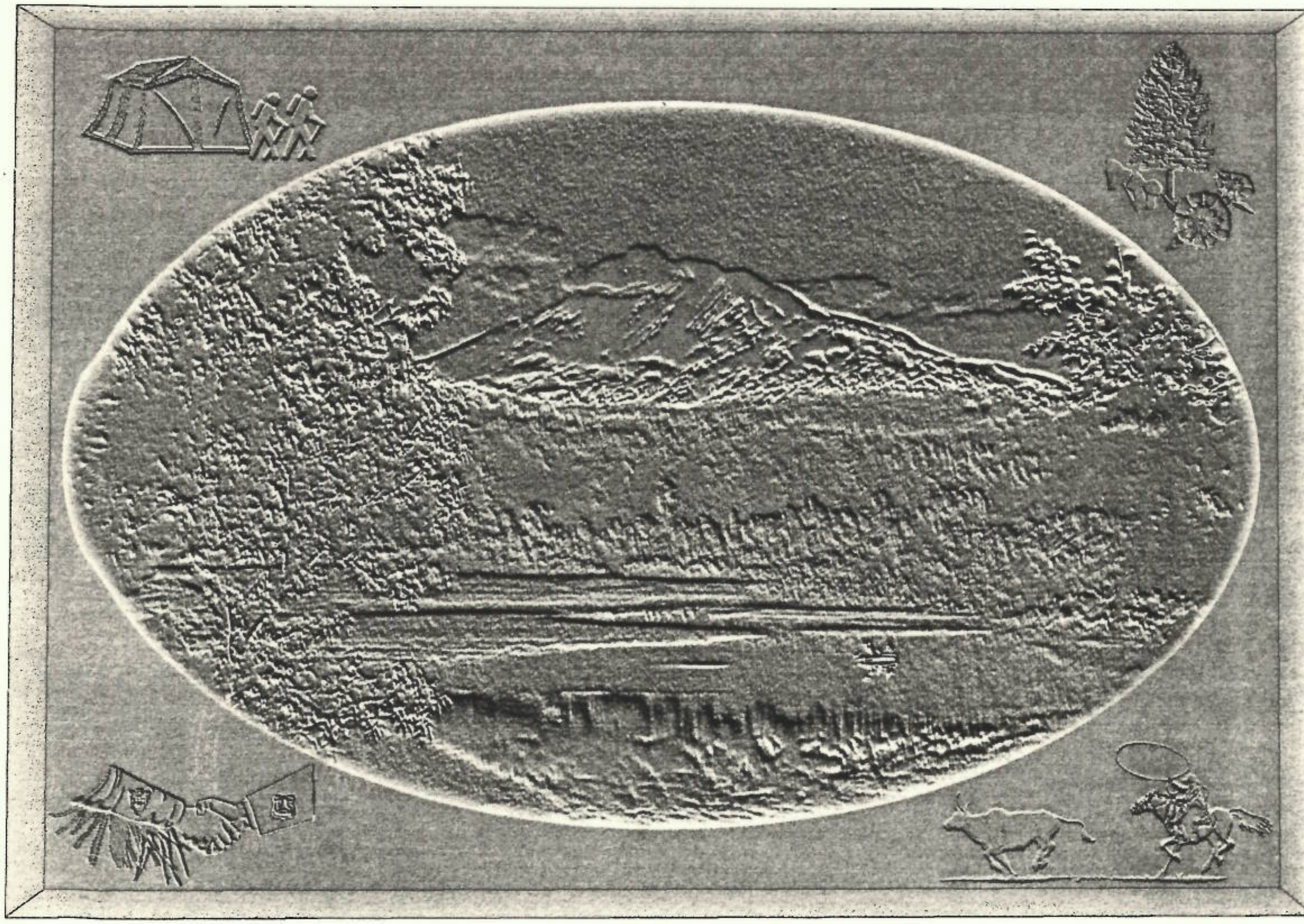
Trout Lake Creek Watershed Analysis

September 1996



Mt. Adams Ranger District
Gifford Pinchot National Forest

Trout Lake Creek Watershed Analysis

Summary of Key Findings

Hydrology

- Nearly half (42%) of the TLC watershed is in elevations with a high probability of rain-on-snow.
- Approximately one third of the TLC watershed is in early seral (hydrologically immature) vegetation.
- Aggregate Recovery Percentages (ARP's) range from 73 to 90 across subwatersheds in TLC.
- Road densities range from 1.8 to 3.9 miles per square mile across subwatersheds in TLC.
- Past harvest has been disproportionately concentrated in rain-on-snow elevations.
- Subwatersheds at greatest risk of increased peak flows are those along the mainstem of TLC (Headwaters, Middle TLC, and Lower TLC).

Vegetation

- The Sawtooth Huckleberry Fields are present in the watershed with a long history of human use, and are still very important with respect to Tribal interests.
- The average annual Forest-level calculated PSQ is 2.9 MMBF of regeneration harvest and 1.6 MMBF of thinning for the entire watershed. The Regional target is 15% higher or 3.3 MMBF of regeneration and 1.8 MMBF of thinning per year.
- The Forest Road 88 visual corridor exceeds the Forest Plan standard and guideline of 15% openings in stands less than 20 feet tall. Therefore, additional regeneration harvest entries should be deferred until next decade.
- The total discrepancy from the Regional target could be as much as 1.3 MMBF per year due to the Forest Road 88 visual corridor (reduction of 660 MBF per year), plus the difference between the Forest calculated PSQ versus the Regional target (400 MBF of regeneration harvest and 200 MBF per year of thinning volume).
- The next timber sales are recommended in the following sub-basins: 1) Skull Creek (thinning), 2) Mosquito Creek (regeneration & thinning), 3) Little Goose/Smoky (thinning), and 4) Dead Horse (thinning).

Human Uses

- Thirteen of the 24 inventoried recreation sites at Wilderness lakes do not meet Forest Plan direction (i.e., are within 100 feet of the shore).
- Documented impacts of recreation use in Indian Heaven Wilderness includes trampling and loss of vegetation, soil compaction and erosion, damage to tree roots and trunks, and exposed human waste.
- Many of the known caves in he watershed are used extensively by recreationists.

Water Quality

A. Water Temperature

- Temperatures have exceeded state standards on nearly every major tributary and in the TLC mainstem.
- Highest recorded temperatures in the watershed (23° C) occurred in lower TLC (below the lake).
- Sources of stream heating in TLC appear to be a combination of:
    1) Upland meadows (>7° C increase measured across one meadow complex)
    2) Wide, poorly shaded reaches of TLC (in part a result of past riparian timber harvest).

TROUT LAKE CREEK WATERSHED ANALYSIS

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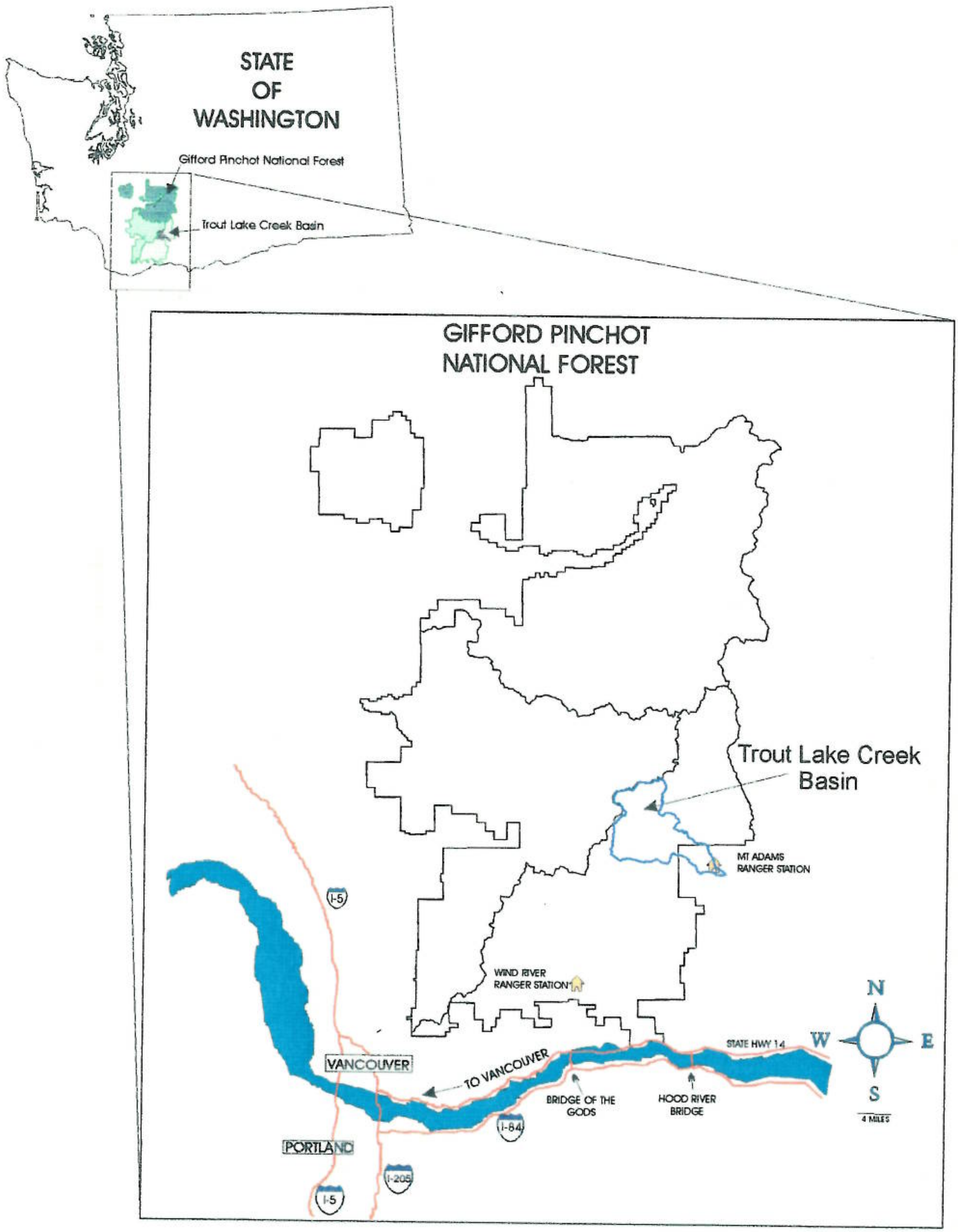
<u>Appendices on File</u>

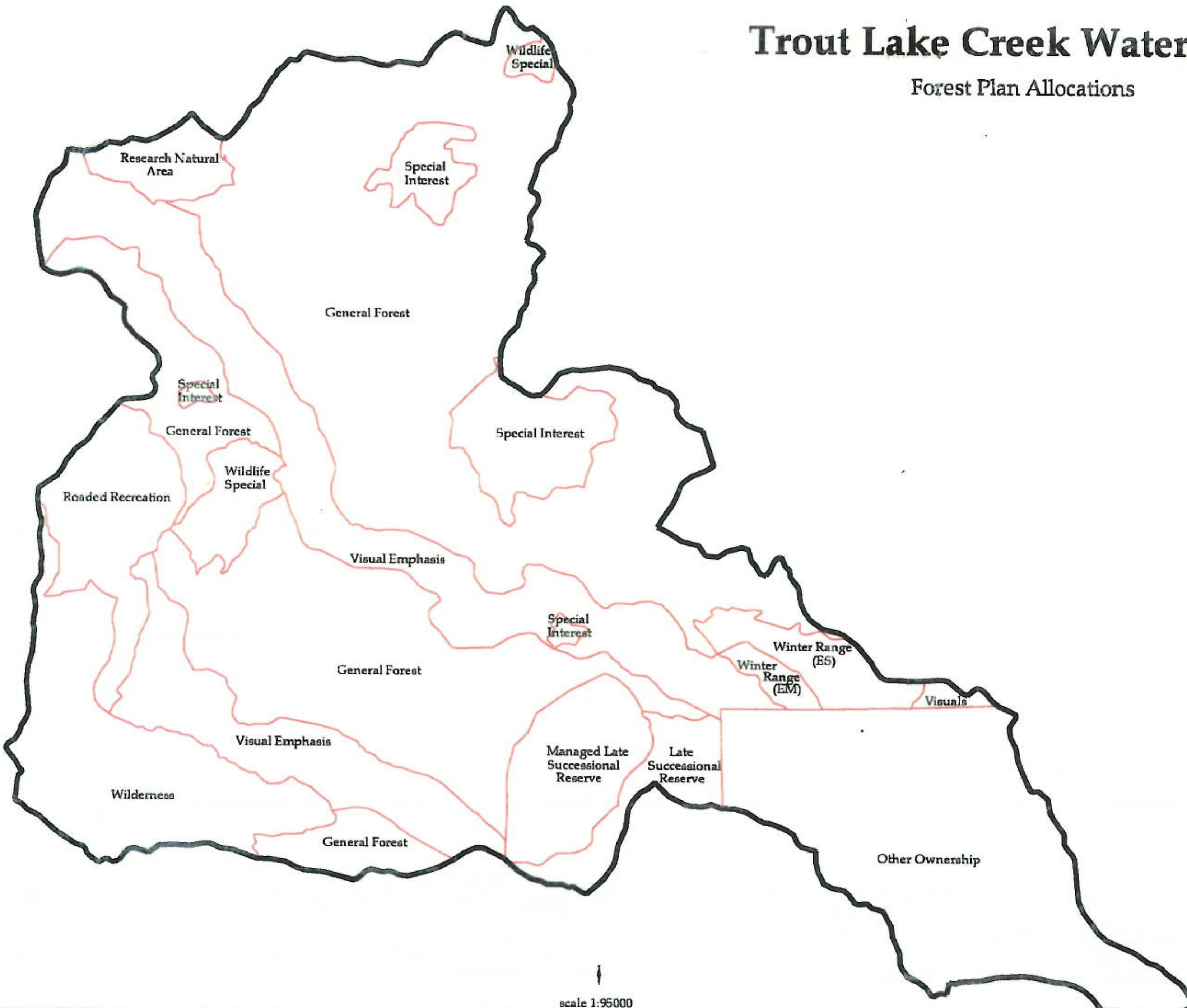
Trout Lake Creek Basin



MAP 1

Trout Lake Creek Watershed

Forest Plan Allocations



CHAPTER 1 - CHARACTERIZATION

Trout Lake Creek flows into the White Salmon River in the town of Trout Lake, in Klickitat County, Washington. The Trout Lake Creek watershed analysis area is approximately 48,000 acres. Due to its proximity to the Cascade crest, this landscape houses an array of site conditions from wet to dry, and from 1960' to 5925' elevation.

