity is often in the mind of the beholder.

A number of other sites within the watershed boundary relate to grazing, including several corrals and loading chutes, stock drift fences, the remains of a sheep bridge across the White Salmon River, a number of former stock driveways, a log watering trough, irrigation ditches, water pipelines, salt log locations, and the remains of camps. Most of these date to after 1917, and were constructed by the Mt. Adams Cattle Association. Of particular interest with respect to the watershed are the pipelines and irrigation ditches. A 1919 Forest Service report on the proposed pipeline indicates that Gotchen Creek itself was considered the dividing line between the watered and unwatered parts of the Mt. Adams Allotment. Forest Service officials felt that the pipeline was needed because cattle were only using range that was within two miles of water, and consequently portions of the range were "badly overcrowded" and other parts were unused.

> As a result, a condition has arisen which must be taken care of immediately to insure the future of the range. The forage in the vicinity of Gotschen Creek and Bird Creek is rapidly being grazed off too closely and trampled down so badly that there is danger of permanently injuring the range. At the present time there are areas where the herbaceous vegetation is entirely lacking, areas which constitute a very perceptible percentage of the range. These areas are growing in numbers and size (Boyce 1919:4).

Several proposed remedies are discussed, including reducing the number of cattle on the range, enlarging the cattle range by incorporating lands then included in sheep range, forcing the cattle into unused range through salting and herding, and piping water to unused portions of the range. The latter alternative was chosen as the most feasible, although the rationale for not choosing the other alternatives provides some insight into the social aspects of their decision:

> The number of cattle allowed on this range may be reduced with great benefit to the range. However, this range plays a very important part in the business of some 20 ranchers. It is depended upon for their livelihood and should not be taken away or reduced. Furthermore, these ranchers live within a short distance of the forest and are engaged in developing a country bordering the Forest. They should be given consideration.
>
> ...The cattlemen live close to the Forest and are developing the country rapidly into an excellent ranching proposition. The sheep men for the most part do not live near the Forest...It would seem that the cattlemen should be given the preference. However, these sheep owners have a standing with

> the Forest Service through their long occupancy of the range. Under supervision they have kept their ranges in good condition and they, too, depend on the Forest for a livelihood (Boyce 1919:4-5).

Information on the four irrigation ditches known to exist within the watershed boundary is sparse, and their date of origin is not known. The irrigation ditch that flows by the Gotchen Creek Guard Station is shown on the 1920 USGS/GLO map, as well as on a 1938 map of the Guard Station site. It may well have been constructed when the Guard Station was constructed, in 1910, or it is possible that it was constructed by one of the early sheepherders. It's source is a spring along the Aiken Lava Bed. A ditch is shown on the GLO map for T. 7 N., R. 10 E., surveyed in 1917, which diverts water out of Wicky Creek into what was then called Wicky Meadows. This area is now called Cherry Flats, and is one of the areas that contains the remains of a large corral, apparently capable of holding 200 head of cattle, and estimated to have been constructed around 1920. The Wicky Meadows Ditch was approximately .75 miles long, and appears to end at the corral site. It was apparently constructed in order to provide a water source for cattle at the corral.

The third ditch is also located in T. 7 N., R. 10 E., but it's purpose is not clearly understood. It is shown on the GLO Plat map, and is referred to in the 1917 survey notes for the township as an "irrigation canal" from Wicky Creek. It measured 12 feet wide and 4 feet deep. According to Ernie Childs, the canal was built by a Dr. Belscheim of Trout Lake, in what Mr. Childs interpreted as some sort of scam over water rights in the White Salmon River. The water was to be diverted from Wicky Creek into the White Salmon River. A cabin is shown in the vicinity on the 1920 and 1922 Forest maps, and Mr. Childs felt that Dr. Belscheim had also constructed the cabin. This cabin has since been destroyed by logging activities. Other sources indicate the cabin may have been built by a placer miner, or also that it was used by a cattleman who used the Buck Creek Trail as a stock driveway.

The fourth ditch is known only from the 1920 GLO survey notes and 1923 Plat map for T. 8 N. R. 11 E., where it is shown as a ditch diverting the upper reaches of Gotchen Creek into Bird Creek. The survey notes go on to state that almost all of the water from Bird Creek is diverted into the Glenwood Valley for the purposes of irrigation. The date of construction of this ditch is not known, although irrigation of the Glenwood Valley from waters off of Mt. Adams began at least as early as 1907.

The final site associated with grazing activities is Cow Camp. Cow Camp is a group of structures built by the Mt. Adams Cattle Association in 1919. Originally consisting of a cabin and six barns, the site has been under special use permit to the Association since 1917. The cabin served as the focal point of range activities, being utilized by the range rider during the grazing season and by Association members during the fall roundup. The District Ranger and other Forest Service personnel were generally invited to Cow Camp each year, riding with Association members in the roundup. Concern with the quality of range lands, encroaching timber, and the impacts of sheep bands are well documented in letters between the Association and District personnel. The Mt. Adams Cattle Association was a well-organized and influential group of ranchers who had a long and positive relationship with the Mt. Adams Ranger District.

Probably one of the best indicators of the importance of grazing in the early history of the watershed is the fact that so many of the place names within the area are derived from early sheep and cattlemen. Crofton, Snipes, King, Smith, Gotchen and Bunnell are all names of men who ran sheep or cattle in the watershed area.

FOREST SERVICE ADMINISTATION HISTORY

One of the first Ranger Stations established on the Columbia National Forest was the Gotchen Creek Ranger Station, located along the wagon road from Glenwood. The cabin was constructed in 1910, with a pasture fence added in 1928, a barn in 1932, a garage in 1933 and a corral in 1938. The cabin is the only structure remaining at the site, and it is one of the oldest ranger stations still in existence on the Forest. A 1910 Special Fire Report discusses the need for this ranger station:

> Range of the greater part of the sheep that use this Forest is in this district, and more than one-half of the bands pass near Gotzen Creek in going to and from the forest, and ...the District Ranger must of necessity keep in close touch with the sheepmen (Stabler 1910).

Columbia National Forest maps from 1911 to 1927 show a Wicky Creek Ranger Station or Wicky Creek Administrative site, located on the east side of Wicky Creek. It is not known if a cabin was ever present at this site. It was apparently used to monitor both grazing activities and recreational access to Mt. Adams. These same maps show a Morrison Creek Ranger Station in the vicinity of the present Morrison Creek campground. The 1920 GLO survey notes for T. 7 N., R. 10 E. refer to a cabin at this site. The cabin is also shown on the 1911 Columbia National Forest map, and was probably constructed in that year. It was most likely a log cabin, similar to a number of other ranger stations constructed in that same year.

Around 1910 the Forest Service became interested in the concept of building fire lookout on mountains, and by 1918 plans were underway for construction of a lookout on the summit of Mt. Adams. Construction took three years to complete, with much of the materials hauled to the top in backpacks. The more unwieldy materials were winched to the top using a large pulley and two counterbalanced sleds. The lookout was completed in 1921 and manned from 1922 through 1924. At that point in time the lookout was abandoned, since storms, the short season available for use, and the poor visibility due to cloud cover resulted in its being ineffective as a fire lookout.

RAILROAD LOGGING

According to District records and interviews with brakeman and engineer Louis Lorengel,, the J. Neils Lumber Company began railroad logging in T. 7N., R. 11 E. in June of 1942. The logging continued seasonally through 1946 and extended west to the White Salmon River. The sale was intended to selectively cut Ponderosa pine, removing 50% of the volume. According to the 1910 Fire Report, the majority of the timber in this area was Ponderosa (then called yellow) pine. The operation consisted of tree length skidding by tractors. At the landing the logs were scaled and bucked, then skidded to the McGiffert Steam Loader for the loading onto rail cars. The loaded rail cars were hauled to Camp Draper where a second engine took over, hauling the logs to the mill at Klickitat. Once a particular area had been logged, the tracks would be picked up and laid elsewhere. A number of railroad grades were constructed in the area between 1939 and 1949, and the majority of these have since been converted to Forest roads.

H. D. Hollenbeck of Trout Lake began logging operations in the Trout Lake Creek basin in September of 1943, selectively cutting Douglas fir and removing approximately 30% of the volume. They constructed the first portions of what are now Forest Roads 88 and 8810.

TRAPPING

The trapping of animals for their furs has been an ongoing activity on the Forest since at least the turn-of-the-century, and may possibly extend back to the Hudson's Bay era. The remains of two cabins which are likely related to trapping are located within the watershed boundary. One was a log cabin, located between McDonald and Crofton Ridges. It was standing at the time of the 1917 Township survey. The second is located along Salt Creek, and is completely deteriorated. The remains of three other cabins known to have been used for trapping are located within 2 miles of the watershed boundary. A reported trapper's cabin was located on Stagman Ridge, but this site has not been field-verified. Trapping was a winter activity, and these cabins were intended for winter occupation. According to Ernie Childs, Mr. Eckhart used to trap on the western slopes of Mt. Adams, and he would bring an old horse and a sled up every fall, kill the horse and use it for bait, and then haul the sled out by hand in early spring. Weasel, raccoon, marten, fisher and fox were species known to have been trapped.

MINING

Only four mines have been documented within the watershed boundary, one at Grand Meadows, one on the summit of Mt. Adams, and the other two along the White Salmon River. The claim at Grand Meadows was filed in 1969, and its location is not known.

By 1927 Wade Dean and a few associates had formed the Glacier Mining company and had filed 17 mineral claims on the summit plateau of Mt. Adams. They began sulfur mining in 1932 on the summit, using the lookout as a shelter. Mining on the summit of Mt. Adams was a major undertaking, since a trail suitable for horses and mules had to be constructed to the summit. Packers moved strings of horses up and down the side of the mountain to carry supplies to the top and pack sulfur back down. In all, more than 1200 trip down the mountain were made, hauling 180 tons of pure sulfur. The routine atop the mountain was strenuous, made more difficult in the thin air and sulfur fumes. At first the miners dug test pits over a half-mile square of the summit crater. Using a hand ax and pick and shovel, they hauled the ice up hand over hand with a rope and five-gallon pail. Later a four-ton gasoline engine diamond drill was hauled to the top. This was accomplished using the motor as a winch and a series of dead-man anchors. The drilling rig literally pulled itself up the mountain. The diamond drill was used to pierce the ice cap that covered most of the crater. The deepest penetration through ice by the diamond drill was recorded as being 210 feet. After this much ice was pierced, the drill went down to depths of more than 300 feet on occasion to obtain the cores needed for study. The difficulty of hauling the sulfur down the mountain made mining economically unfeasible, and after World War II the effort was abandoned. The last assessment work was done in 1959.

The MCC Claims were filed by Loren Meyers in 1961, and were located along the White Salmon River above Williams Mine. Williams Mine was an open shaft mine reportedly begun in 1897, with a cabin built there that same year. Mr. Williams and Mr. Eckhart had opened up a trail to the mine from the Trout Lake Valley by 1917, but it is not clear if they were the original claimants. Three shafts are present at the site, and the longest was apparently 150 feet long and 6 feet high. Many of the mines on the Forest were apparently worked in the winter, when people had time off from their farm work. The extremely high stumps visible in the area are probably due to their having been felled in deep snow. A second claim was filed on this mine in 1958, by SDS Lumber Co.

OTHER WATER USES

In the 1950's the Klickitat County PUD applied for a preliminary power permit on lands within the watershed boundary. Referred to as the White Salmon Hydroelectric Project, the proposal included the construction of dams on Ninefoot Creek, on Trout Lake Creek, and below Trout Lake at River Mile 27. The dam below Ninefoot would be used to divert water to a reservoir below Haystack Butte, which in turn would feed into the reservoir of Trout Lake. The dam on Trout Lake Creek and the White Salmon River would have inundated the upper part of the Trout Lake Valley (including the present Ranger Station site). This proposal was still under consideration as late as 1978, but was later abandoned.

ROADS AND TRAILS

Interviews with Ernie Childs and memos between the Forest Supervisor (K. P. Cecil) and the District Ranger (K. C. Langfield) dated 1937 through 1938 indicate that there was a general belief that Captain George McClellan passed through the Swampy Meadows area in 1853 while surveying a route for a transcontinental railroad. Another reference to this route can be found in a 1926 Forest newsletter called The Columbia Record.. The article describes the route, stating that:

> ...the trail crosses the Twin Buttes burn,...descends to the Mosquito Crossing, passing Steamboat Lake, thence to Swampy Meadows, and probably thence North past Sled Camp,... (The Columbia Record 1926) .

The 1853 journals of the McClellan party indicate that their route actually took them through the Peterson Prairie area and then along the Cave Creek drainage into the Trout Lake Valley.

A number of old trails are shown on early maps for the area. The oldest is the trail shown on the 1886 GLO map of T. 7 N., R. 11 E. and labeled "Trail from Camas Prairie to Mt. Adams". This is the route followed by C. E. Rusk in 1890, and was the route used by those wishing to climb the south side of Mt. Adams. Trails which are shown on the 1911 and 1912 Columbia National Forest maps include the "Morrison Trail", connecting the town of Guler north to the Chain of Lakes area. This trail went through the Wicky Creek administrative site and up McDonald Ridge, along the general routes of Forest Roads 80 and 8040. It is possible that this is the route followed by Francis Marion Streamer in 1878. Another trail heads north from Guler to the Gotchen Creek Guard Station, and is called the "Gotzen Creek Trail". The "Swampy Meadows Trail" is shown connecting the Twin Buttes Ranger Station to the Morrison Trail, on the west side of Mt. Adams.

The Dead Horse Trail and Stock Driveway also appears on maps in 1911, and it was the major stock driveway between Glenwood and the Twin Buttes area. It crossed the White Salmon River near the confluence of Green Canyon Creek. The second major stock driveway was the Hole-in-the-Ground trail, which went north from the Dead Horse Driveway to connect to the Morrison Trail.

Two roads are shown on the 1890 GLO map connecting the towns of Glenwood and Guler. One is in the location of the current road.

The first road shown on early maps is the road connecting Glenwood to the Gotchen Creek Guard Station. This is shown on the 1911 maps, and appears as a road passable by automobile in 1912. It was not connected through to the town of Guler until 1920. The second road to be constructed was the road to Cold Spring Camp, which is shown as completed on the 1917 GLO map. This road followed the general route of the Morrison Trail.

A trail up the west side of the White Salmon River is not shown until 1917, and it is called "Williams Trail". An unnamed trail is shown on one 1912 map that may be in this location, however. This trail connects from the town of Guler northwest to the Swampy Meadows Trail.

CURRENT CONDITIONS

NATIVE AMERICAN USE AND TREATY RIGHTS

CURRENT USES

According to Boyd (1993:9), “Mount Adams has special spiritual significance to the people of the Yakama Nation.” It is featured in several myths of the Yakama, Klickitat and Upper Cowlitz. It is also listed by Walker (1988:259) as a currently used sacred site. Walker writes that “this mountain in Washington is the site of frequent vision questing and other ceremonies identified with the Yakima (sic), Klickitat, and other Sahaptian groups (1988:262).” It was also one of the sacred sites listed in the original court documentation for the American Indian Religious Freedom Act (AIRFA) in 1978.

There are numerous traditional resources which remain of use to Native Americans. This includes huckleberries, beargrass, western redcedar, deer/elk, clean water from Mt. Adams, fish, and medicinal plants. Consumption of these resources off of National Forest lands are not tracked.

FEDERAL TRUST RESPONSIBILITY TO INDIAN TRIBES

The United States has a trust responsibility to tribal governments, brought about by treaties and by law. The welfare, land and resources of the tribe are entrusted to the United States Government. The obligation that the government has toward tribal governments is particularly important where it involves lands that are subject to treaty rights. All of the White Salmon watershed is within the ceded lands of the Yakama Indian Nation, per the Treaty of 1855. On lands ceded to the United States that later became part of the National Forest system, treaty rights and privileges of the Yakama Indian Nation include:

1. The right of taking fish at all usual and accustomed places in common with citizens…and erecting suitable buildings for curing;
2. The privilege of hunting, gathering roots and berries…upon open and unclaimed (i.e. National Forest) land;
3. The privilege of pasturing horses and cattle upon open and unclaimed land;
4. The implied reservation of water to effectuate hunting and fishing rights.

Tribes such as the Yakama, with a treaty reserved right to hunt on open and unclaimed lands and take fish at their usual and accustomed grounds and stations, are currently recognized by both Oregon and Washington as having a "co-management" status for the purposes of setting harvest seasons and other regulations such as limits and gear type or harvest allocation. These reserved rights constitute a property right in the land where the trust resource exists. The State may only regulate Indian hunting and fishing activity off reservation where it is deemed essential to preserve the species.

The tribes' position is that treaty rights extend to the habitats upon which trust resources depend. This claim includes the way fish and wildlife habitats are affected by the manner in which the Forest Service manages timber harvest, recreation, water, grazing and minerals exploitation on National Forests. Tribes maintain that the Government has an obligation to manage habitat in a manner that will not diminish populations of fish, plants and animals to the extent that the Indian share of these resources is diminished.

The United States has an obligation to protect the tribe's property right to usual and accustomed grounds and stations. This obligation includes seeing that the individual successors in interest to these rights are not prevented from accessing these locations and exercising the rights, and to see that the trust resources are protected. The recently completed Tri-Region Anadromous Fisheries Policy and Implementation Guide serves to clarify Forest Service duties and responsibilities with respect to fish habitat and any Forest activity that may affect the quality or quantity of the habitat.