Erosional Processes

Volcanism and glaciation are the primary processes that give the watershed its form. Most of the ground is gently sloping from the northwest to the southeast. Much of the northwest part of the watershed has wet meadows caused from the glacial drift material after the last glacial epoch about 10,000 years ago. The watershed does not have a large proportion of mapped landslides, although the north and northwest portions are considered potentially unstable. Dense roading in the watershed has increased sediment movement (surface erosion) toward streams. Tractor logging has compacted soil, inhibiting water filtration into soil, and promoting further surface erosion.

Hydrology

Elevations in the watershed range from approximately 5400 feet at Steamboat Mountain to less than 2000 feet at the mouth of Trout Lake Creek. Climate is characterized by cool, wet winters and relatively dry summers, with a majority of the precipitation occurring in winter months, and much of this falling as snow. Peak streamflows in Trout Lake Creek are driven by a combination of heavy rains and rain-on-snow in the winter months, and by warmer weather snowmelt conditions that occur during the spring months. Late summer flows are generally fed by subsurface recharge and the numerous wetlands, meadows and lakes throughout the watershed.

Aquatic features of the watershed include more than 50 miles of fish-bearing streams, over 100 miles of intermittent and ephemeral streams, and a multitude of mapped and unmapped springs, wetlands, wet meadows and lakes. Most notable among these is Trout Lake itself, which is located at the lower end of the watershed, and is currently in transition from a lake to a marsh or wetland. Current hydrology of the lower watershed reflects past activities to develop irrigation ditch systems and to relocate stream channels to accommodate land uses or to divert water to points of use. Because of the degree of changes that have occurred and the lack of documentation of specific modification of stream channels, there is still much discussion among local residents as to what the original and natural drainage patterns were in streams flowing through the Trout Lake Valley.

Primary water quality concerns in the watershed include water temperature, fecal coliform, and sediment or turbidity. Coliform levels exceeding thresholds established in state water quality standards have resulted in the inclusion of Trout Lake Creek on the Washington State Department of Ecology's 303(d) list (1994) for the reach below the National Forest boundary. Exceedances of state water temperature standards have been measured throughout most of the drainage as well, particularly during warm and low water years. Turbidity and sediment levels are largely unknown in the watershed, but may be a concern to the extent that they are responsible for what is perceived as an accelerated rate of filling of Trout Lake.

Vegetation

An unusually high diversity of tree species, including 17 conifers and at least 7 broadleaf deciduous occur in this watershed. Relatively large patches of late-successional forests exist among mid-successional forests (generated after wildfires early this century), and among young forests up to 45 years old (established following harvest).

Fire was the dominant disturbance factor prior to the 1940's. McClellan's journal described the vegetation in the central portion of the analysis area (Peterson Prairie and vicinity) in the mid-1850's. Forest stands were open and species, such as the bullfrog, along with habitat destruction, are expected to contribute to the demise of some sensitive wildlife species, such as salamanders and frogs.

Aquatic. No rare or anadromous fish inhabit the drainage. Anadromy is blocked on the White Salmon River at river mile 3.3 by an impassable dam; it is uncertain if anadromous fish ever inhabited Trout Lake Creek.

The watershed streams contain resident rainbow trout, cutthroat trout, and brook trout. The Washington Department of Fish and Wildlife (WDFW) stocked Trout Lake Creek marsh annually with brook and rainbow trout in the recent past. Stocked fish are free to move up Trout Lake Creek and into its tributaries. Fishbearing tributary streams include: Mosquito, Skull, Little Goose, Smoky, Meadow, Cultus, Cave, and Beaver Creek.

Sixteen fish-bearing lakes are present in the watershed and are intermittently stocked with rainbow, brown, brook, or cutthroat trout by the WDFW. These lakes include: Comcomly, Cultus, Deep, Hidden Lakes (1,2, 3), Mosquito, Little Mosquito, Steamboat, Surprise Lakes, Trout, and Wapiki. All of these lakes are popular recreational fishing areas, and three of them are located in Indian Heaven Wilderness.

CHAPTER 2 - ISSUES/KEY QUESTIONS

The following are analysis questions that helped guide discussions of the watershed. Some of them are significant enough to be issues unto themselves. Other questions contributed to the synthesis of the information available on the watershed or obviated gaps in the data.

Erosion Processes

What level of increased sediment has occurred? What role have roads had in increasing the sediment yield?

Has there been an increase in steambank erosion? Where?

Hydrology

What were the historic conditions affecting peak streamflows in the watershed?

What are the current watershed conditions affecting peak streamflows?

How have these conditions changed over time?

What areas of the watershed have the greatest potential for increased peak streamflows?

What are the condition trends for parameters affecting peak streamflows?

What projects or project types are recommended to meet objectives of the Aquatic Conservation Strategy?

Vegetation

Is the planned rate of timber harvest from Trout Lake Creek watershed sustainable?

What is the role of introduced vegetative species in the watershed?

What activities impact vegetation (e.g., streamside recreation use, domestic/recreational stock grazing/watering)?

How should Sawtooth Berry Fields be maintained?

Human Uses

What tribal cultural resources exist in the watershed?

What is the cultural significance of Sawtooth Berry Fields?

How should caves be managed, in particular the few caves that are highly used?

What types of recreational activity occur within the watershed and what is the extent of these activities? Where do they occur?

What activities impact vegetation (e.g., streamside recreation use, domestic/recreational stock grazing/watering)?

CHAPTER 3
CURRENT AND HISTORIC CONDITIONS BY CORE TOPIC

Chapter 3.1
Erosion Processes

Trout Lake Creek Watershed Analysis

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Chapter 3.1

Core Topic: EROSION PROCESSES

Current Condition

The geology and landform of Trout Lake Creek Watershed are important factors influencing the production and transport of sediment. The geology of the watershed is mostly volcanic in origin with interbeds of andesite and basalt with pyroclastic flows and tephra deposits. Many of these flows originated out of the Indian Heaven area. The composition of these flows varies dramatically and gives many different features. One of the most significant features of one flow is the formation of numerous lava tubes. These tubes are formed as conduits for molten material to flow long distances as the rest of the molten material starts to cool around it. The Ice Caves Flow started at Lake Wapiti and went south at least to Husum, WA. This material has been dated at less than 130,000 years old and older than 30,000 years. Most of the other flows in the watershed were probably erupted in this same age period, although there are older and some younger. The oldest rocks in the watershed are in the northern part at Steamboat Mountain which is a remnant of the Columbia River basalts which are dated at about 16 million years.

Most of the soils are derived from volcanic ash deposits and colluvial deposits. Till deposits from past glaciation are also noted in the western and northern portions of the watershed. Glacial activity in the northwest portion of the watershed has formed the landscape into gently sloping ground which trends toward the south east.

Mass Wasting

The potential for mass wasting in the watershed is moderate to low, mainly due to the moderate slopes of most of the ground. Areas susceptible to mass wasting would be in areas of steep ground, deep soils or weathered pyroclastic rocks. Areas of potential instability have been identified in sub-watersheds B (Headwaters TLC) and S (Cultus/Meadow). However, this does not mean that the other sub-watersheds are not susceptible to mass wasting events. Oversteepened stream channel banks could be a big concern especially during periods of high runoff. Map 1.1 shows riparian reserves and delineates areas of unstable and potentially unstable ground in the watershed.

Surface Erosion / Sediment Transport

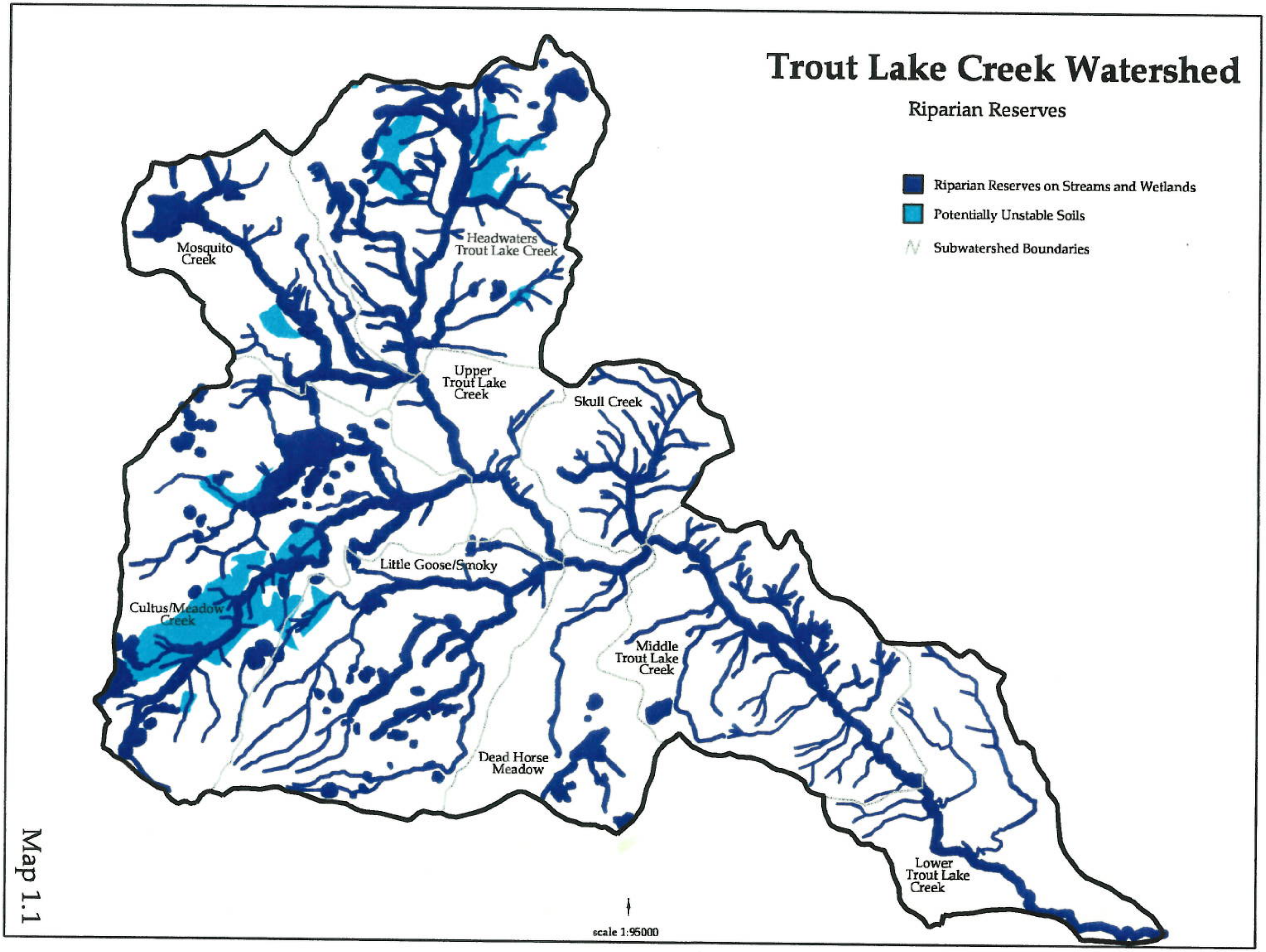
Erosion rates in the watershed are moderate, based on soil classification, slope, aspect and rainfall in the area. Since the onset of road construction in the area began there has probably been an increase in the amounts of sediment moving toward streams. The greatest influx has been within the first few years after construction as this is when the ground is most disturbed and new vegetation has not filled in the fill and cutslopes of the road prism. Roads also have a tendency to channel water and increase velocities of the water as it moves downslope. Fig. 1.1 is a break down by sub-basin showing the amount of sediment being transported from the road systems to streams. These numbers are based on analysis and data gathered from condition surveys on less than 5% of the roads in the watershed. The method used is described in the Washington State Department of Natural Resources Watershed Analysis Guide. As more condition surveys are completed the analysis will be more meaningful. The information provided should give some direction as to which sub-watersheds have more erosion taking place.

Compaction of the soils from ground based management activities has been another factor in increasing sediment transport. The compaction has made the soils less permeable which in turn has increased surface runoff. This surface runoff picks ups any loose matter and moves it down and into streams.

The ultimate concern from sediment transport is where it ends up. In this watershed one likely place would be Trout Lake. Historically this was said to be a fairly large but shallow lake. Due to the flatness of the ground in the

Surface Erosion

Natural conditions for surface erosion were mainly from high intensity fires that would burn through areas leaving bare slopes. Tephra deposits from many of the volcanic eruptions in the area have also had an effect of erosional processes. These conditions would increase the amount of erosion taking place until new vegetation would become established and slow the erosional process down. The main difference between current and reference conditions is the addition of management activities to the landscape and suppression of the large scale fires.


Trout Lake Creek Watershed
Riparian Reserves
Riparian Reserves on Streams and Wetlands
Potentially Unstable Soils
Subwatershed Boundaries
Mosquito Creek
Headwaters Trout Lake Creek
Upper Trout Lake Creek
Skull Creek
Little Goose/Smoky
Cultus/Meadow Creek
Middle Trout Lake Creek
Dead Horse Meadow
Lower Trout Lake Creek
scale 1:95000

Map 1.1

Chapter 3.2
Hydrology Assessment

Trout Lake Creek Watershed Analysis

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Chapter 3.2

Core Topic: HYDROLOGY

Issue Statement

Past land use activities including timber harvest, road construction, and water development may have altered hillslope and instream hydrologic processes and conditions in the Trout Lake Creek watershed. In particular, peak streamflows may have been increased, and summer low flows have been altered by some combination of water extraction or diversions, timber harvest, and road construction. Increased peak streamflows can degrade fish habitat, water quality, and stream channel conditions, and extreme low flows can affect water quality and habitat availability for fisheries.

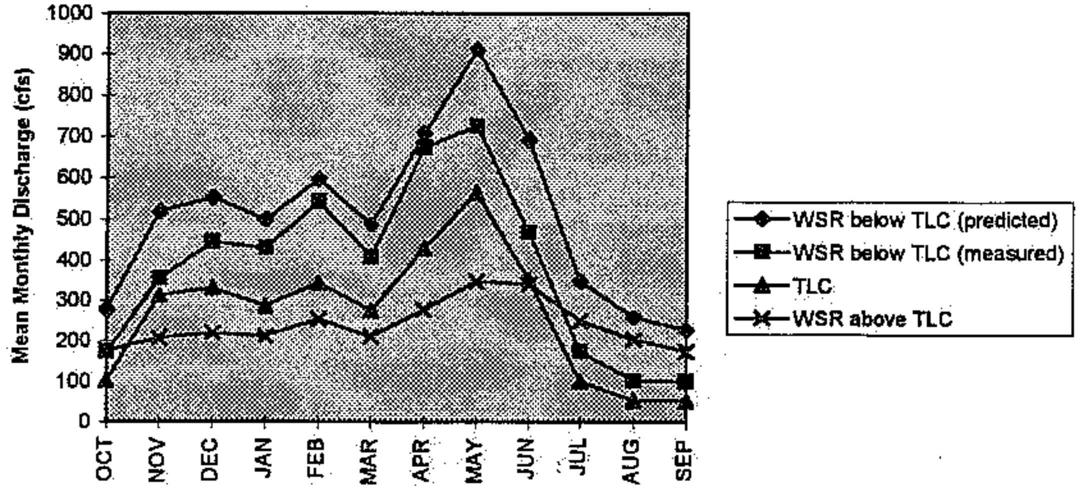
The largest share of remaining forestland in the Trout Lake Creek watershed lies on National Forest lands. Because of this, the potential for future harvest activities to affect peak streamflows may be greatest in those areas managed by the National Forest. Moreover, the Trout Lake Creek watershed was identified as a "Non-Key Watershed" under the Northwest Forest Plan (NFP), and most of the watershed is in a "Matrix" allocation. These designations provided in the NFP suggest that timber production will continue to be emphasized in this watershed over some watersheds with a larger proportion of their land area in Reserve status. For these reasons, the peak flow portion of the hydrology issue will be the focus of this assessment, and National Forest lands will be emphasized.

Historic Conditions

According to historic accounts, the Trout Lake valley floor was nearly covered with virgin forests when early settlers arrived and began clearing land for farming (McCoy, 1987). Since those early years of settlement, human uses have increased in the valley, and more area has been converted from forestland to agricultural, residential, and commercial uses. Water diversions were established as early as 1886 in the Trout Lake Valley for irrigation and for transporting timber and wood products. These ditch systems continue to be used today to move water from Trout Lake Creek and other streams to points of use in the valley. Timber harvest on the National Forest portion of the watershed began as early as the 1940's, but was greatest during the 1970's and 1980's.

Prior to timber harvest, major disturbances in the watershed that may have affected peak streamflows included primarily wildfire and insect or disease outbreaks. In either case, large scale defoliation or loss of forest vegetation would have allowed increased snow accumulation and increased rates of snowmelt during rain-on-snow. Under these conditions, peak streamflows may have been increased, and would have remained at higher levels until forest vegetation recovered. Recovery occurs as young forest stands develop the size, density and strength to both intercept and support a snowload in the canopy and impede turbulent air movement across the surface of the snowpack. Complete hydrologic recovery in terms of response to snow accumulation and snowmelt can take from 25 to 40 years or more in an individual stand, depending on the elevation, type of trees, and growing site.

Areas of the watershed at greatest risk of experiencing increased peak flows due to loss of forest cover would be those areas lying in the elevations with a high probability of experiencing rain-on-snow. This elevation zone is generally defined as being between 1,500 and 3,500 feet. Approximately 42% of the Trout Lake Creek watershed is in this elevation band which includes the entire lower portion of the watershed, and a swath that generally follows the course of the mainstem of Trout Lake Creek (Figure 2.1).



TLC = Discharge at the Trout Lake Creek gauge station.
WSR = Discharge at the White Salmon River gauge station above/below confluence with Trout Lake Creek.

Figure 2.2. Mean monthly discharge on Trout Lake Creek and the White Salmon River compared with predicted discharge on the White Salmon River.

Figure 2.2 illustrates the effects of water losses from Trout Lake Creek and/or the White Salmon River on streamflow in the White Salmon River below the confluence with Trout Lake Creek. The figure displays three data sets from three separate gauging stations: one on Trout Lake Creek below the Lake, one on the White Salmon River above the confluence with Trout Lake Creek, and one on the White Salmon River below the confluence. The fourth curve shown on the figure represents predicted values of discharge at the White Salmon River station below the confluence. Predicted values were derived by simply adding the average discharge values from Trout Lake Creek and the upstream gauge site on the White Salmon River.

Generally, flows at the White Salmon River station below the confluence would be expected to be at least as large as the combined flow from the two stations above. In this case, measured discharge at the lower White Salmon station during the late summer months is less than one half of the flow that is predicted at that site. Summer water diversions are clearly at least in part responsible for this apparent water loss. However, throughout the year discharge at the lower White Salmon site is lower than would be predicted by adding discharge from the upper two stations. It is unknown if this difference is due to natural water losses through the porous basalt channels in these reaches or if some level of water diversion is taking place year-round in the valley.

Peak Flows

The largest annual peak streamflows in Trout Lake Creek typically occur during November through May, with the earlier events being driven largely by heavy rains or rain-on-snow, and the later spring peaks occurring in response

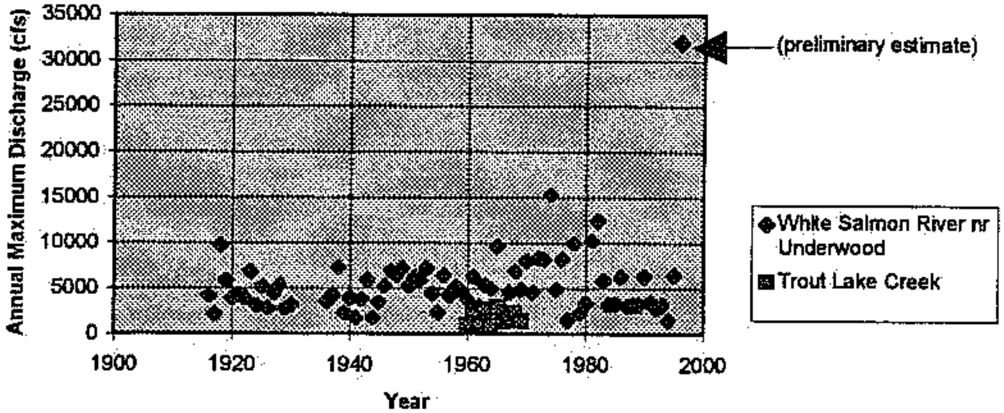


Figure 2.4. Annual peak streamflows on the White Salmon River and Trout Lake Creek.

Vegetation

Approximately 90% of the watershed is in vegetation dominated by coniferous forest. The rest of the watershed is comprised of meadows, agricultural lands, administrative uses (i.e. residential, commercial, etc.), and rock (Figure 2.5). Of the coniferous forest lands, approximately one third of the acreage is in early seral vegetation including seedlings, saplings, and pole-sized trees. The seedlings and saplings have resulted from timber harvest, and the pole sized trees from a combination of past timber harvest and wildfire. These size classes are considered to be hydrologically immature or intermediate in terms of their effect on snow accumulation and snowmelt.

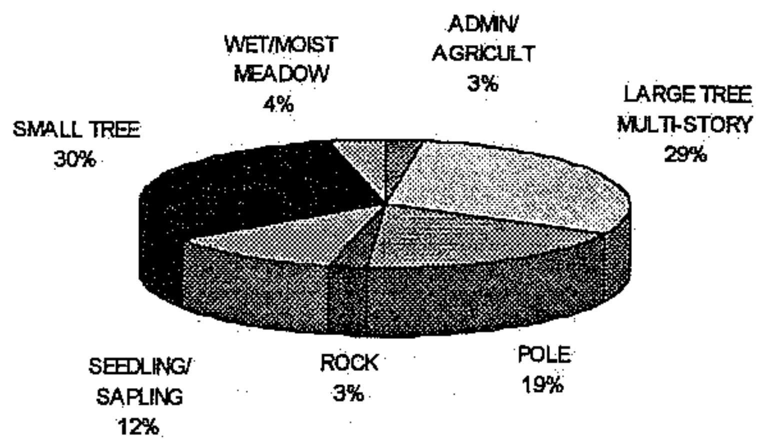


Figure 2.5. Current vegetation and land use in the Trout Lake Creek watershed.

The Aggregate Recovery Percentage (ARP) is an analysis tool used to index of the amount of vegetative cover in a watershed that is hydrologically mature. Hydrologic maturity is defined in terms of the ability of the forest canopy to intercept and retain snow, and to modify rates of snowmelt during rain-on-snow. As an increasing proportion of a watershed is put into an immature condition, the ARP is reduced, and the potential for increased peak streamflows is raised.

Trout Lake Creek Watershed

Hydrologically Unrecovered Stands
And
High Probability Rain-on-Snow Zone

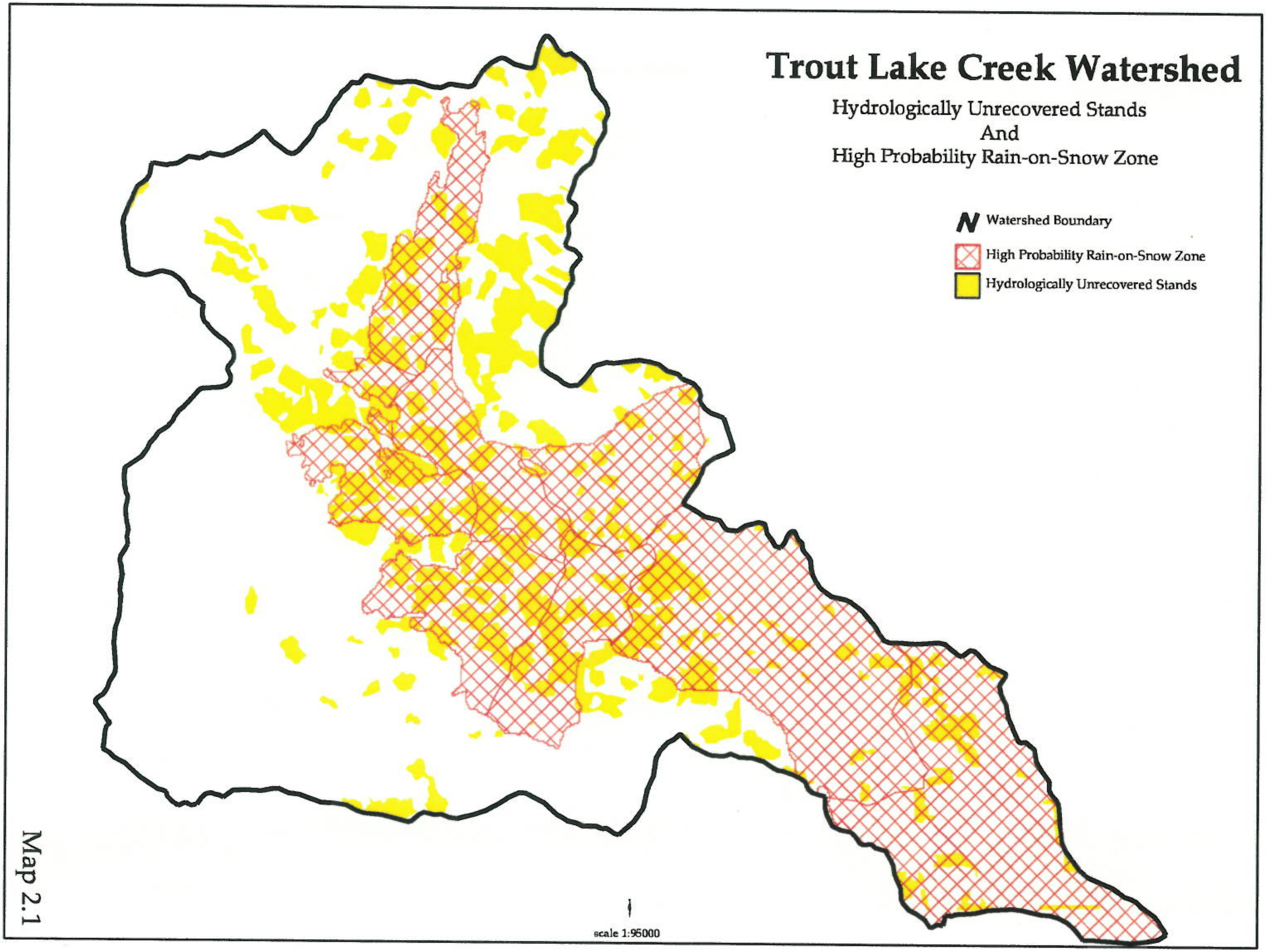


Table 2.2. Road densities and number of stream crossings per subwatershed.

Watershed	Name	Road Density (mi./sq. mi.)	Stream Crossings (#)
TLC1	Headwaters Trout Lake Creek	3.7	63
TLC2	Mosquito Creek	2.9	13
TLC3	Cultus/Meadow Creeks	1.8	30
TLC4	Upper Trout Lake Creek	3.6	6
TLC5	Skull Creek	3.9	31
TLC6	Little Goose/Smoky Creek	2.3	32
TLC7	Dead Horse Meadow	2.4	7
TLC8	Middle Trout Lake Creek	3.3	51
TLC9	Lower Trout Lake Creek	3.9	13
	Trout Lake Creek Watershed	3.0	246

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 scores each of the parameters described above, and then sums the individual scores to arrive at a subwatershed score. The score indicates relative differences between subwatersheds, and allows for a "high", "medium" and "low" rating to be applied to each. Figure 2.6 presents the results of this risk rating. Based on this rating, subwatersheds with a relatively high risk of increased peak streamflows are TLC1 (Headwaters Trout Lake Creek), TLC4 (Upper Trout Lake Creek), TLC8 (Middle Trout Lake Creek), and TLC9 (Lower Trout Lake Creek). Skull Creek (TLC5) is also moderately high.