There may be a trust responsibility with regard to managing other resources as well. Recent increases in the use of National Forest Service lands has led to increased consumption of resources collectively referred to as Special Forest Products. Included in this broad category are species such as berries, roots, medicinal plants, beargrass, mosses, fungi, grasses, shrubs, tree bark, and poles. Many of these resources were and are traditionally gathered by Indian people on ceded lands. The Forest Service has a responsibility to honor treaty rights, and the protection of treaty reserved rights is commensurate with protection of resources. In addition, certain resources, such as huckleberries, are considered both a trust resource and a cultural resource, and management should be commensurate with both of these values.

The exercise of treaty rights appears to be consistent with the stated purpose of the Wilderness Act, and treaty rights do not appear to have been altered or amended by the Act. The exercise of treaty reserved rights is a "historic use" and would normally compliment the preservation goals of the Act.

RESIDENTIAL AND AGRICULTURAL DEVELOPMENT

Agricultural use continues in the lower portion of this watershed, in the town of Trout Lake. Agricultural areas are contained by sloping forest lands and have not expanded significantly in recent years. To the contrary, many former agricultural areas are becoming residential areas. New home construction has increased also increased in the timbered fringe surrounding the valley.

RECREATION

Historically, the Forests have provided a range of recreation settings and developments to suit the range of tastes of its customers. This is the basis of the Recreation Opportunity Spectrum (ROS), which provides guidelines regarding social, physical and managerial settings, so that users may meet their varying expectations. In essence, at one end of the spectrum ("Primitive"), a visitor could expect a pristine setting, no motorized use, little or no facility development, few other visitors and little or no evidence of management intervention. At the other end of the spectrum ("Urban"), a visitor may expect a full line of facilities, including flush toilets, paved parking lots, opportunities to meet and mingle with others, and strict rules regarding use of the area.

The Upper White Salmon River watershed provides the setting and resources that people rely on in order to pursue the various activities they value. Recreation settings within this watershed range from "Primitive" in the Mt. Adams Wilderness, to the "Roaded Natural" opportunity class, which represents relatively natural appearing settings that are accessible by road.

Visitors may engage in several activities during one outing, such as hiking and fishing during the day, while camping at night, or they may simply engage in one activity on a day trip. Based on the increase in use in recent years and the projected growth associated with a rapidly expanding nearby urban area, we assume that the demand for and amount of use will continue to grow for the foreseeable future.

The following activities and attendant facilities have been identified as important aspects of the human uses of the area.

CAMPING

There are three camping facilities in the watershed: Wicky Shelter, Morrison Horse Camp and Morrison Campground, all located on FR 8040. None of these facilities receives heavy use. Most camping occurs at undesignated "dispersed" sites, either adjacent to forest roads, at trailheads or within the Mt. Adams Wilderness. A significant amount of camping occurs in association with climbing the south side of Mt. Adams. Approximately 5200 people visit the South Climb annually. Of those 5200, 75% camp overnight on the climbing route (262 campsites have been identified to date) and many of those also spend one night camping close to their vehicles in the parking area of the South Climb trailhead. The climbing season generally runs from Memorial Day throuhg the end of September, depending on weather conditions and accessibility. General camping use varies throughout the summer season with the majority occurring during the holiday weekends such as Memorial Day, the Fourth of July and Labor Day, and in late summer/early fall when hunting is a major activity.

DAY USE

The primary day use activities occurring in the watershed are hiking, horse riding, skiing, snowboarding and snowmobiling. There has been an increase in mountain biking activity in recent years. In summer, day use occurs on several trails: the Pacific Crest National Scencic Trail (PCT), Salt Creek, Stagman Ridge, Shorthorn, South Climb, Cold Springs, Round-the-Mountain, Snipes Mountain, Pineway, Gotchen , and Buck Creek. All trails are open to horse riders and hiker. Cold Springs, Buck Creek, Pineway, and the lower portion of Snipes Mountain Trail are also open to bicyclists.

WINTER RECREATION

Winter recreation activities occur throughout the watershed, generally from mid-December to April. Program administration and facilities maintenance is accomplished through a cooperative agreement with the Washington State Parks and Recreation Commission. Two winter recreation facilities, Pine Side and Smith Butte Sno*Parks, consist of parking areas, toilets, and trailheads. Both are located on FR 8200. There are approximately 16 miles of groomed cross-country ski trails associated with these Sno*Parks. Both Sno*Parks are also used by snowmobilers, who generally use roads that are ungroomed. These Sno*parks are also used as starting point for travel to Mt. Adams Wilderness and Bird Creek Meadows. There is also Some amount of snowshoing and sledding occurs, but are not the primary winter recreation activities. An undetermined amount of backcountry skiing and snowboarding occurs within the Mt. Adams Wilderness. Snowboarding, in particular, seems to be a growing activity.

MINERALS AND SPECIAL FOREST PRODUCTS

Special forest products include plants, fruits, firewood, rocks and minerals from National Forest lands. The products are used for a variety of purposes such as food, fuel, building and landscaping materials, and medicinal use. Humans from early Native Americans times to the present day have collected products from the forest. Some special forest products are taken for personal use while others are collected as a commercial endeavor. Permits are generally required for the collection of forest products. Depending on the type of use (personal or commercial) a fee may or may not accompany the permit. The following is a discussion of the more common special forest products collected within the watershed.

- **Berries.** Several species of berries, including huckleberries, blackberries, wild strawberries, and elderberries are harvested by Forest visitors during summer and fall. Picking for personal use is not regulated other than honoring Native American treaty right areas. Commercial picking requires a permit.

- **Mushrooms.** Mushrooms and other forms of fungus and lichens are harvested in the spring or the fall, depending on the type. Personal use picking requires a “free- use” permit and there is a fee for the commercial picking permit. Competition can be high for certain species of mushrooms. Collection is prohibited within designated Wilderness and Research Natural Areas.

- **Beargrass.** The tops of beargrass are collected for floral arrangements and basketry. Most all of the collection is for commercial use and there is a fee for the permit. Collection is prohibited within designated Wilderness and Research Natural Areas, however there have been several reports and law enforcement incidents involving illegal harvest within the Mt. Adams Wilderness.

- **Transplants.** Several species of trees and shrubs are removed for both personal use and commercial use. Small conifer trees are sold from overstocked plantations and along roads where thinning is desirable. A variety of shrubs, most notably vine maple in this watershed, are removed by commercial permittees for use in the landscape industry. An individual can obtain a “free-use” permit to dig five transplants for personal use. Commercial collection requires a fee permit. All permitted use is restricted to designated areas to order to avoid resource damage and unintentional digging in protected habitats.

- **Poles.** A variety of pole products are sold to the public for use as house logs and fence poles. The preferred species for pole material is lodgepole pine. Permits are sold for personal use and cutting is restricted to designated areas where tree thinning is desirable.

- **Posts and Shakes.** Down western red cedar is salvaged for fence posts and sometimes shakes. The demand for this product is going down since quality cedar is difficult to find and people are using other materials for posts and roofing. Cedar salvage is only available by permit and is now restricted to landings around timber harvest operations.

- **Firewood.** Firewood cutting was at one time very widespread in the watershed but is now regulated to designated areas along roads and logging landings. Temporary roads may be kept open for a period of time after logging to facilitate removal of firewood.

- **Rocks and Minerals.** There are currently no active mining claims in the watershed. The rock pit at Bunnell Butte (Road 8200732) provides common rock that has been used widely in the watershed for roads both on and off the National Forest. In additon, two areas provide shale/flagstone for personal use. These two areas are located adjacent to Road 2300574, and 8031041.

GRAZING

Grazing occurs on the National Forest within the 32,000-acre Mt. Adams Cattle and Horse Allotment. This allotment is located entirely within this watershed. With this allotment, the Gifford Pinchot National Forest participates in the King Mountain Coordinated Resource Management Plan, a cooperative effort between the Washington Department of Natural Resources, the Yakama Indian Nation and Champion Pacific Timber Company to manage all of the 71,000 acres used by this permitee and his 516 cow/calf units. Cattle graze in the spring at the lower elevations of the watershed. They drift on to the Forest Service land in June and stay until round-up which is in September.

There are no temporary corrals associated with the allotment; however, the historic “Cow Camp” on Forest Road 8225 is used by the permittees during the fall round-up. Animal use tends to follow openings created by timber harvest, roads, and trails. Concentrated use may occur near open water such as with upper Hole-in-the-Ground Creek, Gotchen Creek, and several anonymous springs. There is also a system of pipelines and troughs which have been constructed in the vicinity of Road 8225.

The ten year term permit for this allotment was last re-issued in 1995. Per this decision, a number of range management actions were planned. This included the construction of the new “North” drift fence running east/west between the Forest boundary and Aiken Lava Bed. This fence sought to prevent animals from grazing in the upper Gotchen Meadows or Bird Creek Meadows on the Yakama Indian Reservation. This fence has been constructed. In order to expand use of available forage south of this fence, the new “Pine Tree Springs” pipeline and trough system was to be constructed from Gotchen Creek. This is still under construction, as only a water holding tank and trough have been completed (see Map V).

Several other small fencing projects have been completed in order to keep cattle out of sensitive springs. This include a fence around the “Bugle” springs (off Road 8031023) and around Glacier Springs.

The Twin Buttes Sheep and Goat Allotment overlaps the western portion of the watershed. While active, this portion of the allotment has not been used for over 10 years.

TIMBER MANAGEMENT

Management of forest lands for timber continues today on federal, state, and private ownerships. On federal lands, timber harvest peaked in the 1970’s, as since been reduced due to the Northwest Forest Plan. Refer to the Vegetation / Current Conditions / Disturbance section for additional discussion on timber harvest on federal lands since 1950.

CHAPTER V - SYNTHESIS

Synthesis is the process of comparing the reference conditions to the current conditions (Chapter IV) while considering direction in the Forest Plan and other resource laws which guide the desired future condition. The relevant components of the aquatic, terrestrial, and human landscapes are incorporated. This synthesis discussion addresses the principal issues and key questions identified in the Chapter III, which also provides supporting information to the issues discussed here.

GEOLOGIC AND PHYSICAL PROCESSES

ISSUE: Erosion Processes

Landslides and debris flow can add substantial amounts of sediment and large woody debris to stream systems. These events can be significant though infrequent. These processes are perhaps more important in the steeper western half of the watershed than in the eastern half with its gentle slopes and stable soils.

KEY QUESTIONS:

1. Where are the potential or active mass wasting sites in the watershed?

Active mass wasting sites are located adjacent and below Avalanche Glacier within the Cascade Creek subwatershed. A past active site with potential for future movement is located on the east slope of Haystack Butte. These soils occupy less than 2% of the watershed (see Map F). In general, mass wasting events are rare within the watershed. The primary occurrence would be lahars off the upper slopes of Mt. Adams.

2. Where are the potential mass wasting sites that are likely to be accentuated by management actions?

Avalanche Glacier and other unstable soils within the Cascade Creek subwatershed lie within the Mt. Adams Wilderness and are unaffected by our management actions. The only other area of mapped soil instability is east of Haystack Butte. As part of the Riparian Reserve allocation, this area would not likely be subject to additional timber harvest or road construction. Throughout the watershed, road construction cut and fill sites would have the potential for mass movement. At particular risk are stream crossing with undersized culverts. These culverts could be plugged during a peak flow event, leading to the failure of the road fill. This risk is greater in the western half of the watershed with its steeper slopes and greater road / stream crossings (see also Erosion Processes Item 7).

3. In what part of the watershed is surface soil erosion likely to occur and get into steams?

The western portion of the watershed has the greatest potential for soil erosion which may get into streams. Slopes are steeper, and there are more streams in this portion of the watershed. It has a higher density of past clearcutting and a road density equal to that of the east half.

With its few streams, road density on the east side has greatly increase overall drainage density.
It is unknown if any sediment within Hole in the Ground, Gotchen Creek, or any other streams within Subwatersheds G and H actually reach the White Salmon River. We were not able to identify any surface linkage. These streams become less defined as they drop in elevation, and any channels which may have been present near the confluence with the White Salmon River, have been obliterated by agricultural development.

4. What is the natural rate of sediment production?

The natural rate of sediment production would be the product of the geology, soils, channel types, precipitation patterns and disturbance events. The element that has changed the most in the last 100 years is the reduction in fire as a disturbance event, with timber harvesting a disturbance instead. These disturbances are different in their scale of intensity. Road construction and use is the other major factor that has changed.

Cascade Creek, which is glacially fed, has high natural rates of turbidity that peak during the summer, during the White Salmon River's lowest flows. Most other streams in the watershed are not glacially fed, and have their highest turbidities in winter storms. Sediment contributions from road, timber harvest, trails, and grazing would be greatest during winter storms.

5. Which surface soils are subject to increased erosion from management actions (e.g., roads, timber harvest, grazing, recreation, and fire) and to what extent has soil compaction and displacement increased erosion and sedimentation?

Based on mapping of the soil management units (GPNF Soils Inventory), about half of the watershed has the potential for moderate to high surface erosion. With its greater stream density and steeper slopes, the western half of the watershed has greater potential for increased erosion and sedimentation following disturbance.

In the east half of the watershed with its predominantly gentle slopes, an estimated 6% of the land area may have been compacted from past tractor logging. The great reduction natural grasslands, that consisted primarily of native bunch grasses such as blue bunch wheatgrass (*Agropyron spicatum*), on the east side of the watershed as well as across the Columbia Plateau, has contributed to soil erosion by wind and water. The permanent root systems of bunchgrasses anchor the soil better than the annual grasses, and help with the establishment of cryptogam crusts, which in turn help absorb water into the soil instead of an increased run-off found with compacted soils, and soils whose vegetation has been disturbed by cattle and off-road vehicle use. How much erosion actually occurs and what eventually reaches a stream as sediment remains unknown. The gentle slopes, naturally rapid water infiltration rates, and scarcity of streams, are factors which would retard soil movement to streams. In addition, we have not been able to identify any surface channels in the non-key portion of the watershed that would provide surface water flow and sediment to the mainstem White Salmon River.

6. What is the road erosion potential?

The road erosion potential for the watershed was modeled to be 20 tons per square mile per year. This estimate is low compared to neighboring watersheds (Upper Lewis River, Trout Lake Creek, Bear-Cave Creeks, Little White Salmon River). The actual rate is expected to be lower than modeled due to the use of Forest-wide averaged values for several of the model's variables. Level 2 road condition surveys, which could provide these site specific values, have not been completed in this watershed. Based on the models outputs, Subwatersheds I, K, Y, and Z have relatively high sediment contributions and they also have fish bearing streams. Subwatershed I and Z are drawn around the mainstem White Salmon River.

7. What stream crossings (roads) are at risk for culvert failure?

There has been no systematic inventory of all roads within the watershed to determine which culverts are undersized or which may be partially blocked. Level 2 road condition surveys could provide this information. There are several known problem areas, for which remedies are suggested in the recommendation chapter. In general, culverts in the west half of the watershed (the Key Watershed) may be at greater risk of plugging, have deeper road fills, and may cause move adverse environmental damage if the culvert fails and the fill erodes.

VEGETATION

ISSUE: Disturbance (Fire and Insects)

Either through human or natural ignitions, fire has been one of the major sources of disturbance in the watershed. The occurrence intervals for natural large fires range between 125 and 500 years. Due to lightning, total fire occurrence is relatively high, but large fires resulting from these ignitions are infrequent. Increased human settlement and fire suppression efforts over the past half century have changed the historical pattern of fire on the landscape. Fire suppression may have also changed the species composition and tree density. This in turn may have effected the current health of the forest.

KEY QUESTIONS:

1. How has the natural role of fire within the watershed changed given fire suppression?

Historical evidence along with the numerous forest ecotypes point to a varied fire history. Large stand replacing fire events did occur at long intervals, and lighter underburns occurred at short intervals. Ignition sources were both lightning and Native Americans. Sheep herders and cattleman may have also ignited some of the large fires at the turn of the century.

Fire suppression began in the 1930's and effectively kept fires small. We have no records of large fires (>100 acres) following 1930's.

Grand Fir Zone. Fire suppression along with the selective logging of ponderosa pine in the eastern portion of the watershed has resulted in the increased stocking and density of grand fir and Douglas-fir. This cohort of grand fir is 80-100 years old. In growth of grand fir has also added to the understory. Many of these stands have a varied stand structure with layered canopies, ideal for late-successional species such as the northern spotted owl. While some clearcutting has occurred, most of this forest is relatively unfragmented.

It is within this drier Grand Fir Zone, also characterized as Fire Group 3, that we have likely disrupted both fire frequency and stand composition/structure, which are linked. This situation is not unique to Forest Service lands, as it also occurs on ownerships south with this watershed and lands east of this watershed.

Subalpine Fir Zone. Stands in the Subalpine Fir Zone may susceptible to large fires at this time. Much of this plant association occurs in the lower Mt. Adams Wilderness and adjacent roadless areas. Stand ages are near 150 years, and natural senescence of lodgepole pine and subalpine fir are building downed fuel loads and fuel continuity. For Fire Group 5, the fire frequency interval is 150 years, with a greater propensity for stand replacement type fire. The role of fire has not changed; this watershed is just nearing natural conditions for stand replacement fire.

Pacific Silver Fir Zone. In the Silver Fir Zone, which has much longer fire return intervals, conditions are more stable. With our suppression efforts eliminating nearly all fires, downed fuels are accumulating in the mature and old-growth stands. Information from roadside surveys indicate that fuel loads are on the increase. Areas that once were characterized by fuel model 8, are now moving to fuel model 10. This fuel model is characterized by increased amounts of downed woody material.

2. How has the current spruce budworm outbreak affected forest health and fire risk?

It is within the Grand Fir Zone and Subalpine Fir Zone that a western spruce budworm epidemic is now occurring. Affected Forest Service lands cover 15,000 acres; however, this is only the western tip of 100,000+ acres that are affected. This epidemic was first noted in this watershed in 1994. On the Forest Service lands now affected by the epidemic, we have no historical evidence which suggest such epidemics occurred in the past.

Other conifer insects and disease are also becoming more evident. These disturbance agents are increasing their impacts given the absence of fire. They are also contributing to future fire risk.

Conifer mortality which may result from western spruce budworm alone, or in combination with other insects and pathogens, will add to the downed fuel loads. Because of higher total fuel loading, higher dead fuels, and greater horizontal and vertical fuel continuity, escaped fires in these stands today would have a greater tendency to be large stand replacement fires rather than underburns.

3. What is the current risk of a large fire occurring within the watershed and where is the highest risk?

A large fire could occur anywhere within the watershed, given the right weather and fuel conditions. Some areas are at higher risk. One of the main high risk areas is within the Gotchen LSR which has been affected by the spruce budworm outbreak. Stands are nearly pure grand fir and near complete defoliation. Another area, as described below, is the forest straddling the southern boundary of the Mt. Adams Wilderness. This area has had fire exclusion for many years, and the increase in dead and down trees is noticeable.

High fire risk areas:

- Stands along the major ridgelines have had increased live and dead fuel loading. Horizontal and vertical fuel continuity has increased as well. These areas include King Mountain, Snipes Mountain, Eckhart Point, and Smith Butte have high occurrences of lightning plus western spruce budworm damage.

- The eastern boundary of the Forest, which also serves as the eastern boundary of the Gotchen LSR, has a very dense stand structure. This area has high amounts of downed woody material and ladder fuels. The area has a high potential of a stand replacing fire. This area is also in close proximity to Road 82. This is the main access to Bird Creek Meadows, a popular recreation destination. The area is also frequented by hunters and mushroom pickers.

- Timber stands on the southern edge of the Mt. Adams Wilderness and adjoining unroaded areas (includes Gotchen Roadless Area) have gone longer without fire than other parts of the watershed. This includes stands along Roads 8040 and 8000500 to Cold Springs as well as the McDonald Ridge. These subalpine fir stands are naturally senescing and now have light spruce budworm defoliation.

- Stand conditions between timber harvest areas are at a higher risk than those areas that have been harvested with the logging debris, or slash, treated. There are some areas harvest units where the slash was minimally treated or not treated at all. These areas pose a higher risk of fire. These areas are scattered throughout the watershed.

The probability of a human caused fire is moderate in this watershed. This is based on the recreational use of the area. Smoking and campfires accounted for 44% of the fire starts during the last 20 years. No one area can be pinpointed as being at a higher risk than another simply due to the high and varied amount of use the area receives. If or when the trees affected by the spruce budworm die and fall down, the increase in down woody material will raise the risk of fire from forest users.

The probability of lightning caused fire is also moderate in the watershed. Lightning accounted for 47% of the recorded fires during the last 20 years on Forest Service land. The highest number of lightning caused fire starts were recorded in the area of Crofton Ridge and Stagman Ridge. Most all of the high ridges or prominent points had recorded a fire start. The risks associated with these high points were discussed above.

4. Where can we benefit from managed fires, either prescribed or natural ignitions?

Development of a wilderness fire plan for the Mt. Adams Wilderness could include provisions for allowing a wildland fire to be managed under certain conditions. This area could also benefit from management ignited fires. By applying fire to specific areas prior to a lightning ignited fire, the intensity and severity levels can be managed. The effects of fire can be tailored by prescribed burning to what best mimics fire's natural role. That may mean that in some areas a stand replacing fire is warranted.

Other areas that would benefit from managed fires are in the areas that used to be open stands of ponderosa pine. This includes the Gotchen LSR and matrix lands to the south. Since a large portion of the watershed was at one time dependent on fire for its forest structure and resiliency, there is potential to introduce fire back into those areas. However, not all areas could be expected to accommodate fire without some other treatment occurring first. The objective would be to get stands into a condition that would support low intensity underburns. Finally, dry meadow communities could also benefit from managed fires to reduce tree encroachment, and may benefit sensitive plants which depend on early seral stages.

5. What social and political concerns, including the protection of property and life, will affect fire protection, fire use and fuel treatment programs? Are there feasible measures to deal with these concerns while achieving overall resource concerns in the watershed?

The protection of human life and property are the two primary social and political concerns associated with fire protection, fire use and fuel treatment programs. In addition, recreational use is a big aspect of the watershed, as is the maintenance of late-successional and old growth forest (Gotchen LSR), and the timber value on remaining Matrix lands.

Nationally there is recognition that the exclusion of fire over the past few decades has resulted in a decline in forest health. In addition the fuel profiles have been changing to the point that if the weather conditions are just right and a fire does exceed initial attack, a fire of significant size is more apt to occur. In response to these concerns, an emphasis is being placed on changing the fuel profiles back to a more historical profile rather than waiting for or betting against a wildfire occurring.

A thorough analysis of fuel loading and stand conditions needs to be undertaken (currently in progress) to determine the areas with the highest potential for using prescribed fire or mechanical manipulation. Fuel and stand conditions adjacent to administrative sites, private property, lightning risk zones, and the Gotchen LSR would be initial high priority areas.

The use of fire within the Gotchen LSR would be subordinate to its objective of providing old-growth forest for the species that need the habitat. Due to the current lack of old-growth with the Southwest Washington Province, protection of existing old-growth is paramount; and hence the remaining emphasis on fire suppression. Use of fire as management tool to help develop fire tolerant stands is acceptable where it doesn't cause loss of suitable habitat or risk conflagration. At this point in time, many areas need to have some mechanical manipulation of the stand structure and fuel bed prior to any use of prescribed fire. The 15,173 acres Gotchen LSR covers about a quarter of the watershed and includes the lightning prone King Mountain area and Snipes Mountain.

ISSUE: Vegetation Structure and Composition

KEY QUESTIONS:

1. What was the historical vegetative structure and composition?

Historical vegetative structure and composition reflected fire disturbance on a large scale and numerous disturbance agents (fire, wind, disease, insects) on a small scale. The patch size of distinguishable stands was historically large due to fire, covering hundreds to thousands of acres.

Pacific silver fir, grand fir, and subalpine fir had similar forested zones. Ponderosa pine was more dominant and widespread especially in parts of the eastern watershed, with grassy openings in the understory such that some may have been considered “meadows.” Dry meadows were numerous, probably being maintained by fire.

2. How do current conditions compare with the past conditions?

Within the past 60 years, timber harvest activities have increased the amount and distribution of single layer stands. These younger stands are distributed in small patches across the landscape. Widespread selective cutting of ponderosa pine has also affected the composition of stands that remain late-successional today.

The current acreage of late-successional forest lies within the range of natural conditions suggest by REAP, as modified based on the assemblages of forest ecotypes present in this watershed. Much of the late-successional forest under historical conditions was likely to have been in an old-growth condition.

We are currently near the low end of the natural range for early successional forest. Because we use tree size class to help determine succession stage, much of what has been classed as early or mid-successional forest in the high elevations of the Mt. Adams Wilderness is actually older.

3. How much of the watershed is old-growth forest?

There is an estimated 12,791 acres of old-growth forest in the watershed. Most (12,603 is located on National Forest lands. Within National Forest lands, 6,458 acres of old-growth forest is within non-matrix allocations; these forests are not be managed for timber. The Upper White Salmon River Watershed is one of three watersheds which comprise the White Salmon River 5^{th} Field Watershed. Within the 5^{th} field watershed, there are 34,943 acres of old-growth forest, or 29% of the capable land; an estimated 15% of the lands are comprised of old-growth forest within non-matrix allocations.

4. What are the implications for future conditions?

In the absence of a stand-replacing event, much of the 80-100 year forest in the Gotchen LSR is on track to become old-growth. However, this may not be possible without some change in the density and species composition of the forests toward historical descriptions. This change in structure, while more resilient to disturbance, may be adverse to the northern spotted owl at the stand level. Other species dependent on late-successional forest could be affected as well.

ISSUE: Gotchen Late-Successional Reserve

An analysis of the Gotchen LSR is contained within the Gifford Pinchot National Forest Late-Successional Reserve Assessment (1998).

KEY QUESTION:

To what extent do the objectives of the Gotchen LSR mesh with aquatic and terrestrial condition and issues for the watershed?

The objective for the Gotchen LSR is to provide old-growth forest conditions for the benefit of dependent species. Within the Southwest Washington province, the bulk of late-successional and old-growth forest is on Forest Service Lands and will remain so in the future (see GPNF LSRA). The locations of the Gotchen LSR is critical in providing linkage throughout the province, but also to lands in eastern Washington.

In many ways the Gotchen LSR is currently achieving its objectives. Much of the area is late-successional forest, though not old-growth. The current high densities of grand fir surrounding remnant ponderosa pine, contributes to a high canopy closure and multiple canopy layering. Spotted owl movement suggests that genetic interchange for this species is occurring west to east.

Continuation of current wildlife conditions and the movement of late-successional stands to as old-growth state is at risk. In this relatively dry environment, the current vegetative condition, which is beneficial to spotted owls, is succumbing to spruce budworm and other insects and disease. At present, the amount of mortality is not adverse to the spotted owl, yet it is contributing to a greater risk of catastrophic fire.

This potential large fire would be stand replacing. It would be adverse to the Gotchen LSR's current functions and to meeting province level LSR objectives. Depending on the size of such a disturbance, it could also be adverse to the watershed's other terrestrial and aquatic resources, including water quality, fisheries, and Wild and Scenic conditions. There are considerable recreational values both within and outside of the Mt. Adams Wilderness. There are also timber and grazing resources, which become a greater factor off national forest lands.

Even if a stand replacing fire event does not occur, there is no long-term promise for improved conditions without management action. It may be difficult to achieve old-growth conditions in 50 years (in stands now 100 years old) given insect and disease mortality of grand fir, along with the remnant old-growth pine and Douglas-fir. Stand conditions would remain conducive to disturbance. Fuel loads would prohibit the implementation of any kind of underburning program from either natural or human ignitions.

The treatment strategy put forth by the GP LSRA recognized the current value of the existing forests and the need for a transition to a more resilient vegetative condition. The strategy focused on the benefits of stand level treatments as well as the juxtaposition of these treatments to achieve landscape goals of reduced fire risk. Since the LRSA was completed, the severity of the spruce budworm epidemic has worsened, changing the site conditions. The total effected area has increased as has the area of severe defoliation and likely mortality. This does not align entirely within the Treatment Zones identified in the LSRA, and a review of these boundaries is in order.

ISSUE: Plants of Concern

There are many special habitats in the watershed and numerous plant species of concern.

KEY QUESTIONS:

1. What special habitats occur in the watershed?

Old-growth, riparian areas, meadows, aspen groves, alpine, talus, and lava beds are the more prominent special habitats in the watershed

2. What listed species (federal, state, survey and manage) occur within the watershed?

Listed species occurring within this watershed are listed in Tables 8 and 9.

3. How are habitats and plant populations of concern expected to change over time, especially given forest management within Matrix and the Gotchen LSR?

Plant habitats and populations are expected to change over time whether or not the land allocations in which they occur are managed. Habitat of known populations of State Sensitive species will not intentionally be impaired by management activities. However, habitat for all plants of concern may be manipulated outside of the Gotchen LSR and Smith Butte potential RNA through timber and grazing activities. Grazing is most likely to effect pale blue-eyed grass and intermediate bladderwort. Timber harvest may effect habitat for a number of survey and manage species, but known sites of populations will be appropriately buffered from harm under current management recommendations. Monitoring regimes for the effects of these activities on the species of concern are in place to detect whether there is a negative effect.

ISSUE: Noxious Weeds, Non-Native Plant Species

Noxious weeds and non-native plant species occur in the watershed and have the potential to spread.

KEY QUESTIONS:

1. What introduced species are present and where?

Noxious weeds documented to be present in the Upper White Salmon watershed include:

- *Centaurea diffusa* Diffuse knapweed
- *Centaurea maculosa* Spotted knapweed
- *Centaurea solstitialis* Yellow starthistle
- *Cytisus scoparius* Scotch broom
- *Hypericum perforatum* St. Johnswort
- *Circium vulgaris* Bull thistle
- *Circium arvense* Canada thistle

All of the Washington State noxious weeds have the potential to show-up in the watershed “overnight”; however, the ones with the greatest likelihood for concern are listed as Class B for the counties in the the Upper White Salmon watershed (Yakima, Klickitat, Skamania)(see Appendix).

2. What has been and what is the potential effect of non-native populations on native flora and fauna and water quality?

Noxious weeds: suppress young conifer growth, may be deleterious to some grazing animals, alter native habitat for plants and animals, contribute to soil compaction, and add to soil erosion.

3. What has been and what is the potential interactions of non-native plant populations and management actions?

Noxious weeds and other non-native plant populations are a ubiquitous concern, and no less so in the Upper White Salmon watershed. Management actions and recreation have the compounding, often unsuspecting effect of introducing and then nurturing these species. Vehicles, especially hunters and off-road vehicles as used in logging operations, cattle, and people are the primary means of introduction in the Upper White Salmon. However it has been timber units, roads and areas partially denuded by grazing that provide the habitat for these introductions to take hold. Aggressive management actions aimed at controlling and eradicating invasive species are needed (see recommendations).

TERRESTRIAL WILDLIFE

ISSUE: Threatened, Endangered, and Sensitive Species

The watershed contains suitable or potentially suitable habitat for threatened, endangered, and sensitive species including the northern spotted owl, bald eagle, peregrine falcon, grizzly bear, gray wolf, and North American lynx which has recently been proposed for listing.

KEY QUESTIONS:

Northern Spotted Owl

1. What are the spotted owl demographics? Where are the activity centers located, and in what management allocation do they occur?

The spotted owl populations within the watershed appear stable and perhaps on the increase. The watershed seems to be functioning as "source area" for spotted owls as opposed to a "sink". Six of the 12 activity centers in the watershed are within the Gotchen LSR; the remaining are in Matrix. The activity centers are present primarily within the Grand Fir Zone, large tree multistory vegetation band where the level of fragmentation appears highest. Average spacing between all activity centers is 1.80 miles (Std Dev 0.46 mi) suggesting that future detection of a spotted owl greater than 1.80 miles from a known activity center has a reasonable chance of becoming a pair site.

2. What is the distribution of spotted owl habitat across the watershed? What are the habitat levels within the home range of known pairs?

On Forest Service lands in the watershed, suitable owl habitat is expected to increase. The future condition of National Forest lands in the watershed is likely to be dominated by late-successional conifer forest. This condition reflects land allocations under the Northwest Forest Plan. Under this plan, about 22% of the landscape would be subject to intensive timber harvest. The remaining 78% of the area would continue its vegetative development towards late-successional conditions until some non-timber disturbance reset succession. The resultant capability would favor the late-successional wildlife community and they would tend towards their historical maximum level. None of the known activity centers within the watershed are below threshold levels. Habitat loss, especially within the Gotchen LSR, is projected to occur as a function of insect and disease activity. This will cause a dip in habitat levels. Given successful implementation of the Gotchen LSR treatment strategy, stands which no longer serve as spotted owl habitat will be managed to a more resilient structure and composition. While these stands may not be optimal owl habitat, the hope is that it will lead to a landscape condition that is less susceptible to catastrophic loss from a stand replacing fire. It may also lead to the re-introduction of under-burning in its historical function.

3. What is the condition of the Riparian Reserves and other dispersal corridors. What is the relationship between these corridors and known owl activity center and between the Late-Successional Reserves?

Habitat connectivity is best in the eastern half of the watershed. Much of the past clear-cutting has occurred in the western part of the watershed, and as a result it is more fragmented with little interior, large tree multistory forest. The western part of the watershed is also where the bulk of the Forest Service matrix lands are located. This area also has a greater concentration of Riparian Reserves, half of which are comprised of late-successional forest. Another 30% is in the mid-successional stage, and expected to soon function as dispersal habitat. Thus connectivity via riparian reserves will be provided, though interior habitat is not abundant.

4. What is the habitat quality, in terms of interior forest, in reserves and critical habitat (CHU-WA 42)?

Interior habitat occupies about 52% of the watershed: Large tree multi-storied 15% (10,076 ac.), Large tree single storied <1% (192 ac.), Open habitat 20% (12,974 ac.), Small tree 18% (11,660 ac.). At a gross, landscape scale, patchiness appears greater now than historically; at a finer scale it is more complex. The open interior habitat occurs predominantly in and above the Subalpine Fir Zone where non-forested habitat is present. Small tree stands with interior habitat occur just below the Mt. Adams Wilderness within the Pacific Silver fir, Mountain Hemlock, and Subalpine Fir Zones. Large tree multi-storied stands of interior habitat are scattered across the lower third of the watershed. The bulk of the 15% of the watershed which is interior, large multi-story forest is anchored around the Gotchen LSR. Insect and disease mortality is expected to increase the amount of early seral stands within this LSR. Edge habitat is expected to increase in particular as a function of individual tree and stand mortality.

5. What is the habitat capability overall.

Owl contacts with 0.5 miles of an activity center are most likely with the residents rather than a new pair site; 0.5-1.80 miles from a know site is also probably the resident pair but with less certainty. Given the current habitat levels, habitat capability estimates, and known activity centers, more spotted owls are present (12 pairs) than may be supportable (8). This is evidence for the watershed's continued role as a spotted owl "source". It is also possible that the capability model is underestimating capability of the watershed to support only eight pairs. It is unlikely that additional activity centers may be located in the future.