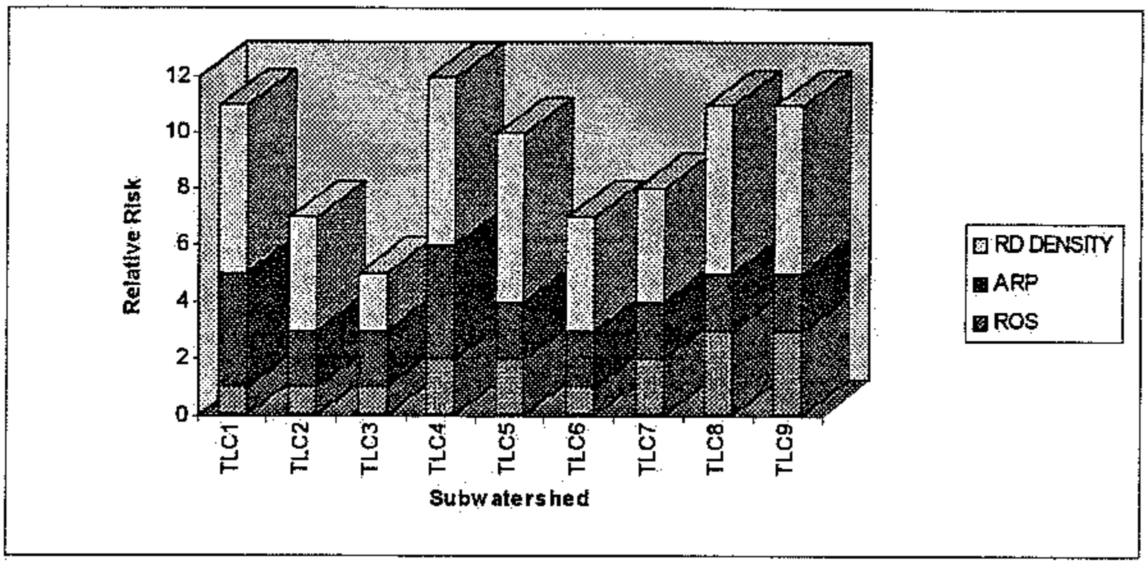


Figure 2.6. Relative risk rating for increased peak streamflows in Trout Lake Creek subwatersheds.

Results of this index suggest that the areas of greatest risk of increased peak flows are those subwatersheds that follow the mainstem of Trout Lake Creek. That is, none of the subwatersheds that are based around major tributaries, with the possible exception of Skull Creek, are identified as having a high risk of increased peak flows. This is reflective of the pattern of timber harvest seen in the watershed, where much of the past harvest has focused on the lower elevations. The lowest risk subwatershed according to this rating is Cultus/Meadow Creek. The low rating in this subwatershed is due to a combination of factors including: 1) timber harvest has not occurred in the Indian Heaven Wilderness which comprises the upper extent of the subwatershed; 2) much of the upper subwatershed was previously burned, so did not have the large trees that have been sought for harvest, and 3) a based on those current conditions. The synergistic effects of harvest-related changes in water available for runoff and changes in water routing due to roads are incorporated in this rating.

The Washington State Department of Natural Resources (DNR) Hydrologic Change module was used to model changes in snow accumulation and subsequent snowmelt during rainfall to predict changes in peak streamflows during the 2-year flood. This methodology focuses on changes in water available for runoff due to timber harvest, but neglects changes in water routing that occur from road systems. The results of these two different methodologies showed relatively poor correlation in this case (Table 2.3). In fact, results from the state model show very little variation across the subwatersheds, even though elevations and harvest intensities differ among them. It is likely that at least part of the difference in results has to do with the relatively high elevations in the watershed. The hydrologic change module is very strongly controlled by elevation because that is the factor that determines air temperature, the key driver for the snowmelt model. With much of the Trout Lake Creek watershed at relatively high elevations, this model predicts very little snowmelt during the types of storm conditions modeled, reflecting the fact that rain-on-snow is more common at lower elevations. Because all calculations were done by computer based on a direct link with GIS, additional error may have been introduced in calculating the values. Thorough validation of the computer code and numerical results is still underway, and at present, confidence in the results is only moderate.

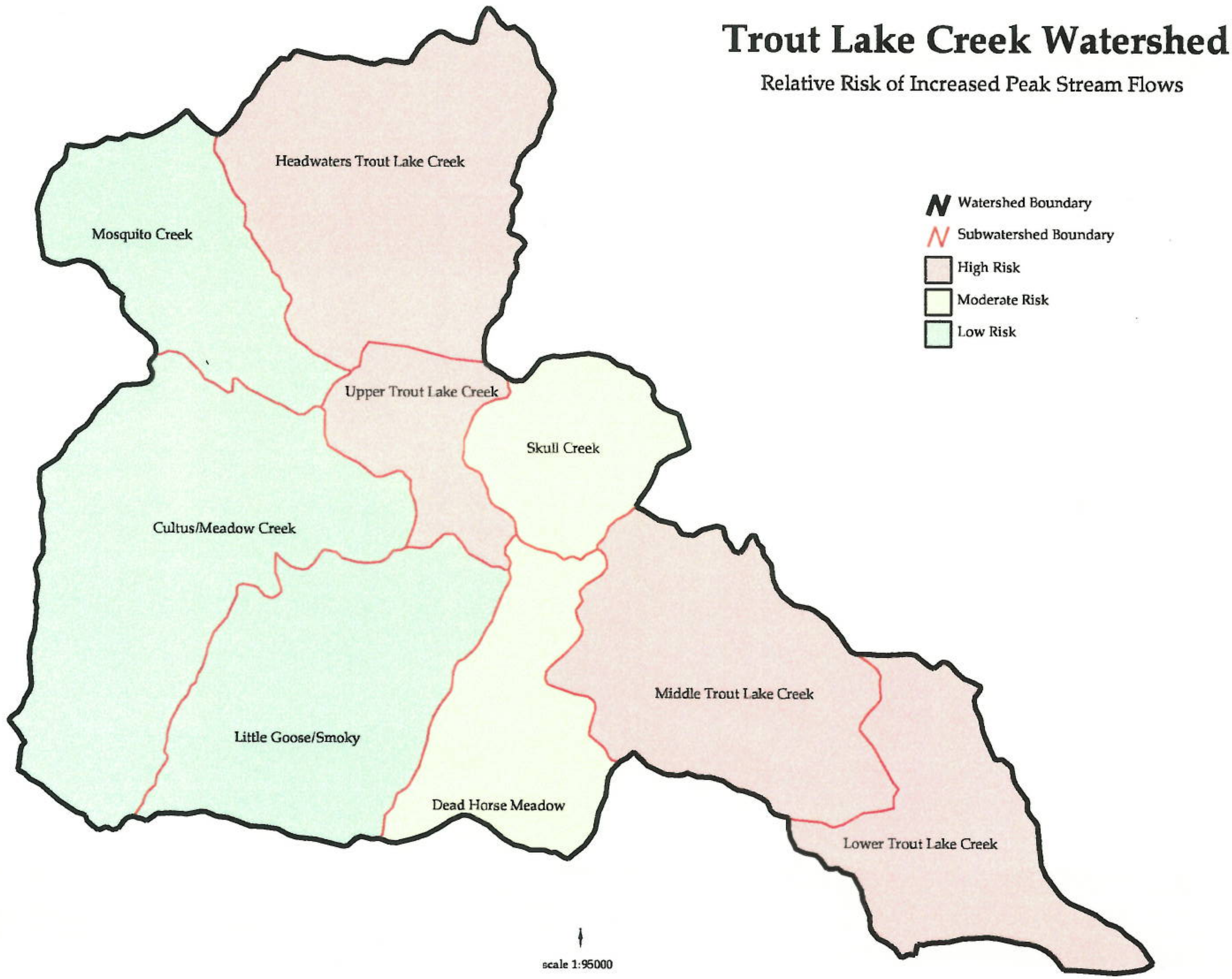
Table 2.3. Summary of peak flow risk ratings and predicted streamflow increases.

	Subwatershed Name	Peakflow Relative Risk Rating	Predicted Increase 2-Yr Flow
A	Mosquito	L	3
B	Headwaters TLC	H	3
L	Skull	M	3
N	Upper TLC	H	3
P	L.Goose/Smoky	L	3
Q	Dead Horse	M	2
R	Lower TLC	H	8
S	Cultus/Meadow	L	3
X	Middle TLC	H	6

Because the risk rating takes into account the effects of roads and the synergism between road-related changes in water routing and changes in water available due to harvest, this tool is felt to be more comprehensive in some respects. However, results of this tool are somewhat less easily interpreted that those provided in the State of Washington's hydrologic change module. Moreover, because it is process-based, the state module may allow for better understanding of how the individual components link to the final result. Validation of these two approaches is now being done on the Forest, and will help with interpretation of the results of each tool. For purposes of this analysis, subwatersheds that were rated as "high" risk or had predicted peak flows increases of greater than 10% are identified as high risk subwatersheds (Figure 2.8). As noted previously, subwatersheds with the highest risk for increased peak flows are those that generally fall along the mainstem of Trout Lake Creek, because of the elevations there and the concentration of past harvest activities in that part of the watershed.

Trout Lake Creek Watershed

Relative Risk of Increased Peak Stream Flows



Map 2.2

Chapter 3.3
Vegetation

Trout Lake Creek Watershed Analysis

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Chapter 3.3
Core Topic: VEGETATION

Historic Conditions

The analysis area has a long history of human use which has greatly influenced the vegetation and associated habitats now present. The most important human activities include fire suppression and timber harvest.

Fire Suppression. Prior to settlement, large-scale natural fires periodically burned thoughout the analysis area. In addition, Native Americans may have maintained large burns by either leaving their drying logs smoldering after leaving the berry fields or by directly setting fire to berry patches at the end of the berry season. The intent was to maintain huckleberry production at high elevation sites. Since about 1910, fire suppression efforts were initiated which have curtailed the occurrence of large-scale fires.

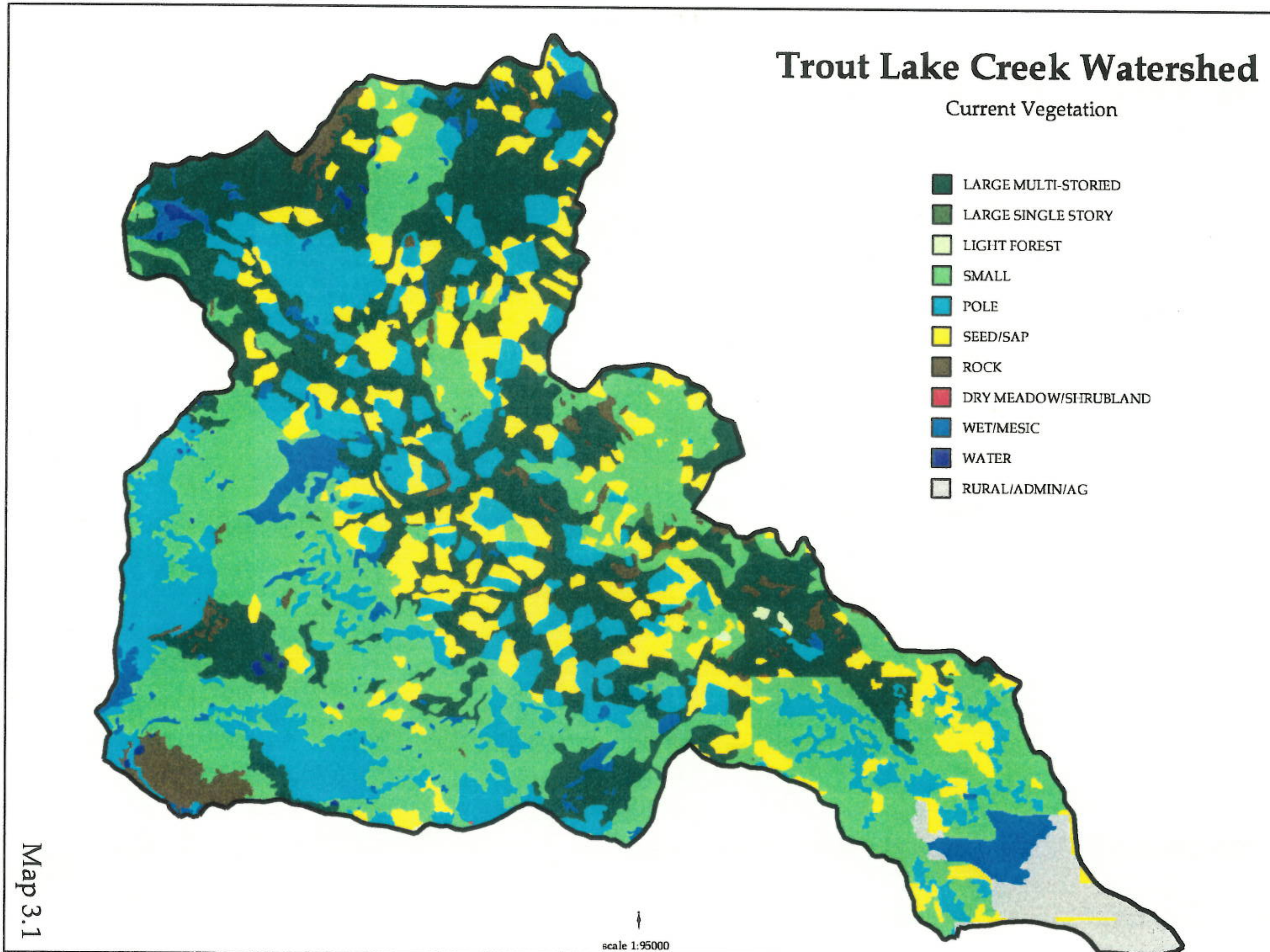
Fire History. Probably the most important factor influencing pre-settlement vegetation was fire. A report was prepared addressing the role of fire on the Mt. Hood and Gifford Pinchot National Forests entitled: Fire Ecology of the Mid-Columbia by Louisa Evers and others in 1994. Several vegetative groups are identified based on ecological Plant Associations which have similar fire histories. The four Fire Groups present in the Analysis Area are: Miscellaneous Special Habitats (Group 0); Dry Grand Fir (Group 3); Cool, Dry Lower Subalpine (Group 5); and Warm, 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 south slopes above Trout Lake Creek, Sleeping Beauty, and Haystack Butte. 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 either tend to stay small (less than 10 acres) because of aggressive initial suppression, or get large (greater than 1,000 acres).

Cool, Moist Lower Subalpine (Group 6). Fire group 6 occurs at the highest elevations in the Analysis Area including the east slopes of Indian Heaven Wilderness and the Sawtooth Berry Fields. This group is the wetter portion of the transition zone between eastside and westside of the Cascade crest. Ecology plot data suggests a fire return interval of 170-430 years. This group may become susceptible to high intensity fires on a 30-year cycle of prolonged drought and high winds. The lack of continuous fine fuels would have greatly reduced the risk of stands within fire group 6 throughout much of the stand history. However, during prolonged drought, the shrubs and forbs can provide a significant fuel load. Also, stands are vulnerable to wind-driven crown fires originating from adjacent stands.