6. Can the movements of spotted owls through the watershed be characterized.

Emigration and immigration of spotted owls, both east-to-west and west-to-east to lands adjoining the watershed has been documented. Sighting records indicate a greater density of spotted owl activity in the eastern half of the watershed. This could mean that there are more owls there, but likely it represents greater visibility because of abundant surveying roads, and possibly greater territoriality of individuals due to resource competition.

Bald Eagle

7. Are there any known bald eagle nests or winter roosts along the White Salmon River in this watershed?

A winter roosting area exists at the lower end of the Upper White Salmon watershed, close to the Trout Lake valley. Bald eagle activity is common (weekly) though not abundant (<10 birds). These eagles forage on dead, domestic dairy cattle, disposed by farmers in the valley. They also feed on road killed wildlife, and wetland waterfowl.

Peregrine Falcon

8. Are there any suitable cliffs that may serve as nest sites?

Suitable cliff habitat for Peregrine falcon nesting does not occur in this watershed. Cliffs are present within the lower White Salmon River canyon in the vicinity of Buck Creek, and in the William's Mine area, but these cliffs lack the needed exposure. Foraging habitat is present across the watershed's forests.

Gray Wolf and Grizzly Bear

9. Does any part of the watershed contribute to a portion of a wolf pack's territory? Are there any potential den or rendezvous sites in the watershed?

There are no Class I sightings nor known territories, dens, or rendezvous sites in this watershed. The Upper White Salmon River Watershed is south of all recovery areas that the US Fish and Wildlife Service have established for grizzly bear or wolf. Still, these animals have a lare roaming territory and the Mt. Adams Wilderness and adjoining unroaded lands provide a large area with little human presence which connects with wild lands to the north along the Cascade Crest where sightings have occurred.

10. What is the habitat condition for the prey base (deer and elk)? What is the percent of thermal cover and road density in deer and elk winter range?

Edge habitat is relatively abundant across the watershed and this is conducive for both deer and elk. These species are closely regulated by the amount and distribution of forage which presently constitutes approximately 18% (11,737 ac.) of the watershed. Cover constitutes about 69% of the watershed: hiding 14% (9,426 ac.), optimal 38% (25,397 ac.), thermal 17% (10,954 ac.).

11. Relative to human presence, what is the watershed's open road density?

Open road density for the watershed ranges from 0.19 to 4.40 miles per square mile. Overall, open road density in the watershed is approximately 2.2 miles per square mile. The projected open road density, after implementation of planned road closures, is 2.1 mile per square mile.

North American Lynx

12. Are there any lodgepole or subalpine forest, or other lynx habitats, located in the watershed?

Similar to the gray wolf and grizzly bear, north American lynx populations are more frequent to the north of this watershed. There have been no sighting in this watershed. In the eastern and northeastern portions of the watershed there exists concentrations of lodgepole pine forest in varying structural stages of development from seedling/sapling through small tree. Lodgepole forest, which especially provides habitat for snowshoe hare, occupies about 4% (2,750 ac.) of the watershed. In general, this eastern portion of the watershed is more favorable to bobcat which would displace lynx. Using the Habscapes model, foraging habitat is present west of Aiken Lava Bed. This area is overlapped by the Gotchen LSR, Gotchen Roadless Area, and allocated unroaded recreation (UD) per the LRMP. It is an area that has been suggested as a Research Natural Area. It is also an area with growing fuel loads of senescing lodgepole pine and subalpine fir, combined with light defoliation from spruce budworm.

ISSUE: Other Wildlife of Interest

The watershed contains suitable or potentially suitable habitat for salamander species, numerous bats, cavity dependent birds, and the great gray owl. There are also nest sites for the northern goshawk and great blue heron rookeries.

KEY QUESTIONS:

Survey and Manage Species (Larch Mountain Salamander, Van Dyke's Salamanders, Mollusks)

1. Are there known populations of these survey and manage species in the watershed? Where is the likely habitat and are land uses affecting habitat or populations?

None of the salamander species listed in the NFP as survey and manage have been found in this watershed. This watershed is within the range of the Larch Mountain and Van Dyke's salamanders and suitable habitat (talus and old-growth forest) is present. This watershed is also within the range of several mollusks on the survey and manage list. As surveying for the species occurs in support of ground disturbing projects, we will learn more about these species and the habitat they occupy. We can predict that coarse woody debris, a habitat component, is on the increase in all mature stands, augmented by insect and disease mortality in the eastern part of the watershed. The effect of future land management on these species may be primarily related to changes in coarse woody debris.

Bats

2. Are there hibernacula, roost, or maternity sites in the watershed? What is the distribution of year round open water which may provide foraging opportunities for bats?

Hibernacula and maternity sites are likely present in the watershed though their specific location remains unknown at this time. Roosts, day and night, are present. While there are no known caves, there may be shallow talus crevices within Aiken Lava Bed. There are no wooden bridges, yet there are older wood structures (Wicky Creek Shelter, Cold Springs Shelter, and Cow Camp) which may provide habitat. These older wood structures have not been examined specifically for bat use. Open water in perennial streams is abundant in the west half of the watershed, yet is limited on the east half. Cattle water troughs serve to increase sources of open water. Throughout the watershed, there are large trees present with the bark characteristics which provide roosting for a number of bat species.

Cavity Excavators

3. What is the abundance and distribution of snags?

Snags, per se, are not a limiting resource except within older clearcuts. Snag density is increasing in the Grand Fir and Subalpine Fir Zones, given increasing mortality from insects and disease. Large diameter ponderosa pine and Douglas-fir snags are limiting on the east half of the watershed due to past selective logging practices. Ponderosa pine snags are particularly important for the black backed and white headed woodpeckers. Per the LRMP, both of these species are to be managed at 100% population potential. Ponderosa pine was selectively logged from these stands in the 1940's and again the 1970's. High density in-growth of grand fir has increased moisture stress on remaining large ponderosa pine, leading to their mortality. Proposed treatments with the Gotchen LSR and implemented projects on its perimeter focus on maintaining the ponderosa pine component. Our plantation management does the same. Still, in the near term future, large ponderosa pine snags will remain a limited resource.

Northern Goshawk, Great Blue Heron, and Great Gray Owl

4. Are there any known nest sites for these species? How has occupancy of these sites changed over time? Are there any wetlands or large meadows suitable for great gray owl foraging?

There are known goshawk nests and heron rookeries with the watershed. Most of these sites are still in use. Management around these sites focuses on maintaining habitat function.

Great gray owl contacts have been made though no daytime confirmation has occurred. Smith Butte meadow, Gotchen meadow, and the Calf Timber Sale plantations are possible foraging dry meadows. A number of great gray owl nest boxes have been constructed around timber sale plantations. The objective was to encourage great gray owl occupancy and foraging of the pocket gophers within the plantations. None of these nest boxes have yet to be used. Historical forests (open ponderosa pine stands) may have been more conducive to great gray owls. Current cutting methods of light and moderate forest retention emulate these conditions.

HYDROLOGY

ISSUE: Peak Flows, Low Flows, and Flooding

The magnitude, frequency and timing of peak and low streamflows in the White Salmon River and its tributaries can be influenced by management activities including timber harvest, road construction and land development. Streamflows are important to all aquatic species which have adapted to the historic hydrology of this watershed.

KEY QUESTIONS:

1. What factors influence peak flows in the watershed?

Some of the primary factors within the watershed affecting peak flows of the Upper White Salmon River include: elevation, geology, vegetative condition, and road density.

2. Where and to what degree are these factors present in the watershed?

Much of the watershed lies at higher elevations where snowmelt processes are the dominant driver for producing runoff. The lower one third of the watershed is in elevations where peak flows are dominated by rain-on-snow processes. Snowmelt from the upper elevation snowpacks and glaciers is responsible in large part for sustaining the substantial summer discharge levels in the White Salmon River, and it contributes to the high discharge levels occurring in spring months. However, during major fall and winter floods, snowmelt combined with rainfall at the lower and middle elevations are more important drivers of peak flows. Floods of this type, occurring in association with rain-on-snow, are generally the largest floods to occur on an average year.

The surface hydrology of the watershed is strongly influenced by soils, geology, and topography. The entire eastern portion of the analysis watershed has very few streams and no apparent surface channels linking this area to the White Salmon River. Flow paths for runoff generated from this eastern portion of the watershed are unknown at this time.

Aggregate Recovery Percentages average 85 across the analysis watershed, and range from 70 in the King Mountain subwatershed to 99 in Wicky/Morrison Creek. Subwatersheds with ARP's of 75 or lower include: King Mountain, Ninefoot Creek, and the Middle White Salmon River. Road density across the watershed is 2.3 miles per square mile. Subwatershed road densities range from 0.2 in Cascade/Salt Creek, to 4.4 in both Green Canyon Creek and Cait Creek. Other subwatersheds with road densities in excess of 3 miles per square mile include: Upper White Salmon River, King Mountain, Lower White Salmon River, Ninefoot Creek, and the Middle White Salmon River.

3. How have these factors changed over time?

The primary change to conditions that affect streamflow hydrology in the watershed is the shift from a fire dominated system to one where timber harvest, road construction, farming and residential development have become the dominant disturbance processes. Wildfire prevention and suppression have reduced the scale and intensity of vegetative changes, and the increased timber harvest of the 60's, 70's and 80's created a more systematic disturbance regime. Large scale, episodic disturbance to the forest at various locations in the watershed has been replaced by chronic, lower level disturbances occurring essentially concurrently across much of the watershed. Road construction and land development have caused persistent changes in the watershed unlike any natural process occurring in the past, and have changed flow paths for water moving from the hillslopes into stream channels.

4. What is the current risk of increased peak flows?

Currently, the Green Canyon Creek, Cait Creek, and Ninefoot Creek subwatersheds have the greatest risk of increased peak flows as a result of past timber harvest and roading. The King Mountain subwatershed is one of the most heavily impacted in terms of both harvest and roading, but there is no known stream reach that integrates the hydrologic effects of these activities in this subwatershed. It is unknown how or where runoff from this subwatershed is translated to the White Salmon River, so the peak flow risk from this subwatershed is undetermined at present. At the watershed scale, approximately 85% of the entire UWSR watershed is in hydrologic mature forest cover, 64% is at elevations above the high probability rain-on-snow zone, and road densities average 2.3 miles per square mile. Based on these conditions, it is unlikely that peak flows in the mainstem of the Upper White Salmon River have been measurably affected by past activities.

5. How will future management activities affect peak flows?

On the National Forest portion of the watershed, timber harvest and road construction are the most important future activities likely to occur that will affect peak and low flows. Hydrologic recovery in this part of the watershed will occur as forest vegetation matures and develops, and as roads and compacted areas are decommissioned or rehabilitated. Actual recovery or lack of recovery in this portion of the watershed will depend on the rate of harvest, the natural rate of recovery of forest vegetation in the watershed, the miles of new road constructed, and the miles of road eliminated by decommissioning. Figure 15 presents the current trends in hydrologic recovery of vegetation in the watershed as indexed by the Aggregate Recovery Percentage.

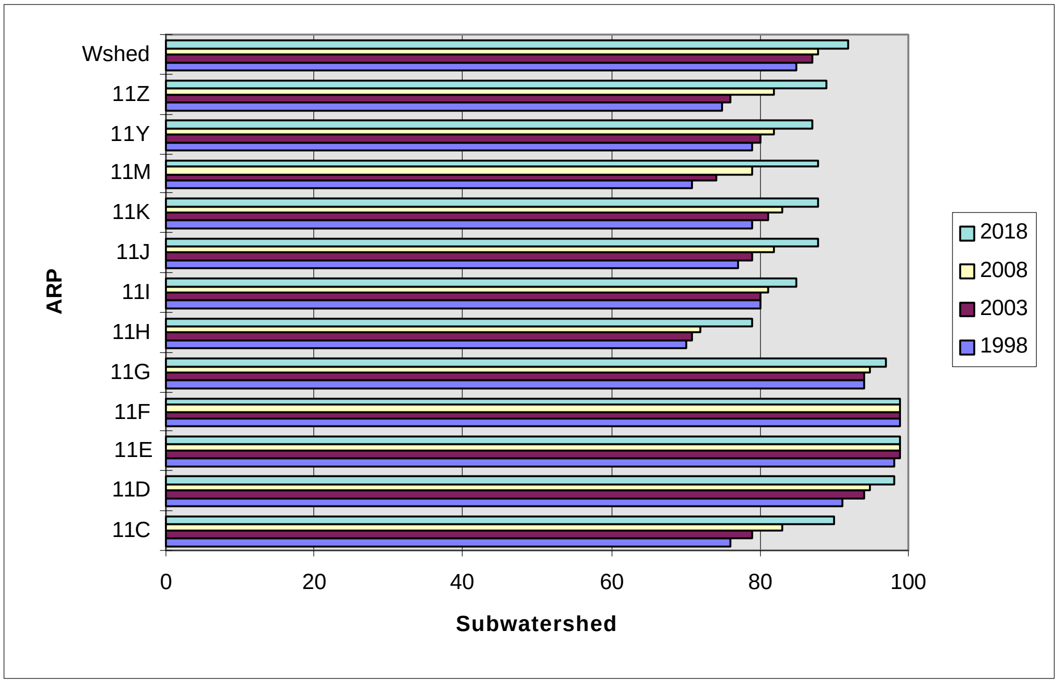

Figure 15. Aggregate Recovery Percentages for the Years 1998-2018, Assuming No Additional Harvest.

Based on current vegetative conditions, hydrologic recovery of forest vegetation is occurring most rapidly in the first decade (1998-2008) in the Upper White Salmon River (11C), Headwaters WSR (11D), and Ninefoot Creek (11M) subwatersheds. The different rates of recovery between subwatersheds indicate differences in the age class of unrecovered (early seral) vegetation.

For purposes of illustrating the current recovery rates, Figure 15 assumes no additional timber harvest openings in the watershed. However, timber harvest is expected to continue both in on National Forest lands, and on the state and private lands below the Forest boundary (see PSQ issue).

Road density is another critical factor related to peak flows Although some road construction may still occur in the matrix portion of the National Forest, the amount of new construction will be low as most lands are already accessible. New roads will be offset by road decommissioning done in association with timber sales or watershed restoration programs. Since 1994, approximately 14 miles of road have been decommissioned on National Forest lands, and an additional 5 miles are scheduled for decommissioning. No new system roads have been constructed since 1994. This will reduce the average road density of the watershed from 2.3 miles per square mile to 2.2 miles per square mile. Road construction below the National Forest boundary is likely to continue for access to new housing and to harvest units on state and private forest lands.

STREAM CHANNELS

ISSUE: Stream Channels

Stream channels and their morphology are important to understanding watershed issues relating to peak flows, water quality and fish habitat.

KEY QUESTIONS

1. What types of channels are present in the watershed and where do they occur?

Because the watershed lies on the slopes of Mt. Adams, stream channels tend to be relatively high gradient, sediment-transport dominated systems. Approximately one half of the mapped streams in the watershed are Rosgen Aa+, with gradients of over 10%. Another third of the channels are Rosgen A channels, and over 10% are Rosgen B channels. Just over one percent of the streams in the watershed are in Rosgen C channels. The Rosgen A and Aa+ channels are found throughout the watershed, particularly in the upper portions. Rosgen C channels, the lower gradient alluvial reaches, occur in the Upper White Salmon River subwatershed on the mainstem of the White Salmon River, in the Cascade/Salt Creek subwatershed, and in the Middle and Lower White Salmon River subwatersheds. Approximately 1.3 miles of Rosgen E channels exist in the watershed, primarily in Green Canyon Creek, but also in the Upper White Salmon River subwatershed. The lower portion of the White Salmon River in the analysis watershed is a Rosgen F channel.

2. What are the factors currently influencing channel condition?

Historical wildfires, combined with past timber harvest in the riparian area, have contributed to a relatively low proportion of late-successional forest in the riparian areas of the watershed. Streams at higher elevations of the watershed are further limited in this regard by short growing seasons and poor growing sites, causing riparian and upland forests there to be very slow growing. The Cascade/Salt Creek subwatershed has just 10% of its riparian areas in late-successional forest. Because these streams lie almost entirely in Wilderness, the vegetative conditions are largely the result of past disturbance and the harsh environmental conditions there, and not the result of timber harvest. The Lower White Salmon River subwatershed has 77% of its riparian areas in early and mid seral vegetation. Although this too may be in part due to past disturbance processes, the combination of timber harvest and land use conversion are probably the dominant causative factors here. The grazing allotment that includes this watershed has relatively few animals using a large area, and as such there are limited areas of concentrated cattle use that affect channel conditions on the National Forest portion of the watershed. Existing road systems have affected channels by establishing static constriction points along the streams at culverts and crossings, which change the routing of sediment and woody debris.

3. How have these factors changed over time?

Historic disturbance to stream channels occurred during floods, fire, and mass wasting. Flooding regimes, and the large scale mass wasting processes in the watershed including landslides, debris flows and lahars have remained unchanged by recent human intervention. However, smaller scale failures including road fill failures and culvert washouts have increased through development of the road network, and in some cases timber harvest. Sediments delivered from anthropogenic sources such as the road prism generally consist of a greater proportion of finer sediments, and happen at higher frequencies and lower magnitude, compared to natural mass wasting processes. In addition, road related failures deliver sediment, but generally not large woody debris to the channel network. Fire has been eliminated as a disturbance process in riparian areas and, for some period of time, timber harvest was introduced. (Currently, on the National Forest portion of the watershed, timber harvest does not occur in riparian areas unless it is done to improve conditions for aquatic and riparian dependent species.) The loss of fire and the often concurrent timber harvest in riparian areas caused a decrease in large woody debris inputs, as well as reducing future recruitment potential. In some cases, large wood was specifically removed from the streams to facilitate a perceived problem with fish passage and conveyance of flood flows.

4. Where are the sensitive channel reaches?

Large woody debris recruitment potential is relatively low in the Cascade/Salt Creek, Wicky/Morrison, Gotchen/Hole in the Ground, King Mountain, Lower White Salmon River, and Green Canyon Creek subwatersheds. The cause of this condition varies, with elevation and fire being the predominant cause in the Cascade/Salt Creek and Morrison/Wicky Creek subwatersheds, and timber harvest being a more dominant factor in the other subwatersheds. Stream channels are corridors for movement of fish, other aquatic species, but also for woody debris and sediment. Road crossings of stream channels can present an interruption of this corridor for all of these elements, as well as forming large sources of sediment with the potential for failure into the stream. Subwatersheds with a high proportion of road crossings include: Cait Creek, Green Canyon Creek, and the Upper White Salmon River. Channels most sensitive to changes in peak streamflows include reaches of: Cascade Creek, the Lower White Salmon River, Ninefoot Creek and Crofton Creek. Channels most sensitive to the effects of grazing include the Rosgen E channels in the Green Canyon Creek and Upper White Salmon River subwatersheds, but also the streams in high elevation meadows including the Gotchen Meadow system. These systems are sensitive to heavy grazing use and, particularly in the case of the higher elevation sites, can be less resilient to change.

WATER QUALITY

ISSUE: Water Quality

This issue relates to water quality in streams on the National Forest, water quality in subsurface water in the Trout Lake Valley, and potential water quality effects to the White Salmon River.

KEY QUESTIONS:

1. What are the beneficial uses in the watershed and where do they occur?

The analysis watershed is the source for the Glacier Springs Water District, a water supply for over 300 people in the Trout Lake community. The source for Glacier Springs water supply is located in a series of springs along the White Salmon River in the Lower White Salmon River subwatershed (11I). Water quality is also important for resident fish that are found throughout much of the western portion of the analysis watershed, as well as downstream in the lower White Salmon River. The White Salmon River within the analysis watershed has been proposed for designation under the Wild and Scenic Rivers program, and portions of the River downstream of the analysis watershed have previously been designated. Water quality is an important part of this designation because the hydrology of the river (including water quality) is one of the Outstandingly Remarkable Values upon which the designation is based.

2. What are the primary water quality parameters important to maintaining those beneficial uses?

Water temperature, turbidity and fecal coliform are all important factors in maintaining support of the beneficial uses identified in the watershed. Turbidity is an issue for all of the identified beneficial uses. Fecal coliform is important to both the community water supply and for recreational uses of the Wild and Scenic River, and water temperature is an important parameter to maintaining the fishery.

3. What processes affect the key parameters of water quality?

Turbidity levels in late fall and winter months generally peak during precipitation and runoff events when streams mobilize stored sediments, when runoff from roads and other non-vegetated surfaces is delivered to surface waters, and when a majority of slope or road prism failures occur. Turbidity peaks during these times can be high, but are relatively short term in nature. During the spring and summer months, turbidities throughout much of this watershed are driven by the input of glacial melt and associated fine sediment. Because glacial melt occurs from spring through late summer and early fall, resulting turbidity levels remain high for months. Average turbidity levels are higher in this watershed during the period of glacial melt than during the winter months, setting this watershed apart from other non-glacially influenced systems in the area.

Water temperatures peak in the summer months when ambient air temperature is high and the solar angle is highest. Those streams in the watershed that are fed by high elevation snowmelt and glacial runoff are less susceptible to excessive heating because discharge levels are maintained at relatively high levels throughout the summer months. Streams including Green Canyon Creek and Ninefoot Creek are not glacially fed, and so have much lower discharge during summer months. Water temperature in these streams are more responsive to increased summer insolation. Much of the eastern portion of this watershed lacks surface streamflow during summer months, so is probably not affected appreciably by summer solar inputs. The maintenance of relatively high summer discharge and potentially the contribution of subsurface flows to the White Salmon River from this watershed are important factors in maintaining cold summer water temperatures throughout the lower White Salmon River outside of the analysis watershed as well.

Fecal coliform levels are affected by waste products of any of the wildlife, cattle, or people using the watershed. Human inputs are greatest in areas of concentrated recreational use (i.e. South Climb, Lunch Counter, Morrison Creek Campground), as well as near housing which is serviced by septic systems. Wildlife and cattle use is more widespread in the watershed, and the effects would be greatest from these sources in areas of concentrated use.

4. What is the current water quality?

Water temperatures in the White Salmon River (near where it leaves the analysis watershed) have been monitored for some 13 years by the Forest Service and Underwood Conservation District. During this time, water temperature reached a maximum of 14°C in August of 1977, and has been below the state standard for maximum water temperature every year. Green Canyon Creek and Ninefoot Creek were monitored for water temperatures for three years each, and with the exception of a measurement of 17°C in Green Canyon Creek during the late summer of 1993, water temperatures in these streams have consistently met the state standard. In general, water temperatures do not appear to be a problem in this watershed because of the combination of sustained summer flow, high gradient channels with relatively low width-to-depth ratios, and limited past clearcut harvesting in riparian areas.

Limited turbidity monitoring over the years by the Forest Service and Underwood Conservation Disrict indicates that average tubidity levels area highest during the spring and summer months, with peak values occurring in the winter during major runoff events. Data are not available to assess compliance with state water quality standards. Based on the density of road/stream crossings, the Cait Creek, Green Canyon Creek, and Upper White Salmon River subwatersheds have the greatest potential for elevated turbidity levels associated with road systems.

Since 1976, over 20 water samples have been collected and analyzed for fecal coliform in the watershed. In every case, the measured value of coliform was within the allowable levels defined in state water quality standards.

5. What are the trends in water quality or in those factors that affect water quality?

Because the Northwest Forest Plan identified much of the Federal portion of the watershed as Matrix, timber harvest and some degree of road construction will continue to occur on the National Forest portion of the watershed. However with the application of Riparian Reserves on all aquatic features, harvest will not occur in riparian areas unless it is done to benefit aquatic systems. On National Forest lands, this should eliminate future reductions in streamside shade that would negatively affect water temperatures. Similarly, sediment introduction from timber harvest on National Forest lands will be reduced by not harvesting along streamsides or in areas that may cause sediment to be delivered to the stream.

Construction of new roads on National Forest lands is being reduced in part to lower the potential for sediment inputs that are commonly associated with roads. Because budgets no longer allow for adequate maintenance of the road network, and because abandoned roads can be sources of continued, chronic erosion, or more catastrophic sediment introduction through fill or culvert failures, efforts are underway to actively reduce the total miles of road on the Forest as well (i.e. through decommissioning). There will continue to be some sediment introduction from new (primarily temporary) roads, and from roads that are being decommissioned, however, the net input of sediment to streams on the Forest is expected to drop. Because the UWSR watershed was not identified as a Tier I Key Watershed in the Northwest Forest Plan, it has not been a high priority watershed for restoration. Money to eliminate existing unused (and unmaintained) roads is difficult to get in this watershed. Without an increase in road maintenance funds, there will likely continue to be sediment production from these unmaintained road systems until they are actively decommissioned. However, some unused roads are revegetating naturally, and sediment from these should continue to decline in the absence of drainage problems associated with culverts, ditches, or gullying of the road surface.

Fecal coliform levels on the National Forest portion of the watershed are likely to increase over time as recreational pressures increase across the Forest. Coliform inputs from livestock and wildlife will presumably continue at rates similar to those of today, and may decrease as a result of proposed and ongoing water development projects, fencing, and other means of discouraging cattle use in streams.

On state and private lands below the Forest boundary, harvest and roading are less restricted, so may continue to affect riparian shade and sediment inputs. Continued home building and development of property along the river and its tributaries will likely add to the loss of shade and increase in sediment introduction over time. Increased development of the valley bottom will require additional septic systems, which will increase the potential for leakage and potential contamination of nearby water sources. Also, with increased development will be increased needs for water. Increased water withdrawals from surface or subsurface sources may affect water quality in the river by simply reducing the dilution factor. Because current growth in the lower portion of the analysis watershed does not appear to be excessively high, these consequences are not imminent.

FISHERIES

ISSUE: Fish Habitat and Populations

Human disturbances such as riparian area harvest, road construction, and stream diversions have altered fish habitat within the Upper White Salmon River Watershed. These disturbances influence water quality and quantity as well as fish population viability.

KEY QUESTIONS:

1. What are the historical and current conditions for fish habitat in the watershed?

The White Salmon River, Green Canyon Creek, Ninefoot Creek, and Morrison Creek do not meet all defined fish habitat “Range of Natural Conditions” or PIG criteria “Desired Future Conditions” (DFC’s), which are meant to represent optimal historical stream conditions in the Pacific Northwest. Most fishbearing streams do meet the locally defined reference condition’s (by Rosgen type), with the exception of the number of large pools/mile in the White Salmon River and two tributary forks of Ninefoot Creek, and the average number of large woody debris pieces/mile in the White Salmon River and Green Canyon Creek. The White Salmon River and Morrison Creek most likely never met the PIG DFC’s for large pools and large woody debris due to their high velocity flows from glacial run-off. Woody debris is especially lacking in the White Salmon River; it serves as a transport reach due to its high stream velocity, bedrock defined banks, and relatively straight channel type. Also a factor in the lack of instream woody debris is that the majority of stream channels in this watershed are Rosgen A and B stream types which have little channel meandering to encourage tree fall into the stream. All streams meet and have met water temperature state standards with the exception of Green Canyon Creek in 1992.

2. How have management activities affected fish habitat?

Fishbearing streams with Rosgen C channels are most vulnerable in terms of negatively responding to changes in stream flow and inputs of sediment and wood. These channel types are also commonly prime fish habitat and spawning sites due to their low gradients. Rosgen C channels occur in Cascade/Salt Creek and in the upper, middle, and lower White Salmon River subwatersheds. All streams in the watershed except Cascade Creek and its tributaries have been affected by management activities including riparian timber harvest, road crossings on streams, and instream woody debris removal. Upland management activities including timber harvest and road construction have altered peak flow conditions and sediment input rates. Road densities are very high and ARP values relatively low in the Upper White Salmon River and Green Canyon subwatersheds. Such management activities have most likely contributed to the fact that these streams do not meet locally defined reference conditions or PIG DFC's.

3. How can future management activities improve the existing habitat?

Any future road decommissioning in the watershed, especially in subwatersheds with a high number of road miles/square mile (Green Canyon Creek, Ninefoot Creek, and the upper, middle, and lower White Salmon River subwatersheds) will help reduce sediment input into streams. Green Canyon Creek may benefit from the addition of instream woody debris placement or riparian thinning to accelerate large tree growth. Implementation of the LRMP with its Riparian Reserve strategy should improve in-stream habitat conditions. Riparian reserves with early seral forest will continue develop and provide streams with large wood, shade and cover. This in turn will increase pool habitat, decrease width to depth ratio, decrease sediment, and decrease water temperatures. No fish stocking in the upper White Salmon River watershed or Trout Lake is planned in the future.

4. What is the current and historical distribution of fish in the watershed?

Rainbow trout and cutthroat trout occupied streams in the watershed historically. While affidavits from local residents and Native Americans say steelhead were found as far up the White Salmon River as Trout Lake Creek, it is uncertain if steelhead ever inhabited this watershed analysis area. There are a series of falls on the White Salmon River at river mile 16.2 (north of BZ corners) which are probable migration barriers. The construction of Condit Dam in 1913 on river mile 3.3 blocked anadromous fish migration upstream of this point. No currently listed Threatened, Endangered or Sensitive (TES) fish species were known to inhabit the watershed historically.

Current fish populations include rainbow trout and eastern brook trout (introduced). Brook trout are present in the lower valley area of the mainstem White Salmon, but not in any tributaries. Rainbow are found in Ninefoot Creek, Green Canyon Creek, Cascade Creek, Stagman Creek, and the White Salmon River. Records from the 1940's and 1950 show rainbow trout inhabited Wicky Creek, but none have been found recently in either Wicky or Morrison Creeks. Cutthroat trout have not been found in recent years and may have been displaced by rainbow and brook trout. No bull trout or other TE and S species have been found in this watershed analysis area.

5. If Condit Dam is removed, what is the anadromous fish potential in this watershed?

Currently, there are no anadromous fish in the White Salmon River above Condit Dam. Fish passage will occur over Condit Dam within seven years either by dam removal or construction of a fish ladder. Both salmon and steelhead would likely move upstream at least to the falls at river mile 16.2. If these falls are negotiated by migrating fish, then anadromous fish would inhabit the Upper White Salmon River watershed in the near future. Tributaries in this watershed that could be potentially used by anadromous fish include Cascade Creek, Stagman Creek, Green Canyon Creek, Buck Creek, and Ninefoot Creek.

Movement of steelhead into this watershed may somewhat diminish the population of rainbow trout due to competition. Without steelhead competition, resident trout numbers will most likely remain stable or increase as fish habitat improves following the growth of riparian forests previously harvested and the decommissioning of roads.

HUMAN USES

ISSUE: Cultural Resources

Native Americans have used the White Salmon River Watershed from thousands of years ago to the present. The entire watershed is land ceded by the Yakama Indian Nation and federal land is subject to the Yakama Indian Treaty of 1855.

KEY QUESTIONS:

1. What areas are of special interest to Native American bands and tribes?

Mt. Adams is recognized as a sacred site. Climbing to its summit is not really an activity they desire or would encourage.

2. What resources are important for traditional uses and how should they be managed?

Fishbearing streams are important to the Yakama Indian Nation. The White Salmon River is considered an anadromous fisheries and they want steelhead back up it. The Yakama's assert that steelhead occurred upstream above Husum falls and Wiengarten Bridge falls as well. Should Condit dam be removed, steelhead would have the opportunity to try these falls and could inhabit this watershed where they would find spawning habitat.

There are numerous other traditional resources of which current and future availability is desired. This includes huckleberries, beargrass, western redcedar, deer/elk, clean water from Mt. Adams, fish, and medicinal plants. In general, these resources appear to be currently available and should remain so. However, there is growing competition for several of these resources (e.g. huckleberries and beargrass) which are made available to the general public.

ISSUE: Dispersed Recreation

Dispersed recreation is highly valued public use of National Forests. However, there are landscape features, such as riparian zones, which are easily impacted by human use.

KEY QUESTIONS:

1. What amount and kinds of dispersed recreation is occurring within the watershed?

In this watershed, with few established campgrounds, there is a lot of dispersed recreation. Recreational activity occurs year round. Hunting and special forest products collection dominates the fall season and is closely tied to roads. Winter recreation of snowmobiling and cross country skiing is focused at the Pine Side and Smith Butte Sno*parks, but radiates northward also along the road network. Dispersed camping also occurs within the Mt. Adams Wilderness.

2. What areas are resilient to dispersed recreational camping?

While most campers prefer water, many hunting camps and camps of those collecting special forest products are often located in upland areas. Typically old landings and dead end spur roads are used, as well as the front end of older skid roads in the flatter east half of the watershed. The areas are fairly resilient to dispersed camping, as many are gravelled or previously disturbed.

3. Are there resources being impacted by this activity?

There are some often used dispersed camp sites in close proximity to streams (e.g. Road 8031 crossing of Cascade Creek) which may be a concern for riparian compaction, coliform and sediment production. Management of these sites can be difficult due to easy road access and users who have a strong attachment to the site. Road decommissioning and closure can result in the elimination of dispersed campsites.

In Mt. Adams Wilderness, water is often a determinant when camping. However, camping also occurs along the South Climb route to the summit. The ridge west of Crescent Glacier and up to Lunch Counter is the camping target of much of the climbing traffic. These camps pose a threat of fecal coliform to Morrison Creek. Coliform levels have been low in the few water samples that have been taken. Sediment is not a concern; these are boulder/cobble streams, and the channel types are not sensitive. The quality of water at Cold Springs is an unknown. This water may be used by those camping near the Cold Springs Shelter.

Smith Butte Sno*park receives a large share of snowmobile users who can easily access the Mt. Adams Wilderness and Yakama Indian Nations lands of Tract D and Bird Creek Meadows. These areas are excellent for snowmobiling, yet this activity is prohibited in both Wilderness and on Tract D lands.

Limitations in plowing funds has made it difficult to keep the Smith Butte Butte Sno*park accessible throughout the entire season. A new sno*park at the Road 82 and 8200101 junction is current being developed. This is midway between Pine Side and Smith Butte It offers better snow conditions than at Pine Side and half the plowing distance of Smith Butte. This is not viewed as a solution to snowmobile trespass into the Wilderness.

ISSUE: Grazing within the Mt. Adams Cattle Allotment

The Mt. Adams Horse and Cattle Allotment lies within the watershed. Approximately 200 head of cattle move north from private land onto the National Forest in the summer. If needed, the annual operating plan provides a means for adjusting the current ten year term permit.

KEY QUESTIONS:

1. How are the assumptions on wetland use and protection faring?

Upper Gotchen Meadows. A primary issue with the re-issuing of Mt. Adams Cattle Allotment in 1995, was the protection of the upper elevation meadows on Gotchen Creek which is near the Bird Creek Meadows area on the Yakama Indian Reservation. The adopted solution was to construct the “north” drift fence on National Forest lands between the Aiken Lava Bed and the Forest Boundary. This fence would tie into an existing drift on Yakama lands. This fence has been constructed as planned.