Cool, Dry Lower Subalpine (Group 5). This fire group is located at the higher elevations of the analysis area below the eastern slopes of Indian Heaven Wilderness. Prior to 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.


Trout Lake Creek Watershed
Current Vegetation
LARGE MULTI-STORIED
LARGE SINGLE STORY
LIGHT FOREST
SMALL
POLE
SEED/SAP
ROCK
DRY MEADOW/SHRUBLAND
WET/MESIC
WATER
RURAL/ADMIN/AG
scale 1:95000
Map 3.1

2) Pacific Silver Fir, and 3) Mountain Hemlock. Inclusions exist from the Western Hemlock, Western Redcedar, Subalpine Fir, and Lodgepole Pine zones as well. 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 analysis area range from about 1,980 feet in the Trout Lake Valley to 5,925 feet at Lemei Rock in the Indian Heaven Wilderness.

The Grand Fir Zone occurs on the warmest and driest sites in the analysis area. These sites are found on south-facing slopes in Trout Lake Creek, Sleeping Beauty, Haystack Butte, and Cakey Butte. Inclusions of the Grand Fir Zone are also found at lower elevations within the Forest boundary in the vicinity of Peterson Prairie. The Grand Fir Zone sites are considered to be the driest on the Gifford Pinchot National Forest. The upper elevation limit of the Grand Fir Zone occurs where abundant moisture and cool temperatures allow development of stands dominated by Pacific silver fir, subalpine fir, or mountain hemlock. The Western Hemlock and Western Redcedar Zones occur in limited locations, such as tributaries where moisture availability is increased. The Pacific Silver Fir Zone comprises the vast majority of the analysis area. These sites are found at higher elevation, cooler locations with greater amounts of precipitation, such as mid to upper elevations of Trout Lake Creek drainage to about 4,000 feet. The Mountain Hemlock Zone occurs at the highest elevations, typically above about 4,000 feet into Indian Heaven Wilderness and Steamboat Mountain. These are characterized as cold sites with deep snowpacks and short growing seasons. There also are inclusions of the Subalpine Fir and Lodgepole Pine Zones in areas where cold air accumulates, such as around high elevation openings with gentle topography.

Seral Stages

All forested ecological seral stages are represented in the Trout Lake Creek analysis area. The District vegetation database lists the forested successional stages by sub-basin as in Table 3-1.

The vast majority of the early seral stands originated following timber harvest over the last 25 years. These young stands are dispersed throughout the analysis area except for the Indian Heaven Wilderness, Steamboat Mountain Research Natural Area, and Smoky Creek burn. Pole-sized stands include primarily plantations that have grown to 5 inches or greater DBH. Mid-successional small tree stands (9-21 inches DBH) originated following wildfires earlier this century (1902-1924). Most of this area is in the vicinity of the Smoky Creek burn. Late-successional forests are located mostly in the Pacific Silver Fir Zone with stand origins from older 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. Plant communities within the Grand Fir Zone generally have a much lower structural diversity and species richness than the Pacific Silver Fir and Mountain Hemlock Zones because of dense, mid-successional stands originating following stand-replacement fire. The Grand Fir Zone is more susceptible to stand replacement fires due primarily to the dry conditions, steep topography, and southerly slopes. Stands tend to be even-aged, composed almost exclusively of Douglas-fir and grand fir with a lesser component of other minor species such as ponderosa pine and Oregon white oak. Because stands are mid-successional or making the transition to late-successional, vertical structure is still developing and canopy gaps are not frequent except in root disease pockets or small bark beetle infestation areas. Understories are comprised of woody shrubs with low amounts of younger conifers.

Fire occurrence in the Pacific Silver Fir and Mountain Hemlock Zones is much more infrequent, and often more of a mosaic burn as opposed to stand replacement fire because of the cooler temperatures and more abundant moisture. Many stands are late-successional, containing a variety of species and well-developed vertical canopy structure. Overstory trees in late-successional stands are commonly 200-300 years old. Gaps have formed in the canopy, with small areas of conifer

Riparian Areas & Wetlands. These areas are adjacent to standing or flowing water, and contain elements of both aquatic and terrestrial ecosystems which mutually influence each other. Riparian habitat contains structural and compositional diversity of natural vegetation. Riparian areas typically receive high use by wildlife such as breeding habitat and wildlife movement corridors. Wetland complexes, though numerous in the analysis area, are rare on the District and even more so on the Forest. The Grand Meadows wetland complex contains colonies which include State sensitive intermediate bladderwort (Utricularia intermedia). Also associated with Grand Meadows is an isolated population of Alaska yellow-cedar (Chamaecyparis nootkatensis), the only individuals known to occur on the Mt. Adams District.

Talus. 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 moss and lichens, including Barrett's penstemon.

Cliffs. Cliffs provide habitat for peregrin falcons, although no falcons are known to occur within the analysis area. Such potential suitable falcon habitat exists on Steamboat Mountain, Bird Mountain, and Sleeping Beauty. The rocky slopes of Sleeping Beauty is also home to a small band of mountain goats.

Caves. An abundance of caves (predominantly lava tubes) are present within the analysis area. These provide unique habitat for cave-adapted organisms including bats and rare invertebrates. Many caves are important archaeological sites. Also, caves are a recreational attraction for spelunkers. There are a number of requirements associated with the management of caves originating from the Federal Cave Resources Protection Act of 1988.

Non- Native plants

Discussion has been primarily concerning plants that are native to the watershed; that is, plants that existed here prior to euro-american settlement. Non-native plants, also termed exotics, are threats to natural biodiversity. Such threats include undesirable species and/or species that have increased disproportionately to other desirable native and non-native species. In the analysis area, many exotics occur, but a list has not yet been tabulated. At this point, the only exotics that are managed are listed under noxious weeds. However, existence of any non-native species deviates from the historical point of reference, and should be tracked at some level.

Noxious Weeds

Noxious weeds and other invasive non-native plants are a threat to ecosystem health. These species are able to displace and out-compete native species, they reduce the quality and quantity of forage available for animals, and may cause runoff and soil erosion to increase (Lacey et al. 1989).

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

In the Trout Lake Creek watershed, noxious weeds are exchanged from east to west (and vice versa) of the Cascades. Noxious weeds have been surveyed on most roadways in the watershed. The condition of the watershed in terms of noxious weed infestations is average; there are weeds that by law, require immediate treatment and those that legally and economically need to be treated eventually (see Table 3.2). Particularly problematic areas are within the riparian zone of sensitive stream channel types (e.g., Rosgen Class C and E) and in wetlands. All weed occurrences are considered to be above the threshold level.

Forest Health (Insects & Diseases)

Forest health concerns within the analysis area include western white pine blister rust, laminated root disease, Armillaria root disease, and bark beetles.

White pine blister rust. Blister rust is an introduced disease affecting western white pine trees. Ribes species (currents and gooseberries) are alternate hosts. This disease has caused large-scale mortality of white pine over many years. White pine occurs as a minor species throughout the analysis area. 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 disease. This disease is found primarily on the southerly slopes of Sleeping Beauty and Haystack Butte, causing 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 disease. Armillaria is found mostly in the upper Trout Lake Creek drainage. Conifers affected by this disease depend on the particular strain or sub-species. One strain affects mostly Douglas-fir and true firs, while a different strain affects ponderosa pine and true firs. The disease normally becomes established on trees of low vigor, then spreads by root contacts. Armillaria found within the Trout Lake Creek drainage appears to be infecting Douglas-fir within plantations, resulting in small openings within the stands. 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 analysis area include the Douglas-fir beetle, fir engraver, western pine beetle, and mountain pine beetle. To minimize the effects of bark beetles, maintaining tree health and vigor by controlling stocking levels through thinning is the most effective method.

Late-Successional Forest. The Record of Decision specifies that 5th field watersheds should maintain at least 15% of the Federal Lands in late-successional forests. If the watershed is below the 15% minimum threshold, all remaining late-successional stands should be protected (ROD, page C-44). The Trout Lake Creek analysis area contains a total of 44,594 acres of which 6,128 are private. The total Federal Land base is therefore 38,388 acres. Within the analysis area, there are a total of 13,184 acres of large tree, multi-storied stands (late-successional forest), or 34.4% of the Federal land. Further, there is a total of 7,056 acres of late-successional forest within non-harvest allocations (such as Late-Successional Reserves, Administratively Withdrawn, Special Interest Areas, etc.), or a total of 18.4% of the Federal land area.

Probable Sale Quantity

Timber harvest levels have been calculated for the purpose of establishing the Probable Sale Quantity (PSQ) target for the Gifford Pinchot National Forest per the Record of Decision standards and guidelines. The Forest originally calculated a harvest level of 73 million board feet (MMBF) per year, then later reduced the projected harvest outputs to 63 MMBF following more detailed analysis. However, the current PSQ level assigned to the Forest by the Region remains at 73 MMBF (approximately 15% greater than the most recent Forest projections).

The expected PSQ outputs shown in Table 3.3 were provided by the Forest Headquarters for each sub-basin. For verification purposes, the age class distribution and harvest acres were calculated on an area control forest regulation basis for each sub-basin within the Trout Lake Creek watershed, and are included in the Analysis File. The projected Forest-level harvest acres and volumes are consistent with the area control regulation calculations done for this Watershed Analysis.

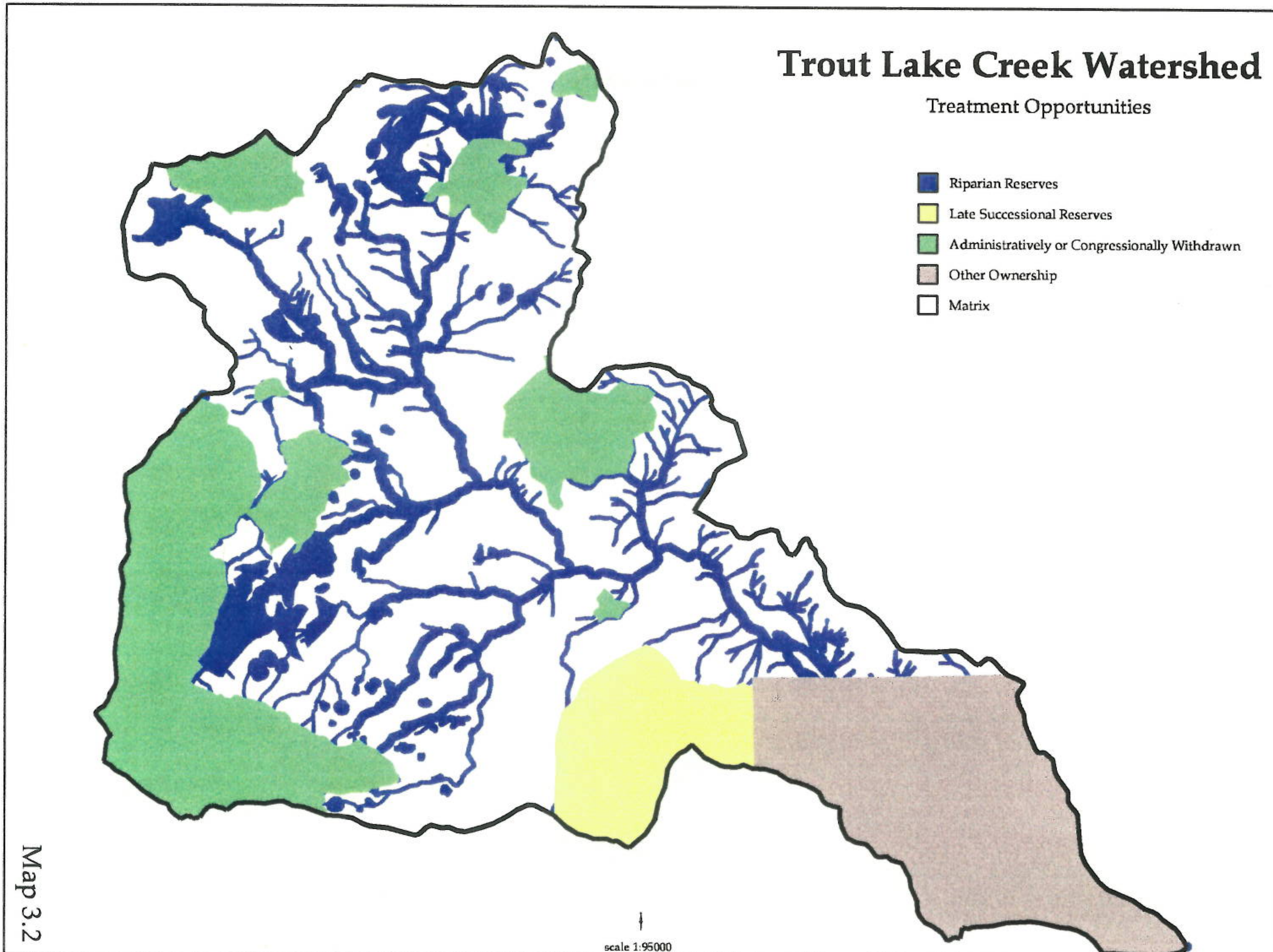
Coniferous trees are encroaching upon the Sawtooth Berry Fields, reducing huckleberry production. These fields once encompassed approximately 6,000 acres, but now have dwindled to about 1,500 to 2,000 acres as a result of natural succession. Based on examining the rate of succession, it has been estimated that these fields could be completely overgrown by conifers within 40 years in the absence of natural disturbance or land management activities.

Huckleberry Production Studies. Vegetation management studies have been conducted at various times since the mid-1930's to study the effects of various activities on berry production in the Sawtooth Berry Fields. The earliest study was conducted from 1934-1942 to determine the effects of sheep grazing. Observations indicated that grazing was a benefit to the huckleberries by reducing competing vegetation. During the late-1960's and into the 1970's, various vegetation management treatments were applied to determine the effects on huckleberries. Treatments included grazing, cut-and-burn, burn, and control. Burning was found to significantly reduce berry production for at least 5 years until the plants matured. More recently, a series of small-scale vegetation management treatments were applied in 1991-1992 (in cooperation with the Yakama Indian Nation) including mechanical treatment with a hydro-ax, conifer thinning, pruning and girdling. It appears that such treatments may help to maintain or possibly increase current levels of berry production, although extensive monitoring has not been done due to lack of funds and personnel. Larger scale vegetation management treatments were planned but not yet implemented, again due to insufficient funds. The Yakama Indian Nation is interested in continuing with cooperative efforts to reduce conifers, thereby maintaining or increasing the huckleberry resource.

Tribal Interests. The Sawtooth Berry Fields are situated on ceded lands, subject to the Treaty of 1855. Article 3 of the Treaty guarantees certain rights to tribal members on ceded lands including the gathering of berries. Conflicts arose over camping, grazing, and huckleberry gathering during the Great Depression. In response, an informal agreement known as the "Handshake Agreement" was made between then-Forest Supervisor J.R. Bruckart and Chief William Yallup. The agreement set aside portions of the Sawtooth Berry Fields east of Forest Road 24 for the exclusive use by members of the Yakama Indian Nation. The Handshake Agreement is still in effect today.

Data Gaps and Potential PSQ Limitations

- Incomplete small wetland information which will likely reduce the amount of suitable acres available for harvest.
- Incomplete inventory information on successional stages, primarily plantations which have advanced from early- to mid-successional. This may affect ARP's and other analyses that rely on size classes or successional stages.
- Incomplete inventory information on presence and distribution of TES plus Survey and Manage plants and animals. This could affect future project locations and mitigation.
- Limiting regeneration harvest in the rain-on-snow zone until existing young stands recover from a hydrologic standpoint.
- Additional no-harvest buffers for caves and great gray owl habitat.
- Additional canopy retention for prescriptions on harsh sites such as low elevation south slopes or high elevation Mountain Hemlock zone.


Trout Lake Creek Watershed
Treatment Opportunities
Riparian Reserves
Late Successional Reserves
Administratively or Congressionally Withdrawn
Other Ownership
Matrix
scale 1:95000
Map 3.2

Chapter 3.4
Human Uses (Present Day)

Trout Lake Creek Watershed Analysis

Chapter 3.4
Core Topic: HUMAN USES

INTRODUCTION

The Trout Creek Watershed has a long history of human use, most likely beginning several thousand years ago with the migration of Native Americans into the area (see Appendix A on Past Human Uses of Trout Lake Creek). The following descriptions are of relatively recent activities.

Since the early 1900's, recreational activities have been an integral part of the human use of the Watershed. The Watershed provides the setting and resources that people rely on in order to pursue the various activities they value. In some cases, facilities, such as campgrounds, are the focal point of these activities. In other cases, such as Special Forest Products gathering, the natural resource and/or the activity takes the forefront, and few, if any, facilities are used.

Visitors may engage in several activities during one outing, such as hiking and fishing during the day, while camping in a campground at night, or may simply spend a day engaged in one specific activity. 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. Some studies (e.g. Washington State Comprehensive Outdoor Recreation Plan) suggest that the demand for "semi-primitive" (i.e., relatively undeveloped) recreation settings will increase, while the supply will diminish with increased human use.

The following activities, and, where appropriate, attendant facilities, have been identified as important aspects of the human uses of the Watershed.

CAMPING

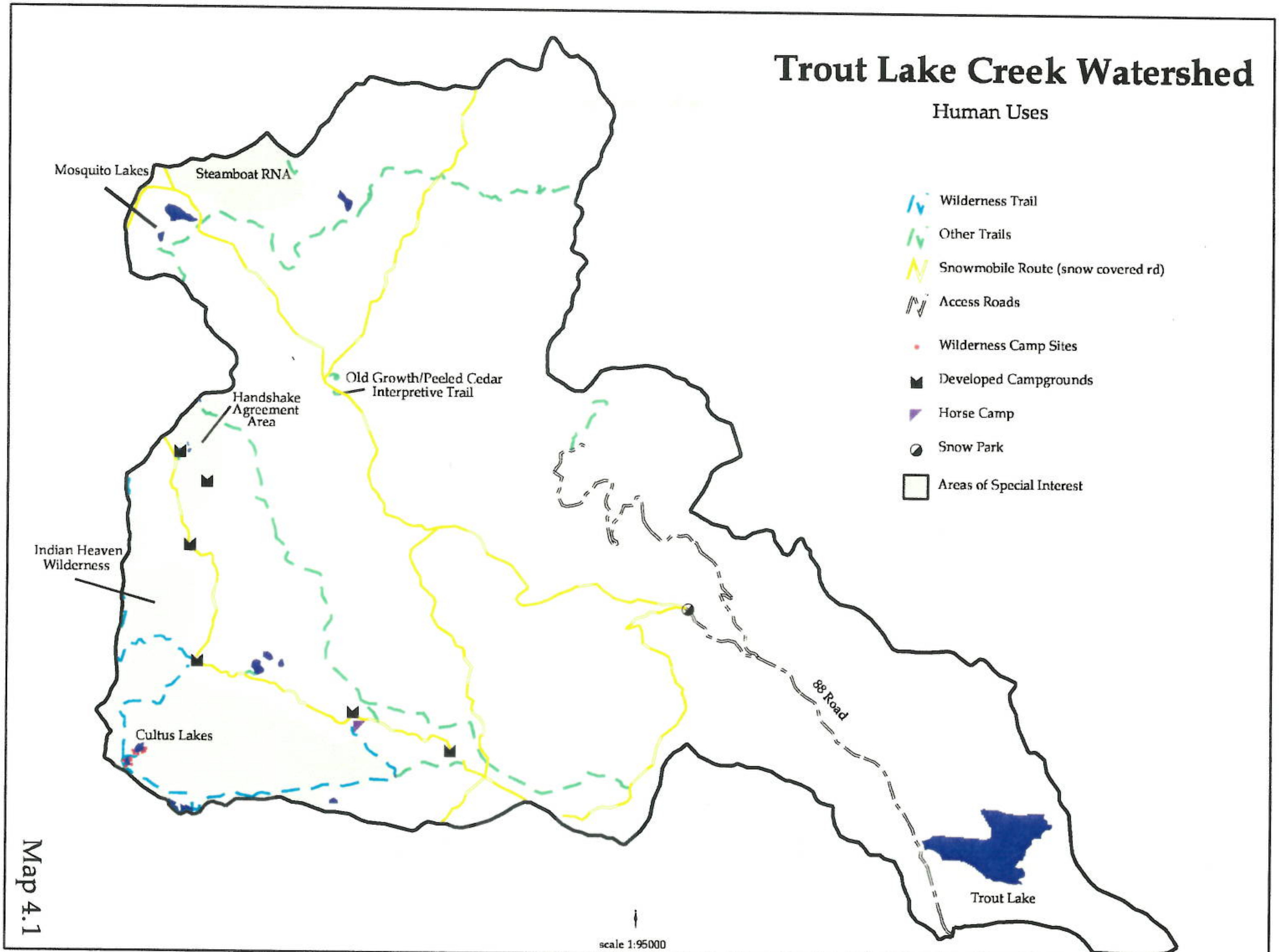
Developed Campgrounds
There are four developed campgrounds used by the general public:
- Little Goose
- Cultus Creek
- Smoky Creek
- Trout Lake Creek

All four campgrounds have a variety of users, ranging from tent campers to those who arrive in motor homes valued at several thousand dollars. The camping season generally runs from Memorial Day to the end of hunting season in mid-November, depending on weather conditions and accessibility. 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 huckleberry-picking is a major activity.

Indian Camps. In addition to the above-mentioned campgrounds, there are three additional sites traditionally used by Native Americans. They are:
- Meadow Indian Camp
- Cold Springs Indian Camp
- Surprise Lakes Indian Camp

Horse Camps. Little Goose Horse Camp is the only camping facility with provisions for horse use.

DISPERSED CAMPING



Trout Lake Creek Watershed
Human Uses
Wilderness Trail
Other Trails
Snowmobile Route (snow covered rd)
Access Roads
Wilderness Camp Sites
Developed Campgrounds
Horse Camp
Snow Park
Areas of Special Interest
Mosquito Lakes
Steamboat RNA
Old Growth/Peeled Cedar Interpretive Trail
Handshake Agreement Area
Indian Heaven Wilderness
Cultus Lakes
88 Road
Trout Lake
scale 1:95000

Map 4.1

WILDERNESS USE

The northeast portion of the 20,690-acre Indian Heaven Wilderness (IHW) is within the Watershed. This Wilderness was added to the National Wilderness Preservation System through the 1984 Washington Wilderness Act. A mandatory non-limiting Wilderness permit system has been in effect since 1992. Information obtained through the permit system for the last four years has provided us with the best use estimates to date (1992-1995).

Average Number Users/Year	Average Number RVD's*/Year
8,000	18,110

*(RVD = Recreation Visitor Day/ one person for 12 hours)

Visitor demographics derived from the Wilderness permit system suggest that most users come from the local and Portland/Vancouver metropolitan areas. Recreation use of Indian Heaven Wilderness (IHW) is varied. The ratio of day-use to overnight use is approximately 40%-60%. Activities include hiking and horse riding, backpacking and camping, and a significant, though unquantified, amount of fishing and hunting. The portion of IHW within the analysis area contains two lakes which are popular recreation destinations. Camping and day use occur at these destinations, primarily on shorelines and in riparian areas. Destinations & corresponding numbers of inventoried/monitored campsites are as follows:

Destination	Number of Sites	Sites w/in 100ft. of Lakeshore
Deep Lake	19	12
Cultus Lake	5	1

These lakes are periodically stocked by the Washington Department of Fish and Wildlife and this likely adds to their attraction as recreation destinations.

Impacts to Lakeshores

Impacts to lakeshores associated with angling and camping include trampling and loss of vegetation, soil compaction and erosion, damage to tree roots and trunks, and exposed human waste. Although human use may contribute to degradation of water quality, displacement of wildlife and alteration of habitat (especially amphibians), and potential visitor dissatisfaction and displacement to less impacted areas, no data is currently available.

Some inventoried campsites at Deep and Cultus Lake exceed current Forest Plan standards for at least one indicator, and 13 of 24 sites are located within 100 feet of lakeshores. A Forest-wide revision of Wilderness Management direction is currently in process. This revision would likely identify some campsites for closure and restoration.

TRAIL USE

Facilities

Trails are considered recreation "facilities," and as such are designed and maintained to certain specifications for various types of use. Below is a list of trails open for various uses within the Watershed. Some trails need drainage and tread improvements to meet standards and to prevent erosion. These trails are identified in the "Recommendations" section of this document.

CAVES

There are numerous lava "sinks" and caves within the Watershed. Until recently, there was very little guidance/policy available for implementing the National Caves Resources Act. "Cave management" consisted primarily of not providing information to recreationists regarding caves. In spite of this stance, many caves in the Watershed are visited frequently by individuals and members of various caving organizations. Recently, national policy has been developed and new management actions are being considered and implemented. A Cave Management Plan has been initiated on the Forest, but an inventory of caves within this watershed has not been completed. These caves are recognized not only for their recreational value, but also as valuable geological and biological resources.

SPECIAL USES

Special Use Authorizations within the Watershed include:

- Smoky Creek CCC Camp (Mountain View Recreation Club Organization Camp)
- Linear Rights-of-Way (Flattop Mountain Radio Transmitter)

Other occasional special uses occurring within the watershed include small rock collection, apiary placement, recreation special events, and commercial photography. The rock pit and storage area at Forest Roads 88 and 8821 are used for Forest road-building and maintenance.

Chapter 3.5
Water Quality Assessment

Trout Lake CreekWatershed Analysis

Table of Contents

Chapter 3.5

Core Topic: WATER QUALITY

Waters Within Trout Lake Creek Watershed

Streams within the Gifford Pinchot National Forest (National Forest) are classified 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 winter months, and others may flow for most of the year, but run dry for a short period of time in the late summer. Table 5.1 lists the miles of stream in the watershed, and the acres of lakes, ponds, wetlands and meadows. The distribution of these aquatic resources is illustrated on Map 5.1.

Table 5.1. Summary of aquatic resources in Trout Lake Creek watershed.

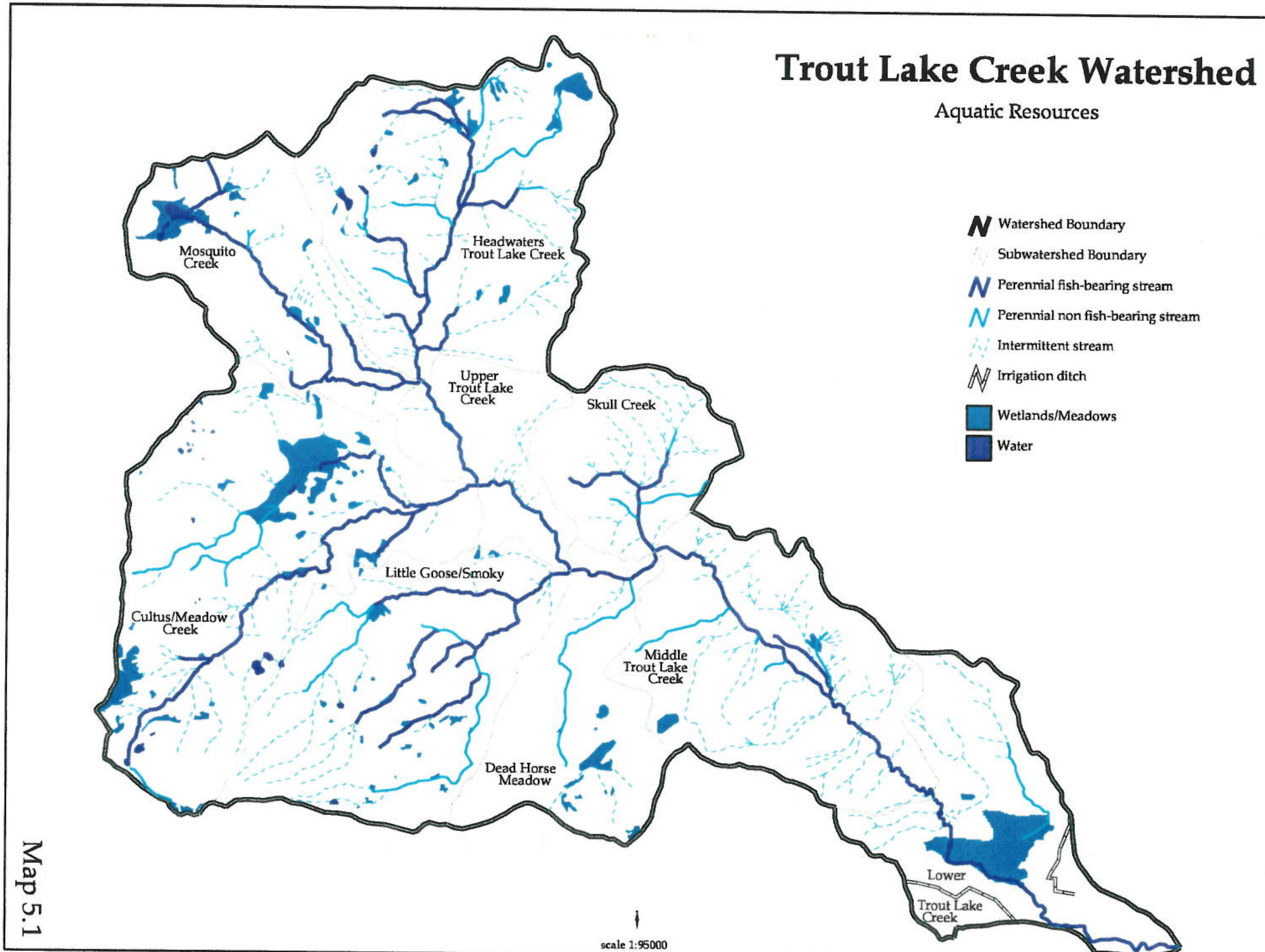
Aquatic Resources	Miles/Acres
Perennial Fish-Bearing Streams	54 miles
Perennial Non Fish-Bearing Streams	25 miles
Intermittent Streams	114 miles
Lakes/Ponds	106 acres
Wetlands/ Meadows	1658 acres