This fence and the upper Gotchen meadows were reviewed in Fall 1998 in support of this watershed analysis. As expected, this wire fence has high maintenance needs. The fence was down for several hundred feet in the vicinity of the Snipe Mountain Trail (#11) when examined. Evidence of grazing and cattle feces suggest light cattle use in upper Gotchen meadow. Cattle hoof prints were present in the stream near trail #11, but so were tracks of horses. It is not known if the cattle that were using this area were from the Mt. Adams Allotment, or were from the Yakama Indian Nation who permit their cattle to graze in the Tract D. There is no fence along the National Forest boundary, and the drift fence on the Yakama Reservation side needs maintenance.

The ecology these meadows were of interest, and the extent to which livestock may have altered the hydrology. Much of these meadows appear to be dry, and there are areas denuded of all vegetation. These meadows were assumed to have been heavily used by sheep at the turn of the century. It was postulated by Bill Leonard, ecologist with the Washington Department of Ecology, whether historic bank crushing and downcutting in the steam channels by livestock may have led to a dewatering of the meadow. Over the intervening 90 years, this process may have led to the loss of moist wetlands and transition to the dry wetlands that are now present. Subsequent investigation by Tom High, a Forest Service ecologist and soil scientist, found no evidence of downcutting within these streams. In addition, numerous soils pits did not show signs seasonal water inundation which would still be expected to be present. This suggests no change in the hydrology has occurred. The quality of the vegetation in these meadows is still of interest, as is its potential without livestock grazing.

Other Riparian Areas. Elsewhere in the allotment, riparian impacts were noted. Any place where a trail or road crosses perennial water flow and the slopes are gentle, cattle may be accessing water. Even a few cattle over a short period of time can crush stream banks and add fecal coliform. In general, these situation are assumed to affect a small percentage of the watershed's riparian areas. However, where it does occur, site level impacts should be mitigated, especially where springs are affected. There are several springs where relatively short fences could be constructed to protect these features. Cattle exclusion fences have been constructed at Glacier Springs and Bugle Springs. These fences have been maintained and are effective.

2. Are pipelines and water troughs successful in distributing cattle throughout the eastern end of the allotment?

In order to disperse cattle away from springs in other areas of the allotment where there is available forage, a system of pipelines and water troughs have been constructed over time. Many of the existing water troughs are being used. The latest development, the Pine Tree Springs pipeline has begun with the placement of a water holding tank and trough. These systems expand the available water for both cattle and other wildlife. They also provide a water source for fire suppression initial attack, which is an important consideration for the Gotchen LSR given its current vegetative condition.

ISSUE: Timber Harvest from National Forest Lands

Scheduled timber harvest is permitted from matrix lands on the National Forest. However, timber harvest can only be considered in the realm of meeting all other ecosystem needs.

KEY QUESTIONS:

1. What is the probable sale quantity (PSQ) from these matrix lands and how well has it beet met.

Regeneration Harvest From Matrix Lands. Timber harvest levels have been calculated for the purpose of estimating the timber contributions from this watershed to the Mt. Adams Ranger District and Gifford Pinchot National Forest (see Table 34 and 35). There are an estimated 12,690 acres of matrix lands less Riparian Reserves which factor into PSQ (Probable Sale Quantity) scheduled harvest. The PSQ column shows the acres and volume estimated for the watershed per the Forest's August 1997 update of PSQ. An area control model was used assuming management of suitable lands under a minimum 110 year rotation and no constraints from present vegetative conditions. This method yields the acres that could be harvested on a sustainable basis while following all LRMP plus Northwest Forest Plan standards and guidelines. The 10-year period for which the acres and volumes are displayed begins in 1994 with the adoption of the Northwest Forest Plan, and continues to the year 2003.

Table 34. Decadal Regeneration Harvest Acreage from Matrix Land by Allocation.

Subwtrshed	ES Acres	NL Acres	TS Acres	VL Acres	VM Acres	Total Acres
C	0	3	100	0	4	107
D	0	17	41	0	8	66
E	0	10	14	0	0	24
G	0	0	79	4	0	83
H	0	0	95	0	23	118
I	5	10	1	25	3	44
J	0	0	178	0	0	178
K	0	1	73	0	42	116
M	0	0	71	0	0	71
Z	7	0	63	0	15	85
UWSR	**12**	**41**	**715**	**29**	**95**	**892**

Table 35. Decadal Regeneration Harvest Volume in MBF from Matrix Land by Allocation.

Subwtrshed	ES MBF	NL MBF	TS MBF	VL MBF	VM MBF	Total MBF
C	0	70	2,345	0	91	2,506
D	0	342	961	0	188	1,491
E	0	201	300	0	0	501
G	0	0	2,117	118	0	2,235
H	0	0	2,355	0	554	2,909
I	130	281	32	737	98	1,278
J	0	0	3,936	0	0	3,936
K	0	36	978	0	1,435	2,449
M	0	0	1,760	0	0	1,760
Z	220	0	1,646	0	433	2,299
UWSR	**350**	**930**	**16,430**	**855**	**2,799**	**21,364**

It is important to note that actual PSQ estimates for General Forest lands (TS allocation) are calculated at the District level. The General Forest allocation is the primary allocation providing timber. Thus decadal rates of harvest could vary substantially from the amount estimated for any one subwatershed. It could also vary from the amount estimated at the watershed level; though, this variation would likely be much smaller.

Commercial Thinning. The PSQ model for determining thinning acres was based on a query of the vegetation data base for stands that were 40-120 years old, had 70% or greater canopy closure, and had trees in the 10-21" dbh size class. The model assumed all Matrix stands would be thinned at least one time per rotation. According to the PSQ modeling, commercial thinning is a minor contribution with 82 acres scheduled for 250 MBF during the 10-year period from 1994-2003.

In addition, there are stands within the Gotchen LSR allocation which may be harvested where insects and disease have rendered the stands as non-suitable owl habitat. Harvest activities are permitted within the LSR in order to meet late-successional forest objectives. Consequently, further investigation of stand conditions may uncover areas where timber harvest and follow-up activities (such as fuel reduction and species diversification) may improve LSR conditions in the long-term. Any potential timber yield from harvest within the LSR or Riparian Reserves is not included in PSQ calculations since such volume is not part of the programmed timber harvest level for the Forest.

Harvest Activities Post NWFP. Since the Northwest Forest Plan went into effect in 1994, the following harvest activities have either been completed or awarded on contract:

Table 36. Sold Timber Sales Since 1994.

Sale Name	Thinning Acres	Thinning MBF	Regeneration Acres	Regen. MBF
Edit	0	0	104	5,098
Pace	0	0	35	842
East	352	3,394	194	2,937
Joker	0	0	20	200
Baby Bare	26	35		
Mama Bare	120	3,125	135	2,119
Papa Bare	0	0	179	6,007
Total	**498**	**6,554**	**667**	**17,203**

The PSQ harvest level for the Upper White Salmon Watershed is 892 acres of regeneration harvest yielding 21,364 MBF, and 82 acres of thinning yielding 250 MBF for the decade starting in 1994 when the Northwest Forest Plan went into effect. Regeneration harvest of 17,203 MBF has occurred since 1994, thus additional timber sales yielding approximately 4,160 MBF should be possible providing that all management constraints can be met. Other timber volume, not associated to PSQ yet contributing to annual timber objectives, may occur from salvage or thinning within the Gotchen LSR and Riparian Reserves, and mechanical fuel reductions prior to prescribed burning. Timber yield from these latter actions is incidental to achieving LSR and riparian area objectives.

2. Are there any resource limitations which would prevent attainment of the PSQ?

The PSQ model does address the major management allocations and standards and guidelines; however, it is difficult to model subwatershed specific concerns. At this finer scale of resolution, other resources requiring protection will be discovered, such as new aquatic features and TES or survey and manage species sites. These discoveries may reduce the PSQ, where they exceed the allowances built into the model for these as yet unmapped resources. Also at the subwatershed level, there may be cumulative hydrologic concerns which may affect the amount of timber available.

An attempt was made to estimate the future trend in ARP at the watershed level resulting from implementation of the PSQ level of regeneration harvest (Figure 16). The PSQ level represents our best guess at future federal harvest, though the actual rate and timing of this harvest is unknown. Accordingly, no attempt was made to refine these projections to the subwatershed scale, where timber harvest could have a more measurable impact.

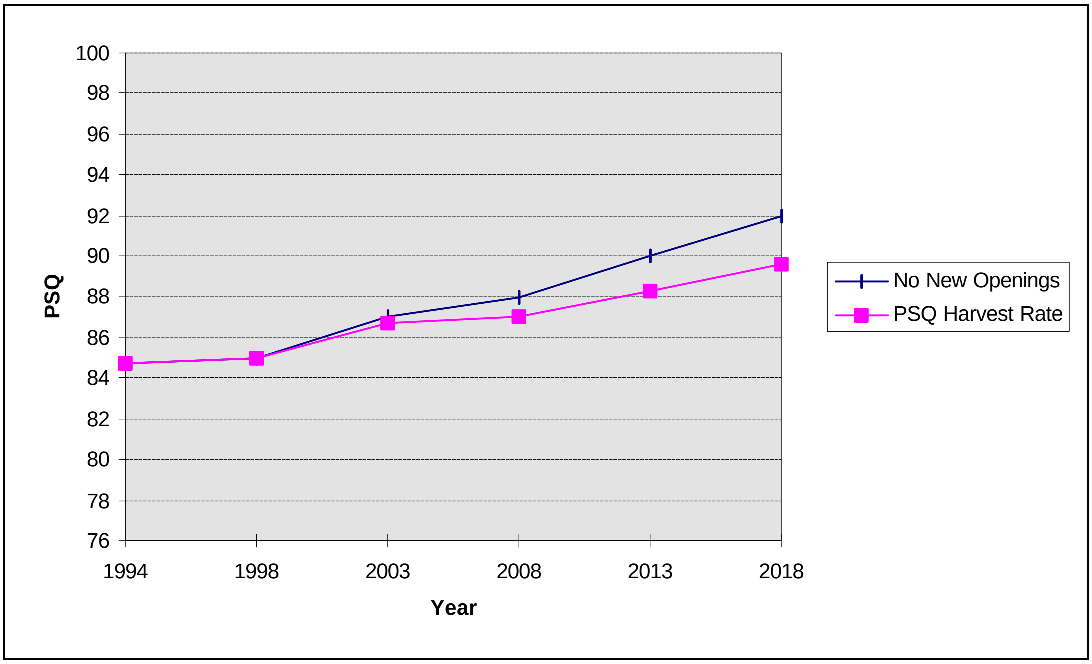

Figure 16 - Predicted Aggregate Recovery Percentage (ARP) for the UWSR Watershed Based on No New Openings and Based on Openings Created from Timber Harvest at the PSQ Rate on Federal Land.

Per the initial Upper White Salmon River Watershed Analysis in 1994, the ARP level for the federal portion of the watershed was 88.7%. When both federal and non federal lands are included (current watershed delineation) the ARP in 1994 is estimated to have been 84.7%. Today, the ARP level for the entire watershed is 85%, given the executed and planned regeneration harvests in timber sales that have been sold since 1994. With no further openings from timber harvest, ARP would rise to 92% by year 2018. Given future regeneration harvests at the PSQ level, the ARP for the watershed would still rise, though only to 89.6%. If this rate of timber harvest is sustained over time, and lacking catastrophic disturbance, the ARP level is projected to stabilize at 94%. This suggests forest cover on the federal portion of this watershed will have net hydrological recovery per the assumptions and limitations of the ARP model.

This projection is incomplete, however, without an assessment of harvest rates on non federal lands in the watershed. Non federal lands in the Upper White Salmon River watershed comprise 13% of the land base , and occur in Subwatersheds H, I, and J. No reliable estimate of harvest rates can be made due to the number of land owners and the their land management objectives. But assuming that half of the non-federal lands are sustained in a forest condition that is hydrologically immature (roughly a 70 year rotation rate), these lands could depress the watershed's overall ARP by 6.5%. In addition, some forest lands in the lowest portion of the watershed will likely be converted to residential and other uses. Conversion of forestland, because it is permanent, will have more persistent effects on streamflows in the watershed.

3. Are there non-timber resources that can be improved through stand management which yields a commercial amount of timber?

There are two areas where vegetation management is desired to improve non-timber resources. The primary area is within the Gotchen LSR, where spruce budworm, along with other insects and pathogens, are degrading overly dense grand fir stands. As described previously, (see Gotchen LSR Issue and Key Question) several vegetation management projects are proposed to reduce the risk a catastrophic fire. While timber is not the primary objective, some of the hazard reduction and salvage treatments may yield a commercial amount of timber. Timber yield from these projects is “unscheduled”; meaning it does not factor into PSQ estimates; yet it would still contribute to the Forest’s annual timber sale objectives. Consequently, these projects may be budgeted and managed (STARS database system) with other timber sales.

Other resource management which may yield commercial amounts of timber are thinnings within dense stands 60 to 80 years of age. In general, thinning can maintain and improve the growth of residual trees, and provide downed woody material and future snags for wildlife. These treatments may be tailored to meet several resource objectives, depending on the management allocation and landscape need. These treatments can also be tailored to improve conditions for oak, aspen, or old-growth remnant trees within the stand. Stands of this age and density are present near Cakey Butte (Subwatershed K). This stand condition may also be found within the oldest plantations throughout the watershed.

CHAPTER VI - RECOMMENDATIONS

RESTORATION PROJECTS

Gotchen LSR Treatments

Objective: Implement the numerous vegetative treatments described for the Gotchen LSR (Gifford Pinchot National Forest Late-Successional Reserve Assessment (LSRA), also located in Appendices for this analysis). Of particular importance is the treatment of stands which are rapidly declining from western spruce budworm and other insects and disease. Treatment Zone 1 should be re-assessed due to the continued expansion and intensification of the budworm epidemic in relation to effected stands and overall fire risk to the LSR. In addition, an aerial spray project of BT or other insecticide, limited to high value resources (e.g. forest within spotted owl cores) may be warranted in order to meet the primary LSR objectives of achieving old-growth forest for dependent species and avoiding catastrophic disturbance.

Location: Gotchen LSR.

Description: Treatments are described in the LSRA. Changes to the Treatment Zones identified in the LSRA and the addition of any aerial spray project would require Regional Ecosystem Office review and approval..

Mid-Successional Stand Thinning and Structural Enhancement in Riparian Reserves

Objective: The objective of thinning and structural enhancement in these Riparian Reserves is to accelerate the development of forest stands toward late-successional characteristics, such as large individual trees, snags, downed logs, and canopy layering. It is also the objective to maintain or improve the erosion filtering capacity, stream shade, bank stability, and coarse woody debris recruitment potential within the reserve. Thus the candidate stands for treatment are typically 40-80 years of age (younger stands preferred), within a landscape lacking late-successional connectivity, and where the individual stand's development trajectory suggests stagnation or slow structural development.. .

Location: Overly dense stands comprised of small trees that are 40-80 years of age within Riparian Reserves. Plantations along Green Canyon Creek.

Description: Thinning via tree girdling, topping, or felling reduces inter-tree competition, maintaining or increasing the growth of residual trees. Gaps created in the stand stimulate understory development. Created snags and downed logs provide immediate structural improvement to the stand. Because of the numerous Riparian Reserve objectives discussed above, the treatment is typically focused on the outside half of the reserve. If there are sufficient excess trees (refer to GPNF LSRA for guidelines on snags and downed logs) and it is commercially viable to remove them, it may be desirable to do so. Timber is not the principle objective, though it could provide revenue to implement the project or leverage treatments over a larger area. Within the Riparian Reserve there are 2550 acres of stands in the pole and small tree size category. Further exams and field review are needed to determine which of these stands are suitable and feasible for treatment.

Along the upper reach of Green Canyon Creek there are have been numerous clear-cut harvests which have influenced the poor fish habitat conditions that are now present. Many of these clear-cut are now densely stocked with pole and small saw sized trees. While there is lots of woody debris recruitment from these stands, it is of small dimensions. There may be some opportunities to improve instream habitat by thinning dense stands to accelerate tree growth, which will provide large woody debris in the future.

Early-Successional Forest Thinning in Matrix and Riparian Reserves

Objective: Young stand thinning seeks to reduce tree stocking of very dense sapling stands so as to maintain or accelerate stand growth and avoid stagnation. Lower branch pruning of western white pine may also occur to reduce infection and mortality from white pine blister rust. Other aspects of species diversity can also be manipulated at this time.

Location: All subwatersheds that contain overstocked sapling stands. Areas are examined periodically and a needs list is maintained. Candidate stands are typically clear-cuts that have been reforested. Sapling stands contain trees with an average diameter less than 5 inches dbh.

Description: In young stand thinning, trees are felled to achieve a desired spacing and stocking level. Spacing and stocking levels vary by land allocation (Matrix vs. Riparian Reserves). Leave trees are typically the largest individuals and include the least common conifer species. Leave trees spacing may be altered to achieve big game hiding cover or accentuate natural openings and perpetuate gaps within Matrix. Excess trees are not of a commercial size and are usually left of site, though occasionally noble fir trees are removed as transplants and white pine boughs are removed for ornamental greenery. Lower branch pruning of western white pine removes all of the lower branches within four feet of the ground. Stand treatment prescriptions would be based on site specific analysis and resource needs.