Beneficial Uses and Key Water Quality Parameters

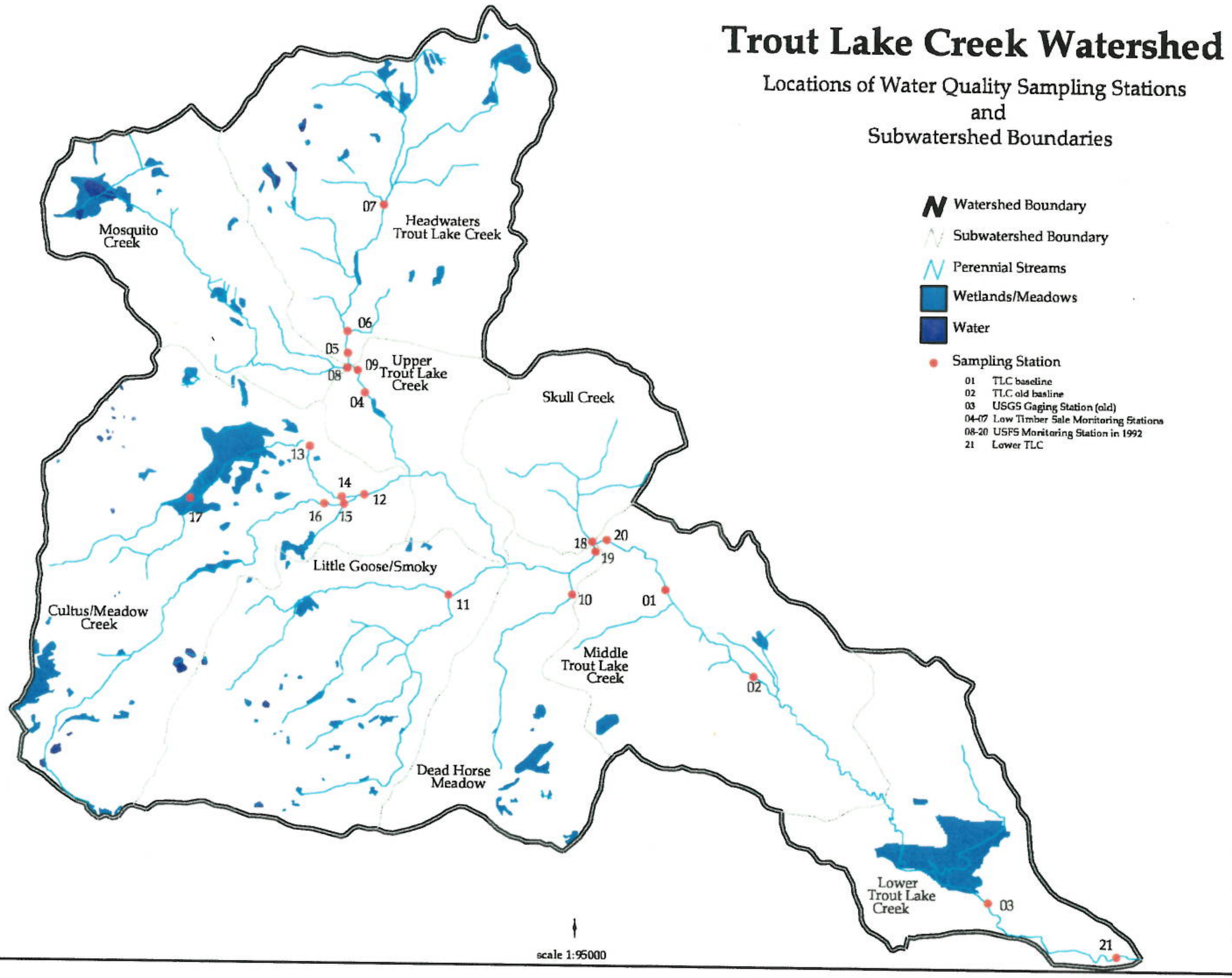
National Forest lands encompass eight of the nine subwatersheds comprising Trout Lake Creek (TLC) watershed, and are the primary focus of this analysis. State and private lands in the lower-most subwatershed of the TLC are also included. Streams and lakes within the watershed are rated by the Washington State Department of Ecology (WSDOE) as either Class AA (extraordinary), Class A (excellent), or Lake Class. 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. TLC watershed has a number of important beneficial uses that drive the need for water quality protection. Table 5.2 identifies the beneficial uses that occur in the watershed, the subwatersheds they are located in, and the primary water quality parameters of concern. The table is not inclusive of all water quality parameters that may affect the identified beneficial use, but identifies the key or dominant parameters of concern. Subwatersheds and the distribution of aquatic resources are shown on Map 5.1.

Table 5.2. Summary of beneficial uses in TLC watershed and their associated primary water quality parameters of concern.

Beneficial Use	Subwatershed	Primary Parameters of Concern
Domestic Water Supply	11 S,P,X,R	Turbidity, Fecal Coliform
Resident Fisheries	All	Temperature, Turbidity
Aquatic Life	All	Temperature, Turbidity
High Use Recreation	11 A,S,P,X,R	Fecal Coliform, Turbidity


Trout Lake Creek Watershed
Aquatic Resources
Watershed Boundary
Subwatershed Boundary
Perennial fish-bearing stream
Perennial non fish-bearing stream
Intermittent stream
Irrigation ditch
Wetlands/Meadows
Water
Mosquito Creek
Headwaters Trout Lake Creek
Upper Trout Lake Creek
Skull Creek
Little Goose/Smoky
Cultus/Meadow Creek
Middle Trout Lake Creek
Dead Horse Meadow
Lower Trout Lake Creek
scale 1:95000

Map 5.1



Trout Lake Creek Watershed
Locations of Water Quality Sampling Stations
and
Subwatershed Boundaries
Watershed Boundary
Subwatershed Boundary
Perennial Streams
Wetlands/Meadows
Water
Sampling Station
01 TLC baseline
02 TLC old basline
03 USGS Gaging Station (old)
04-07 Low Timber Sale Monitoring Stations
08-20 USFS Monitoring Station in 1992
21 Lower TLC
Mosquito Creek
Headwaters Trout Lake Creek
Upper Trout Lake Creek
Skull Creek
Little Goose/Smoky
Cultus/Meadow Creek
Middle Trout Lake Creek
Dead Horse Meadow
Lower Trout Lake Creek
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
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18
19
20
21
scale 1:95000

Map 5.2

Table 5.3. Summary of data sources and level of confidence it was given.

Parameter of Concern	**Source of Data**	***Confidence Level**
Water Temperature	USFS, Summary of WQ monitoring baseline and inventory stations, Gifford Pinchot NF, 1976-84.	moderate
	Underwood Conservation District (UCD), White Salmon River watershed basin WQ investigation report, draft, March 1994	high
	USFS, Trout Lake Creek baseline monitoring station # 03110502, hard copy files, 1976-82.	moderate
	USFS, Trout Lake Creek baseline monitoring station # 03110503, hard copy files, 1983-94	moderate
	UCD, water temperature data, 1995.	high
	USFS, water temperature monitoring data for Meadow Creek, hard copy files, 1994.	moderate
	USFS, water temperature monitoring data for Mosquito Creek, hard copy files, 1992.	moderate
	USFS, water temperature monitoring data for Skull Creek, hard copy files, 1992.	moderate
	USFS, water temperature monitoring data various sites on mainstem TLC, hard copy files, 1991-94.	moderate
	USFS, Low timber sale water temperature monitoring, hard copy files, 1980-81.	moderate
	USFS, WQ monitoring results, White Salmon River basin assessment and enhancement project, 1993.	moderate
Turbidity and Fecal Coliform	USFS, discharge notes, TLC station # 03110502, hard copy files, 1976-82.	moderate
	USFS, discharge notes, TLC station # 03110503, hard copy files, 1983-87.	moderate
	Underwood Conservation District, White Salmon River watershed basin WQ investigation report, draft, March 1994	high
Current Vegetation and Road Crossings	USFS, Geographical Information System, 1996.	moderate/high

*high = data supported by fully documented quality assurance and quality control procedures.
*moderate = data supported be partially documented quality assurance and quality control measures.

Creeks (11 S). Little Goose/Smoky Creeks (11 P) stands out as having relatively low maximum water temperature, at 4° to 9° C cooler than all other subwatersheds in the watershed. This is thought to be a result of the spring-fed nature of Little Goose Creek. Maximum water temperatures recorded for the White Salmon River above and below TLC showed an increase of 4° C in this reach suggesting that warm water from TLC is causing, or contributing to warmer temperatures in the White Salmon River.

Possibly of greater consequence than maximum water temperature from a beneficial use standpoint, is the duration and frequency with which high temperatures occur. The longer the duration, and the greater the frequency of high temperatures, the greater the likelihood of incurring adverse impacts to fish and other aquatic organisms. Table 5.5 represents data collected by Underwood Conservation District (UCD) from May 5 to October 5, 1995, and shows the number of days that water temperatures exceeded 16° C at four sites in TLC, and at sites on the White Salmon River above and below TLC.

Table 5.5 Number of days water temperatures exceeded 16° C from UCD data, 1995.

Subwater shed	Location	Temperature C		
		Maximum	Minimum	Days>16 C
11 Sa	Meadow Creek, below	16.5	5.6	1
11 Sb	Meadow Creek, above	9.1	2.7	0
11 X	Middle TLC	17.8	3	13
11 R	Lower TLC	23	5.3	57
WS1	White Salmon R. above TLC	12.6	4.6	0
WS2	White Salmon R. below TLC	17.2	6.2	3

Lower TLC (11 R) exceeded 16° C on 57 days, while upstream, Middle TLC (11 X) and Cultus/Meadow Creeks (11 S) recorded 13 days and one day, respectively. This indicates that although maximum temperatures are relatively high throughout most of the watershed the impact to beneficial uses such as resident fish and other aquatic organisms may be much greater in the lower watershed. The White Salmon River below TLC (WS2) exceeded 16° C on three days, compared to 57 days for TLC, while the White Salmon River above TLC (WS1) did not exceed 16° C. This data substantiates the warming of the White Salmon River in the reach including TLC, yet maximum temperatures recorded in this reach of the White Salmon River are still within the state Class A standard of 18° C. Meadow Creek stream temperatures increased by 7.4° C from above (11 Sa) to below (11Sb) a large open wetland/meadow complex. This data suggests that water temperatures may be somewhat high in the watershed even under undisturbed conditions due to the heating that occurs in wetland/meadow systems in the watershed.

Factors Affecting Water Temperatures

Differences observed between streams in terms of both maximum water temperature and in the number of days that temperatures exceed state standards may be caused by a number of factors. Ambient air temperature and stream discharge are two factors that can vary substantially from year to year, and are important factors affecting water temperature. Figure 5.1 shows the yearly maximum temperature recorded at TLC baseline station for 13 years during the period from 1977 to 1995, and reflects the year to year variation in maximum temperatures that is largely attributable to differences in air temperature and discharge.

Table 5.6. Percentage of open riparian condition for each subwatershed in TLC.

Subwatershed	Name	Early Seral	Wetland/ Meadow	Agricult./ Resident.	Total
11 B	Headwaters TLC	15	11	0	26
11 A	Mosquito	6	19	0	25
11 S	Cultus/Meadow	6	25	0	31
11 N	Upper TLC	5	2	0	7
11 L	Skull	18	0	0	18
11 P	Little Goose/Smoky	10	7	0	17
11 Q	Dead Horse Mdw	9	18	0	27
11 X	Middle TLC	11	3	0	14
11 R	Lower TLC	8	19	31	59

Lower TLC (11 R) has 59 percent of its riparian in open condition, far greater than any other subwatershed in TLC. Cultus/Meadow Creeks (11 S) was next highest with 31 percent in open riparian condition. Headwaters TLC (11 B), Mosquito Creek (11 A) and Dead Horse Meadow (11 Q) also have 25% or more of their riparian vegetation in early seral condition. Although Upper TLC (11 N) has only 7 percent open riparian condition, it has a maximum stream temperature equal to the second highest maximum recorded in the entire watershed (20° C) suggesting that other factors may be affecting temperatures in this subwatershed.

Another factor affecting the capability of solar radiation to increase stream temperatures is a stream's width to depth ratio. In general, as a stream becomes broader and shallower (increasing width-to-depth ratio) a greater proportion of the volume of the stream becomes exposed to solar radiation at the water's surface, thus becoming more readily heated. Width to depth ratios are relatively high (>20) along most of the mainstem of TLC, a condition likely to contribute to increasing stream temperatures, particularly where the riparian canopy is open. Aerial photo interpretation identified the lower portion of Middle TLC (11 X) and the adjacent upper portion of Lower TLC (11 R) as reaches where substantial channel widening has occurred over the past two to three decades (see Stream Channel section of this report). These areas generally coincide with some of the reaches previously identified as having the greatest temperature increases.