Within the grand fir zone in Matrix, treatments should focus on retaining large ponderosa pine, western larch, and Douglas-fir. Stand densities should be at or below full site occupation. This should facilitate stand underburning in the future, as well natural in-growth of shade intolerant species (ponderosa pine, western larch, and Douglas-fir).

A total of 1,764 acres of regeneration harvest occurred on federal land during the 1980’s which are candidates for precommercial thinning over the next 10 years. In addition, 2,618 acres of regeneration harvest was completed during the 1970’s which have potential for pruning. Because of limited funding and the higher priority of precommercial thinning, it is anticipated that pruning activities will focus on white pine blister rust control and conifer bough sales within Matrix.

Prescribed Underburning

Objective: Re-introduce fire as means of maintaining open, mature stands comprised of early seral conifer species (ponderosa pine, western larch, Douglas-fir). This would replicate historical conditions in the east half of the watershed that is within the grand fir ecological series. In addition to reducing down fuel loads under managed condition, underburning will help reduce stocking of grand fir and may promote regeneration of shade intolerant species. This action would reduce fire hazards within stands, and provide a landscape arrangement which reduces the potential of large catastrophic fire.

Location: Gotchen LSR and surrounding matrix lands in the grand fir ecological series. Some candidate stands have been previously commercially thinned, and some of these thinnings contain remnant old-growth ponderosa pine and western larch. Candidates stands may also be young plantations, that may or may not have been pre-commercially thinned. This treatment is listed in the Fire Plan for the Gifford Pinchot National Forests LSRA.

Description: Stands would receive a light underburn in the spring or late fall. Previously thinned stands are good candidates in that stocking and ladder fuels are reduced, and existing skid roads may serve as control lines. Still some preparation prior to burning is likely to be needed to tie firelines together and arrange existing fuels. In some stands, the commercial removal of some trees may facilitate stand preparation. Additional underburning would be needed in the future to maintain the desired condition. Opportunities are limited to implement this treatment and not affect current habitat suitability for late-successional species. Still, it appears valuable to attempt this treatment given our imperfect knowledge of the ecological consequences of the current landscape. Projects within Gotchen LSR would need to be consistent with the GPNF LSRA or be individually approved by the Regional Ecosystem Office.

Meadow Maintenance

Objective: Reduce or eliminate the loss of dry meadow habitat to conifer succession and stabilize existing populations of quaking aspen. Over the years, conifers have invaded the meadows and resulted in a reduction in meadow size. The invading conifers also compete with some of the native meadow plant species.

Location: Dry meadow habitat is found at Gotchen Guard Station, west of Morrison Campground, and the old ski bunny slope off Road 8040 (SE1/4, NE1/4, Sec 15). Small meadows are also found dispersed across the watershed.

Description: Initiate projects that reduce the invasion of conifers into the dry meadows and help restore early-successional native vegetation.

- Cut invading seedling, saplings, and poles. Material cut could be piled for burning or sold as a special forest product, e.g. lodgepole pine poles.
- Underburn portions of the meadows on a regular basis to maintain early successional condition.
- Release aspens to stimulate regeneration. This would involve making clearings up to one-half-acre in size around individual aspen trees or groups of trees. Competing conifers would be cut. A few aspen would be cut to stimulate root sprouting. To assure success of regeneration, fence enclosures would be installed to protect sprouting aspen from browsing and grazing damage from deer, elk, or cattle.

Upper Gotchen Meadow Test Plot

Objective: Determine vegetative recovery of ungrazed meadow. Sheep and cattle have historically grazed these meadows. Recent construction of the North Drift Fence in the Mt. Adams Grazing Allotment has sought to eliminate cattle grazing in this area. Still, some grazing is occurring either from Forest Service permitted cattle or cattle from the Yakama Indian Nation. Information from this test will help to determine the restoration potential in these high elevation meadows.

Location: Upper Gotchen Meadows (Section 32) south of Mt. Adams Wilderness.

Description: Construct a fence around a 10 by 10 meter plot to exclude cattle, in a representative section of this meadow. Establish photo plots both within and outside of exclosure. Establish vegetative transect both within and outside of exclosure. Measure, inventory, and photograph vegetation in the spring, summer, and fall.. Measurements should occur annually for a minimum of five year. Because of heavy snow loads in this area, expect to maintain fence annually. Such expense would likely limit the long-term use of this test plot.

Noxious Weed Removal

Objective: Reduce noxious weed populations, while establishing other vegetation to prevent re-colonization by noxious weeds. The reduction of noxious weeds aids native plant populations, improves range forage, and may reduce erosion.

Location: Known noxious weed problem areas include knapweed populations in the Green Canyon Creek subwatershed and the Road 23 rock pit (Section 33), and tansy ragwort populations in the Crofton Ridge area.

Description: The most easily implemented method is hand pulling. Other options include the use of biologic agents and herbicides. A Forest-wide programmatic Noxious Weed Environmental Assessment is currently in progress to determine how and when these other options may be used. In all cases, revegetation efforts should follow eradication projects to encourage occupation of disturbed sites by native plants.

Gotchen Creek Ditch Repair

Objective: Determine the future need for the Gotchen Creek Ditch and possible repair of 50 feet of ditch.

Location: Gotchen Creek Ditch, in the vicinity of Gotchen Creek Guard Station.

Description: The Gotchen Creek Ditch diverts water from an unnamed perennial stream and routes its along Gotchen Creek Guard Station and southward to Cow Camp and Gotchen Creek. This ditch provides perennial water flow to the Guard Station and its meadows for cattle use. It also supports a fire engine water fill where it crosses Road 8225060. Drinking water for the Guard Station is provided by a separate pipeline. Currently, this ditch has a 50 foot breech, allowing over half of the flow to escape and disperse throughout the adjacent forest. This breech is located just below the initial diversion and above the Guard Station. If continued use of the ditch is desired, this breech should be fixed. This may push perennial flow in the ditch all the way to Cow Camp. If the ditch is not longer desired, the diversion should be pulled, leaving all flow within this perennial stream and its downstream wetlands.

Road Management

Roads serve a variety of human uses and also create a variety of resource impacts. The following general recommendations have been made and are followed by specific recommendations for problem areas. The Mt. Adams Ranger District Access and Travel Management Plan also provides additional guidance for road management actions.

Level 2 Road Condition Surveys

Objectives: Level 2 road condition surveys provide highly reliable data on the current condition of roads. Such information permits identification of problems sites and conditions leading to future problems.

Location: All federal roads in the watershed.

Description: Conduct level 2 road condition surveys. The condition of the road surface, culverts, cut and fill slopes, and entrance management are recorded. Priority areas for survey are subwatersheds I, K, Y, and Z and the southeast corner of Gotchen LSR (see general recommendations for rationale).

Road Obliteration or Decommissioning

Objectives: 1) Restore hillslope hydrologic functions by reducing interception of subsurface flow, increasing surface infiltration; and reducing volume of water routed through roadside ditches. 2) Reduce sediment production from road surfaces, cuts and fills, road crossings, and culvert or fill failures. 3) Reduce wildlife and human interaction.

Location: Priority within subwatersheds would be roads that have resource damage (fill failure, culvert failure, gullying) in proximity to streamcourses, mid-slope roads, and other roads that are not needed in future. (see general and specific recommendations on the following page).

Description: Road obliteration requires removal of culverts and rock, shaping of the cut and fill slope back to natural contours, and re-vegetating bare soils. This prescription is applied to where roads are not desired in the short or long term future. Road decommissioning requires removal of culverts, surface ripping, waterbarring, and barrier construction at the entrance. Road decommissioning is applied to roads that are not needed in the short term, but may be needed in the long term. Subsoiling/ripping of compacted soils on adjacent landings within past harvest units should also occur in conjunction with these projects (see Subsoiling). In all cases were soils are disturbed, revegetation with forbs and grass is crucial not only to limit erosion, but to reduce the potential for noxious weed invasion/re-invasion.

Road Closures

Objective: Decrease open road density to reduce potential harassment to wildlife. Strive towards an open road density of 2.0 miles per square mile.

Location: See the following general and specific recommendations.

Description: Road closure requires construction of barrier near the road entrance (rock, earth, gate) to discourage motorized access. Legal closure (via CFR code) which makes vehicular trespass illegal, may or may not be applied. Stormproofing of the road behind the closure would occur as needed.

GENERAL RECOMMENDATIONS

- Complete road management actions planned in conjunction with Pace, Bare (Mamma and Papa), Edit, and East Timber Sales. These sales have either recently been completed or are in the progress. All of these sales include road management recommendations. A variety of funding sources should be pursued to implement these recommendations including Knutson-Vandenberg (KV), Jobs-in-the-Woods, 1997 Flood (ERFO), along with other state and private contributions.

- Focus future investigations for road obliteration and decommissioning candidates in Subwatershed I, K, Y, and Z. Based on road generated sediment models, these subwatersheds have the greatest road generated sediment potential and direct linkages to the White Salmon River. Streams within these subwatersheds are also fish bearing.

- Gotchen LSR contains extremely high road densities in its southeast corner (also the Forest's southeast boundary). Much of surrounding forest is early successional pine plantations. Future management will most likely be limited to young stand thinning and underburning, along with fire protection. Selective road decommissioning is desired to reduce wildlife harassment, and prevent trespass on to Champion Timber Company roads that are closed to vehicle travel to protect deer and elk (Road 8200170). Road decommissioning is preferred to road closures, as the gentle topography and past harvesting make it easy to circumvent closures.

SPECIFIC RECOMMENDATIONS

Road 23 (Culvert Replacement)

Objective: Remove the fish migration barrier currently created by the Road 23 culvert in Ninefoot Creek. This would make possible upward migration of resident trout and other migrating species should they inhabit this watershed in the future.

Location: Road 23 crossing of Ninefoot Creek.

Description: Replace existing culvert on Ninefoot Creek. Replace with a culvert which is fish passable or with a bridge. This project should take place only if monitoring determines that the rainbow trout population below this culvert is no longer affected by a parasitic copepod (*Salmincola spp*.) which was found on the trout below the culvert in the early 1990's. The copedpod was not found on fish inhabiting the stream above this culvert barrier. However, culvert replacement should occur regardless of parasitic inhabitance if bull trout or steelhead are found to inhabit this watershed in the future.

Road 8031101 and 8031107 (Decommission)

Objective: Reduce sedimentation from surface erosion and improve Riparian Reserve continuity. These road segments parallel the White Salmon River, cross two perennial streams, and are mostly within a Riparian Reserve.

Location: Road 8031101 from its junction with Road 107 to its northern terminus. Road 8031107.

Description: Decommission the lower end of Road 8031101 and all of Road 8031107. Remove all culverts on live and intermittent streams. There is one bridge crossing a perennial stream which may be left in place. These roads were constructed for the partial harvest which occurred on both sides of the roads. There may be future use for this road for timber haul from adjacent matrix lands allocated Wild and Scenic River (NL).

Road 8040550 (Reconstruction)

Objective: Reduce surface erosion and improve access for passenger cars. This road provides access to the Cold Springs Campground, starting point for the South Climb Trail up Mt. Adams.

Location: Road 8040550 from Morrison to Cold Springs Campgrounds.

Description: Reconstruct this excessively rutted and gullyed, native surface road. The reconstruction plan and objectives would be consistent with the current environmental analyses being conducted to regulate recreational use of the South Climb and the Mt. Adams Wilderness as a whole.

Road 8200170 (Decommission)

Objective: Reduce wildlife harassment within the Gotchen LSR and reduce vehicle access onto adjacent Champion Timber Company roads which are also closed to public access for the benefit of deer and elk.

Location: Road 8200170.

Description: Decommission Road 8200170. At a minimum, block access via berm or debris at the road's terminus where users have been accessing closed roads on Champion Timber Company lands. Non Forest Service funds may be available to construct this closure.

Road 8225150 (Decommission and Stormproof)

Objective: Reduce sedimentation from fill failure and reduce road maintenance costs. Road 8225250 has two culverts that have recently been plugged (and cleaned), and a deep culvert on Gotchen Creek is currently plugged. Streamflow has diverted along and across the roadway, eroding and gullying the running surface. The diverted streamflow created flooding around the Gotchen Guard Station in 1996 and 1998.

Location: Road 8225150

Description: Decommission Road 8225150 from Road 8225 to Road 8225071. This segment of road crosses Gotchen Creek and two other perennial streams. This road provides access to the Snipes Mountain Trail (#11) and the Pine Tree Springs water pipeline and cattle troughs which are under construction. Access to Pine Tree Springs would still be possible from via Road 8225071. Access to the current Snipes trailhead would be lost. In a companion project, the trailhead could be re-located. Options for re-locating the trailhead include the Roads 8225 and 150 junction, Gotchen Guard Station, or Road 8225060 and 731 junction. Depending on trailhead location, 0.3 to 0.5 miles of new trail or roads-to-trail conversion would be needed.

Stormproof Road 8225150 from its junction with Road 8225071 to its northern terminus. This segment of road does not contain any culverts but does cross several ephemeral draws which are causing roadway erosion. Stormproofing includes re-grading the roadway, and installation of water bars and fords at the ephemeral crossings. This road would remain open to use, primarily to support completion and subsequent maintenance of the Pine Tree Springs pipeline and troughs.

Road 8810110 and 8810120 (Decommission)

Objective: Reduce surface erosion and improve Pacific Crest Trail continuity. These native surface roads cross the Pacific Crest Trail.

Location: Road 8810110 and 8810120.

Description: Decommission both Road 8810110 and Road 8810120. Attempts have been made to decommission both roads in the past; however, vehicles have circumvented the berms constructed at the road entrances. This road needs to be re-ripped and the road closure device (berm or boulders) re-constructed in a more effective location.

ONGOING HUMAN USES

Smith Butte and West Aiken Research Natural Area Proposals

The Research Natural Area (RNA) program is a federal designation for unique and representative ecosystems. These ecosystems are preserved for study and education, and protected from further human developments. Two areas within this watershed are being considered for RNA designation.

Recommendations:

Smith Butte: Smith Butte became a proposed RNA in the LRMP. The proposed areas is approximately 175 acres. Smith Butte has steep slopes on all aspects. The northern and western slopes provide a relatively cool and moist environment that contrasts to the drier and windy ridges on the south and east. Elevation change from the base to the summit is 600 feet (3700' to 4300'). This proposed RNA would contribute the following elements to the RNA system: grand fir/elk sedge and grand fir/vine maple plant associations, and 2.5 acres pristine grassy meadow. The forested communities are unique in that they have not been logged, nor likely grazed. It is, however, within the area receiving the heaviest defoliation by spruce budworm on the Forest. It is also within Gotchen LSR.

West Aiken: In 1979 West Aiken was brought to the attention of Jerry Franklin, then of the Pacific Northwest Research Station, as a potential RNA. It is not being formally considered for RNA designation at this time, however it should be treated as a potential RNA, especially in the event that the Big Lava Beds, an area with similar ecosystem features in the Little White Salmon watershed, does not receive RNA designation.

The RNA designation for West Aiken could cover 500-1000 acres. This includes the western portion of Aiken Lava Bed and forests west to Gotchen Creek Trail (#40). West Aiken would intend to preserve the lava bed characteristics of Aiken Lava Bed, and additionally, the Grand Fir and Subalpine Fir Zones late-successional and old-growth forests to the west of it. Old-growth ponderosa pine are scattered throughout the area, which encompasses the little-used Cold Springs Trail (#72). The true fir in these forests are being lightly defoliated by spruce budworm. In addition to being within the Gotchen LSR, this area is also within the Gotchen Roadless Area.

Bunnel Butte Geologic Special Interest Proposal

Geologic Special Interest is an LRMP allocation to recognize and interpret unique geologic features. Bunnel Butte has been proposed for this designation by the Forest Geologist.

Recommendation:

Bunnel Butte is located off of Road 8200069. It is a cinder cone that has been mined for rock, leaving a cross-section of volcanic layers exposed. The cinder cone covers approximately 10 acres. This area lies within the Gotchen LSR.: Designation of Bunnel Butte as a geologic special area would complement the current allocation of LSR. Cinder from this pit has been used as surface rock on some of the nearby roads. Future removal of rock from this pit, if allocated a geologic special area, could only occur if its was consistent with both the geologic special area objectives as well as the still standing LSR objectives. Because of the surrounding LSR allocation, future rock needs from this pit would be little to none.

Native American Traditional Uses

The entire watershed is on ceded lands and the federal portion is subject to the Yakama Indian Treaty of 1855. It is likely that Yakama Indians will continue to collect traditional resources from the watershed, including clean water and such foods as huckleberries, trout, deer, elk, and bear, along with cedar bark, beargrass, cedar roots, and medicinal plants. Many of these resources assume symbolic as well as practical importance.

Recommendations:

- Recognize federal trust responsibility to ensure a continuing supply of traditionally used resources over time.

- Continue frequent and open dialogue with the Yakama Indian Nation regarding proposed projects on ceded land and other management actions effecting traditional uses. Included in this dialogue should be management of their cattle in the Bird Creek Meadows area and their movement onto Forest Service land.

Recreation

The watershed provides a range of recreational opportunities and demand for these opportunities is increasing.

Recommendations:

- Continue to maintain existing developments and day use sites (Morrison Campground, Cold Springs Campground and Shelter, Wicky Creek Shelter). Maintenance includes safety improvements such as hazard tree removal at sites, and brushing and grading of access roads suitable for passenger car travel.

- Dispersed camping should be permitted and facilitated where impacts are acceptable. The watershed will continue to attract dispersed camping for both hunting and collection of miscellaneous forest products. While some dispersed campsites may warrant rehabilitation (see restoration recommendations), most sites cause no problems. Dispersed camping is a need to consider when determining which roads to close to benefit water and wildlife resources.

- Capacity for winter recreation is expected to remain unchanged. Continue to maintain and plow to Pine Side Sno*Park and Smith Butte Sno*Park. Development of a parking area at the Road 82 and 8200101 junction may compensate for Smith Butte in years where large snow accumulations and low Sno*Park funding make it impractical to plow the extra three miles to Smith Butte. This terrain is well suited for cross-country ski use which is facilitated by groomed and signed trails. This area is also well suited to snowmobile use; however, these Sno*Parks tend to facilitate snowmobile use in areas closed to motorized traffic, namely Mt. Adams Wilderness and Bird Creek Meadows. Atkisson and Flattop Sno*Parks provide alternative snowmobiling areas on the District, offering 50 miles of groomed trails.

- Continue management of the Upper White Salmon River in light of its possible Wild and Scenic River Designation. The Upper White Salmon River Wild and Scenic River Study Report and Final Legislative Environmental Impact Statement was completed in July of 1997. It has since been forward to Congress, who will determine the river’s federal designation (if any) and its management plan.

Special Forest Products

Special Forest Product collection occurs watershed-wide. Collection is for both personal use and for commercial re-sale. Within the last five years, collections of mushrooms, beargrass, and huckleberries appears to be increasing.

Recommendations:

- This watershed analysis has not revealed any reason to not offer both personal and commercial permits for the collection of mushrooms, huckleberries, or beargrass from federal lands in the watershed. This includes both matrix land and the Gotchen LSR. Permits and product removal should continue to be monitored on a Forest-wide basis, and communication with the Yakama Indian Nation should be maintained over the availability and management of traditional plants.

- Other miscellaneous forest products (vegetative transplants, posts, poles, shakes, firewood, common rock) currently occur only from designated areas. This is expected to remain the same. The restriction to designated areas has allowed us to direct these activities to sites where the impact is neutral or beneficial for the desired management objective of the area.

Commercial Timber Harvest

Based on review by the interdisciplinary team who prepared this watershed analysis, several areas of the watershed were identified where commercial timber may occur in the next five years. We reviewed the need for forest manipulation to meet management objectives, as well as other resource values which may be compromised by such action. The following general project areas are listed in priority.

EAST SIDE GRAND FIR ZONE

Description:

The east side grand fir zone is primarily Subwatersheds F, G, H, I, and Y. The primary area is where current stand densities and composition is effecting forest health and raising the risk of a large stand replacing fire. This includes areas currently affected by western spruce budworm. It includes both the Gotchen LSR and matrix lands to the south.

Concerns:

- Relative peak flow risk is high in Subwatershed H and Y. Cait Creek in subwatershed Y provides perennial flow to the White Salmon river and is in the Key portion of the watershed. There are no streams in Subwatershed H that have direct surface linkage to the White Salmon River. This portion of the watershed is designated Non-Key.

- The bulk of the watershed’s interior late-successional habitat occurs in this area. This habitat is currently of high quality for spotted owls; however, its long-term stability is in question.

- Portions of Subwatershed H provide habitat for the King Mountain spotted owl activity center (#328). This activity center is at high risk of incidental take because of insufficient habitat within 1.8 miles of the nest site.

- All actions taken within the Gotchen LSR, need to consistent with the goals and objectives for that allocation. Any commercial timber yield would be incidental. Actions must be consistent with GPNR LSRA or be reviewed by the Regional Ecosystem Office.

Recommendations:

- The GPNF LSRA outlines a range of treatments for the Gotchen LSR (see Appendix) These treatments should be implemented as warranted. Many of these treatments would yield an incidental amount of commercial timber.

- The ecological justification of the Gotchen LSR treatments would also apply to matrix lands south of the Gotchen LSR. However, given matrix objectives include timber production, treatments may be modified from those proposed in the LSR. Given that we have just implemented East Timber Sale in this area, the need is low for additional forest manipulation at this time.

- Timber harvest should seek to improve conditions for Oregon white oak, quaking aspen, and old-growth ponderosa pine in this area.

- Little to no new roads are needed in this area. Other road management actions (such as decommissioning) should considered fire suppression needs.

CAKEY BUTTE

Description:

There are many young, dense stands (70-100 years old) in the vicinity of Cakey Butte (Subwatershed K). There are opportunities for commercial thinning these stands where they occur within the General Forest and Visual Emphasis allocations. Per our PSQ analysis, there may also be regeneration harvest opportunities.

Concerns:

- Relative peak flow risk is high in Subwatershed K.. This is part of the watershed that has been designated Key.

- Green Canyon Creek was surveyed in 1991 and at that time fish habitat conditions were less than optimal reflecting much past riparian harvest. Despite this, fish populations at survey time were relatively high. However, no population sampling has been done since that time. Maximum water temperatures in Green Canyon Creek exceeded the state threshold of 16ºC in 1992.

- Portions of this subwatershed provide habitat for the Skull Creek spotted owl activity center (#3216). This activity center is at high risk of incidental take because of insufficient habitat within 1.8 miles of the nest site.

Recommendations:

- Given the resource concerns and stand conditions, timber harvest opportunities should focus on commercial thinning. Regeneration harvest should be limited to those stands with substantial laminated root rot. Pound Timber Sale (1990) was the last commercial timber sale in this area, and it was primarily commercial thinning.

- There may be older plantations of sufficient tree size and density that a commercial thinning is now warranted.

- There would be opportunities to review plantations within Riparian Reserves for possible restoration projects (see previous section on restoration). These projects may not yield commercial timber, however, their identification and analysis may be facilitated by a timber sale.

- There are opportunities to decommission existing roads in this area reducing road density and overall drainage density.

SUBWATERSHEDS C AND D

Description:

Our PSQ analysis shows regeneration harvest opportunities will remain within these subwatersheds even after completion of 80 acres of regeneration harvest that is scheduled in the Edit and Pace Timber Sales. Peak flow risk is low within Subwatershed D.

Concerns:

- Relative peak flow risk is high in Subwatershed C. This is part of the watershed that has been designated Key.
- The retention of scenic quality is an objective for much of the land within these subwatersheds with the visual corridors for Road 23 and the potential Wild and Scenic White Salmon River.
- Much of the mature forest is old-growth.

Recommendations:

- Regeneration harvest should strive to connect existing early successional stands. Thus stands with reduced interior habitat would be harvested, and a less fragmented future landscape would be created. This would more closely resemble natural stand patterns in the Pacific silver fir zone.
- Harvest openings in the immediate foreground of Road 23 should be small or moderate and heavy retention cutting methods should be used to retain scenic quality.
- There are opportunities to decommissioning existing roads, and thereby reduce road density and overall drainage density.

Mt. Adams Cattle and Horse Allotment

The Mt. Adams Cattle and Horse Allotment occurs entirely within this watershed. The Forest Service's allotment covers 32,998 acres. This is part of the 73,882 acres managed under the King Mountain Coordinated Resource Management Plan, which include other non-federal grazed lands. An estimated 516 head of cattle drift from state and private land on to federal land in June and graze through September. The allotment is managed on a ten year term permit, and was last issued in 1995. Mid-term modifications are made through adjustments in the annual operating plan.

Recommendations:

- **North Drift Fence**. The new north drift fence has been constructed and should be effective in keeping cattle out of the upper Gotchen Meadows if it is maintained. The fence is currently down in the area adjacent to the Snipes Mt. trail. Annual maintenance of this fence is needed to make it effective.
- **Riparian Impacts**. Riparian zone impacts elsewhere in the watershed are inevitable without complete fencing of riparian areas within the allotment. While overall impact may be light there are some specific locations where action is needed to minimize riparian and water quality impacts. Because cattle in the area make use of roads and trails, any flat crossing of perennial water flow has the potential for heavy cattle use and adverse riparian impact. Limited fencing should be installed to protect the head of springs and other sensitive riparian features. In other places it may be more practical to armor stream banks with gravel to minimize sedimentation yet allowing cattle access to water.

New Fences: It is recommended that a fence be constructed around a spring at the southern end of Aiken Lava Bed north of Road 8225150. Cattle have crushed stream banks and reduced water quality by sediment and feces introduction. A fence around the head of this spring, would protect the structure of the spring and its riparian vegetation which includes quaking aspen. The surrounding Aiken Lava Bed provide a natural barrier on three sides of the spring, such that a short fence of 100-200 feet would effectively protect the spring from cattle. Review of existing fences around Glacier Springs and Bugle Springs (off Road 8031023) show these fences to be effective. At this site, water would still be available to cattle downstream of the fence in areas with less riparian vegetation.

Bank Armoring: In areas where cattle have shown repeated congregation and use, yet are impractical to fence, or would result in displacing cattle watering to undisturbed riparian areas, it may be desirable to armor or harden the damaged stream bank. Gravel or other rock could be used. The stream bank could be graded to encourage cattle access to water at this point. A potential location to attempt this project is Morrison Creek near the Crofton Ridge Trailhead (Morrison Campground).

- **Pipelines and Troughs**. The new Pine Tree Springs pipeline and cattle troughs are under construction. This is expected to expand range use to the east, away from Gotchen Creek. As water in the east side environments is limiting, it is recommended the float valves on water troughs be well maintained. In addition it may be desirable to provide other open water sources for wildlife from which cattle are excluded.

- **Coordination** Coordination with YIN on grazing of their cattle on Forest Service land is necessary, especially in the area of upper Gotchen Meadows.

MONITORING

VEGETATION

IVEG Data Base Update

Objective: Keep IVEG data base current so as to improve accuracy of analysis. Key areas to update are locations of small wetlands (less than one acre) and development of plantations beyond pre-commercial thinning age entering mid-successional development.

Parameters to Monitor: Stand development changes in plantation and small wetlands.

Location/Timing: Field review and examination of the features can occur during timber sale field reconnaissance. Data base updates should occur concurrent with project level environmental analysis.

Threatened, Endangered, Sensitive (TES), Survey and Manage (S&M) Species Inventory

Objective: Determine presence of TES and S&M plant species and update digital data base of species locations.

Parameters to Monitor: TES and S&M plant species.

Location/Timing: Determine presence of TES and S&M plants and animals prior to project implementation. Field review and examination to occur in support of project environmental analysis. Implement surveys to protocol for Level II survey and manage species. Update inventories accordingly.

Wilderness Vegetation and Fuels Mapping

Objective: Provide refined information on vegetation and fuels within the southern end of Mt. Adams Wilderness and unroaded lands outside of the Wilderness. This information will support a Mt. Adams Wilderness Fire Plan and subsequent use of prescribed natural fire.

Parameters to Monitor: Vegetative mapping (supported by photo typing and stand exams), forest fuel loads (from transect and fuel photo series), and threatened, endangered, and sensitive plant and animal locations.

Location/Timing: This information is needed to develop a Mt. Adams Wilderness Fire Plan. Information is also needed from the other watersheds within the Wilderness.

Western Spruce Budworm

Objective: Provide continued information on the spread and intensity of the western spruce budworm epidemic affecting Forest Service lands and non-federal lands to the east. This information would support vegetation or herbicide treatments within and adjacent to Gotchen LSR.

Parameters to Monitor: Western spruce budworm spread and intensity; vegetative mapping (supported by photo typing and stand exams); forest fuel loads (from transect and fuel photo series), and threatened, endangered, and sensitive plant and animal locations,

Location/Timing: Aerial surveys in the spring provide landscape level data on budworm spread and intensity. This should be supported with ground truthing and larvae sampling. The Westside technical center of the Region's Forest Insect and Disease Group will continue to lead aerial surveys and aid in ground sampling.

TERRESTRIAL WILDLIFE

Northern Spotted Owl

Objective: Determine trends in spotted owl populations and their movements across the watershed. Assess spotted owl response to varying habitat structures, especially those resulting from the spruce budworm epidemic and silvicultural treatments that maintain moderate or higher canopy closure. Assess whether habitat changes favor competing species such as barred and great horned owls.

Parameters to Monitor: Spotted owl nest sites, populations, and movement. Competing owl populations.

Location/Timing: Continue partnership in NCASI (National Council of Paper Industry for Air and Stream Improvement) to provide watershed wide monitoring of spotted owl populations. Monitoring should continue to explore population dynamics and habitat relationships.

Bats

Objective: Determine species present and trends in bat population in response to habitat manipulation.

Parameters to Monitor: Bat populations and species. Movement across the watershed and habitat used.

Location/Timing: Continue partnership with volunteer bat biologists and Champion Timber Company for bat survey and research. Consider survey of the older (and historic) wooden structures for bat occupancy and use including: Cow Camp, Wicky Shelter, Cold Springs Shelter, and Gotchen Creek Guard Station.

Northern Lynx

Objective: Determine presence and distribution of species.

Parameters to Monitor: Lynx presence and habitat used.

Location/Timing: Lynx survey should focus on areas of the watershed above 4000 feet elevation and habitat with the potential of supporting this species. Use of the Habscapes model may be useful to determine likely habitat. Carnivore bait stations with cameras or print plates may be used.

Amphibians

Objective: Determine species present, distribution, and population trends

Parameters to Monitor: Species presence and habitat used. For Cascades frogs be attentive to birth defects, population structure, and changes in distribution.

Location/Timing: Monitor springs, livestock watering areas, and mesic meadows. Monitor upland sites and perennial streams where disturbance is planned, consistent with Survey and Manage Guidelines for salamanders. Conduct surveys in the spring and fall.

Wild Turkeys

Objective: Determine species population trends. Wild turkeys were introduced in this watershed in the 1980's. This population appears to be increasing in numbers and distribution.

Parameters to Monitor: Turkey abundance and distribution.

Location/Timing: Current population information has been gleaned from the wildlife sightings data base. Consider a formal survey of the watershed.

Woodpeckers

Objective: Determine species present, distribution, and population trends. Conduct a landscape assessment of the woodpecker community noting species composition, distribution, and demographics.

Parameters to Monitor: Species presence and habitat. Of particular interest are black backed and white headed woodpeckers.

Location/Timing: Watershed-wide assessment of habitat conditions and species present.

Great Gray Owl

Objective: Determine presence and distribution of great gray owl.

Parameters to Monitor: Number of individuals detected.

Location/Timing: Most likely habitats, such as Peterson Prairie and Deadhorse Meadow.

HYDROLOGY

Hydrologic Change Model Validation

Objective: Validate input parameters (climatic variables) for the model.

Parameters to Monitor: Air temperature and wind speeds during rain-on-snow.

Location/Timing: Climatic data is available from local weather stations. Validation should be done prior to use of the model again on this watershed.

Hydrologic Change Model and Peakflow Relative Risk Rating--Comparison

Objective: Validate that both tools used for assessing risk lead to common results, or if they differ, identify the specific reasons why they differ.

Parameters to Monitor: Results of the Hydrologic Change Model and Risk Rating.

Location/Timing: Can be done at the District prior to the next watershed analysis iteration.

WATER QUALITY

Water Temperature

Objective: Identify which streams meet or do not meet water quality standards, and areas where beneficial uses may not be fully supported based on water temperatures.

Parameters to Monitor: Hourly water temperature.

Location/Timing: Green Canyon Creek and Ninefoot Creek for one additional year.

Turbidity

Objective: Identify current turbidity levels in each subwatershed.

Parameters to Monitor: Turbidity and flow.

Location/Timing: Major tributaries during a range of flows.

Fecal Coliform

Objective: Determine compliance with state water quality standards and locate areas that may need particular management emphasis.

Parameters to Monitor: Fecal coliform.

Location/Timing: Monitoring should be done near all high use areas for one year on a quarterly basis to assess conditions through different parts of the year. Frequency of sampling may then concentrate on high use periods only. Particular areas of concern include Cold Springs Shelter water supply, Morrison Creek at the campground, and the White Salmon River at the Forest boundary. Glacier Springs Water Association conducts periodic water sampling at Glacier Springs.

FISHERIES

Rainbow Trout Population Health

Objective: Determine whether a parasitic copepod (*Salmincola spp*.), which was found on rainbow trout in the early 1990's, is still present on trout in Ninefoot Creek and the White Salmon River. If this copepod is not longer present, then the culvert for the Road 23 crossing should be replaced. This culvert is currently a upward fish migration barrier.

Parameters to Monitor: Presence of parasitic copepods on rainbow trout. .

Location/Timing: Sample trout within Ninefoot Creek both above and below the Road 23 crossing. Also sample trout within the White Salmon River near the Ninefoot Creek confluence.

Fish Population Sampling

Objective: Determine if cutthroat and bulltrout are present in the watershed, and establish population estimates of existing species in order to determine any future negative impacts to existing populations if anadromous fish are reintroduced into the upper watershed.

Parameters to Monitor: Number and species of fish.

Location/Timing: All subwatersheds in the analysis area where accessible during September and early October (bull trout spawning time).

HUMAN USES

Special Forest Products Permits

Objective: Determine trends in the types of products collected and amounts. Establish initial starting point in determining resource impact. Coordinate with the Yakama Indian Nation concerning traditional resources of these products.

Parameters to Monitor: Number and types of permits. Monitor on Skill Center and Forest basis.

Location/Timing: Tally number of permits at end of year.

Cattle Grazing within the Upper Gotchen Meadows

Objective: To determine the amount of livestock grazing which is occurring and rate of vegetative recovery from past grazing.

Parameters to Monitor: Forage quantity, quality, and species distribution. Monitor within and outside of a cattle exclosure. Establish photo plots.

Location/Timing: Upper Gotchen Meadows in the vicinity of the Snipes Mountain Trail. Monitor in the spring prior to cattle coming up to the pasture and in the fall after cattle are removed.

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