Interpretation

Maximum temperatures have been within the upper end of the range of natural conditions described by REAP (7 to 20 C) for all subwatersheds, except Lower TLC (11 R) which exceeded this range (maximum 23 C). In part, the occurrence of relatively high water temperatures appears to be a response to open riparian conditions, a situation which is largely due to the presence of numerous large wetland/meadow complexes, along with past riparian timber harvest and conversion of land to agriculture or residential uses. The cooler temperature noted for Little Goose/Smoky Creeks is thought to be maintained by the spring-fed nature of these drainages, and their relatively intact riparian condition.

Five subwatersheds were found to have open riparian conditions near or above 30 percent. These included: Headwaters TLC (11 B), Mosquito Creek (11 A), Cultus/Meadow Creeks (11 S), Dead Horse Meadow (11 Q) and Lower TLC (11 R). Of these, Lower TLC (11 R) had roughly twice as much open riparian as the other four subwatersheds (59 percent). For the most part this difference is due to agricultural and residential development (31 percent) in Trout Lake Valley. Open riparian consisting of early seral vegetation resulting from logging, and open wetland/meadow areas associated with Trout Lake, comprised the remaining 27 percent. Not surprisingly, this subwatershed showed the highest maximum temperature and the greatest duration and frequency of temperatures exceeding 16 C. The highest maximum temperature of 23 C, and the percentage of open riparian (59 percent), both exceeded the RNC.

respectively). Variability in the duration and frequency of high water temperatures was shown to occur on a yearly basis, and was strongly influenced by yearly differences in streamflows and ambient temperatures.

Water temperatures in the White Salmon River have been shown to increase by as much as 4.6 C in the reach that includes the confluence of TLC. This increase is undoubtedly influenced by the influx of warm water from TLC, but may also be affected by other water sources outside TLC watershed. These sources may include irrigation ditches, other tributaries, and open riparian conditions along the White Salmon River.

Table 5.7. Maximum, minimum and average turbidity for TLC, White Salmon River above and below TLC, and Trout Lake Water Company irrigation ditch (TLWC). Data from Forest Service and Underwood Conservation District.

Subwatershed	Years Monitored	Avg. (ntu)	Max. (ntu)	Min. (ntu)
11 B	1986-1987	0.6	1.0	0.4
11 X	1976-1994	1.3	9.1	0.2
11 R	1976-1994	2.4	13.5	0.8
WS aboveTLC	1994	18.3	120.0	1.6
WS belowTLC	1994	34.2	200.0	1.4

Data in Table 5.7 indicates turbidities in TLC watershed are generally low during summer months. The maximum turbidities observed in the White Salmon River above TLC appears to be associated with natural processes of glacial melt and run-off from Mt. Adams. The data above suggests that the largest sources of turbidity were not from TLC, but could include irrigation ditches, roads and small tributaries draining areas of high agricultural use, and residential development in the valley. The data is insufficient to establish any trends in sediment production for most of the watershed on the National Forest.

Long-time local residents have frequently remarked that Trout Lake has noticeably filled with sediment over the past 20 to 50 years. An assessment of aerial photographs taken of the lake from 1969, 1979 and 1989, indicated that the lake was closely approaching its current condition as early as 1969. A photo of the lake taken in 1882 shows a much different situation with most of the lake consisting of open water with a relatively narrow margin of emergent herbaceous vegetation. Currently only as much as a quarter or less of the lake bed consists of open water, and emergent vegetation and hardwood trees occupy much of the area. The degree to which sedimentation of the lake is the result of natural and human causes is unknown, however it is reasonable to assume that intensified timber harvesting, roading, and agricultural and residential development in the watershed has increased sediment production above natural levels. The lake itself may actually function to filter sediment from reaching the lower portion of TLC and the White Salmon River. For example, a turbidity measurement taken by UCD in Lower TLC (below the lake) during a large flood event in February 1996 was measured at 66 NTU, whereas Rattlesnake Creek a tributary of the White Salmon River near Husum, WA, measured at over 600 NTU during the same event (UCD, pers. com.).

Factors Affecting Turbidity

Road stream crossings, and destabilization of streambanks caused by activities such as timber harvesting, and agricultural and residential development in riparian areas, are factors that can increase turbidity. The density of road stream crossings within a subwatershed can provide a useful index to assess sediment production. Figure 5.4 shows gives the road stream crossing density for subwatersheds in TLC.

Chapter 3.5.3

Fecal Coliform

Historic Conditions

Historic fecal coliform levels were linked to areas of concentrated use by warm-blooded animals including humans. Populations of warm-blooded wildlife species fluctuated greatly over time, in response to changes in habitat conditions. Fecal coliform levels corresponded to the density and abundance of warm-blooded wildlife. Human use of the watershed was undoubtedly concentrated near waterbodies, and occupancy was probably seasonal with most of the use occurring during the summer. Effects on the watershed were likely very localized, and largely diluted due to the seasonal use of the watershed and the relatively small population in comparison to the size of the watershed. In all, historic fecal coliform levels varied considerably, but were probably not anywhere close to the high maximum levels observed in some subwatersheds currently.

Current Conditions

Data on fecal coliform levels in TLC watershed has been collected from only a few sites on an infrequent and irregular basis. Table 5.10 summarizes data collected by the Forest and by UCD from 1976 to 1995. The state fecal coliform standard for TLC (class AA) requires that levels shall both not exceed a geometric mean of 50 colonies per 100ml, and not have more than 10 percent of all samples used to calculate the geometric mean in exceedance 100 colonies per 100 ml.

Table 5.9 Summary of fecal coliform data for TLC from 1976 to 1994 in mpn per 100 ml. Data from Forest Service and UCD.

Subwatershed	Location	Average	Minimum	Maximum
11 R	Lower TLC	305	18	1700
11 X	Middle TLC	23	5	45
WS1	WS above TLC	24	18	45
WS2	WS below TLC	1435	18	5400
TLWC	WC ditch	3131	18	16000

The data indicates that fecal coliform levels on the Forest are within state standards (11X), whereas levels in Lower TLC (11 R) at times far exceed the standard. Furthermore, TLC and other drainage systems in Trout Lake Valley, such as the Trout Lake Water Company irrigation ditch (TLWC), are substantial contributors of fecal coliform to the White Salmon River. Maximum fecal coliform levels in Lower TLC (11 R) and White Salmon below TLC are 34 and 54 times the standard for class AA and A. Dairies, other animal keeping operations, and residential development are likely contributors to these high levels, although there have been no studies done to identify specific sources. Potable water systems used at Little Goose Creek and Cultus Creek Campgrounds on the National Forest are regularly tested throughout the summer camping season and have shown no exceedances of standards.

Summary of Findings

Both water temperature and fecal coliform levels have been shown to exceed state standards in TLC watershed. Table 5.10 identifies those subwatersheds in which primary water quality parameters are known to have exceeded state standards. Maximum temperatures have exceeded the standard in all but one subwatershed of the watershed. The potential impact of high temperatures to resident fish and other aquatic life is likely to be much greater in the lower watershed, including Lower and Middle TLC, where the duration and frequency of high temperatures are many times greater than in the rest of the watershed. Loss of riparian shade as a result of conversion of land to

Chapter 3.6
Fish Habitat Conditions and Distribution

Trout Lake Creek Watershed Analysis

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Chapter 3.6
Core Topic: SPECIES AND HABITAT
FISH HABITAT CONDITIONS AND DISTRIBUTION

Historic Conditions

Anadromous Fish

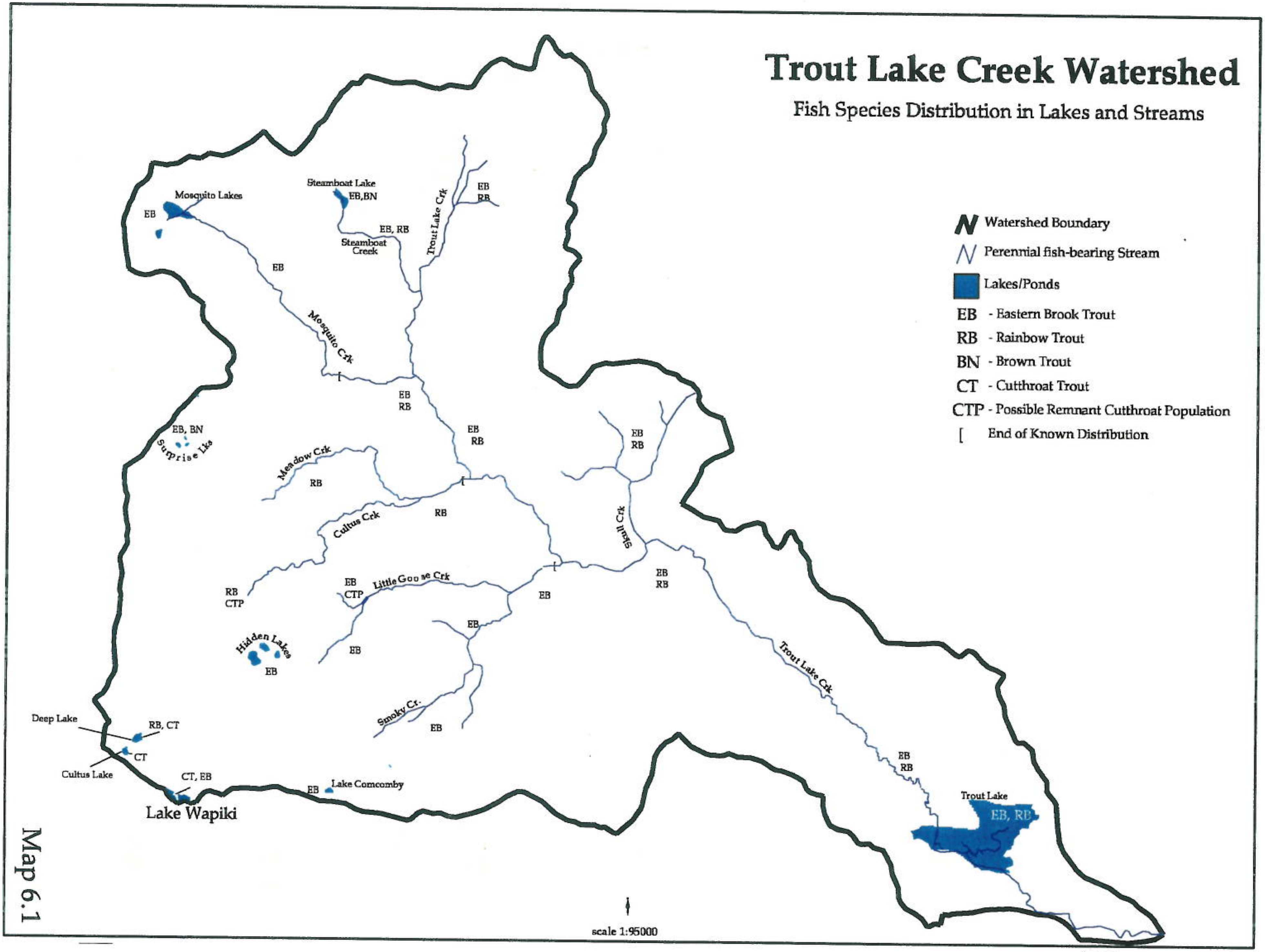
Condit Hydrologic Project is located on the White Salmon River 3.3 miles upstream from the confluence with the Columbia River. A concrete dam is present at this site and was completed in 1911. In 1913 a fish ladder was included in the Condit project and was washed out that same year. This dam has blocked upstream migration of salmonids since 1913. Prior to construction of Condit dam, anadromous fish could migrate at least to Husum Falls on the White Salmon river (river mile 7.6). Steelhead easily migrated to river mile 16.2 where three sets of falls exist. The upper drainage above this falls had no anadromous fish according to studies of the area (Trout Lake Creek confluence is at river mile 25.8). However, affidavits from local residents said steelhead where found as far up as Trout Lake Creek before the dam was built. It therefore is uncertain if steelhead ever inhabited the White Salmon River above river mile 16.2 or Trout Lake Creek. PacifiCorp Electric Operations is presently applying to the Federal Energy Regulation Commission (FERC) for a new license to operate the Condit Hydroelectric project. PacifiCorp is currently considering options to reintroduce anadromous fish into the White Salmon River above the dam. If this occurs, it remains uncertain if anadromous fish will reach Trout Lake Creek in the future.

Resident Fish

Documentation of historic resident native species inhabitancy in Trout Lake Creek is also lacking. Washington State Fish and Game records (1920's) show Trout Lake Creek's natural fish population to be rainbow (*Oncorhynchus mykiss*) and cutthroat trout (*Salmo clarki*). It is unknown whether these were true "natural" populations, or if this meant they were successfully reproducing at that time. No records exist which show presently listed proposed, endangered, threatened and sensitive fish species were ever in the drainage. It is also uncertain if any of the lakes in the watershed contained fish prior to stocking.

Fish Habitat

Specific data on historic stream channel conditions in the basin does not exist. Due to this data gap comparisons are made to the Range of Natural Conditions (RNC) determined for the Hood-Wind Subbasin in the Regional Ecosystem Assessment Report (REAP) (USDA, 1993). This report characterizes various ecosystem components in pre-settlement times. The RNC's for the Hood-Wind subbasin are 40-60 pools per mile and stream temperatures ranging from 7-20 C (Table 1). Comparisons were also made to the Columbia River Anadromous Fish Policy Implementation Guide (PIG) Desired Future Conditions (DFC's) (USDA,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. Due to the variability of stream systems, a range of DFC values should be determined for each particular watershed area. This has not been done in the Trout Lake Creek drainage, so the general PIG DFC criteria for good fish habitat was used in this analysis. The criteria are: 80 pieces of large woody debris (LWD) per mile, width to depth ratios less than 10, and stream temperatures less than 16 C (Table 6.1). The number of pools per mile is based on stream width and therefore varies by stream.


Trout Lake Creek Watershed
Fish Species Distribution in Lakes and Streams
Watershed Boundary
Perennial fish-bearing Stream
Lakes/Ponds
EB - Eastern Brook Trout
RB - Rainbow Trout
BN - Brown Trout
CT - Cutthroat Trout
CTP - Possible Remnant Cutthroat Population
[End of Known Distribution
Mosquito Lakes
EB
Steamboat Lake
EB,BN
EB, RB
Steamboat Creek
Trout Lake Crk
EB
RB
Mosquito Crk
EB, BN
Surprise Lks
Meadow Crk
RB
Cultus Crk
RB CTP
EB CTP
Little Goose Crk
Hidden Lakes
Smoky Cr.
Skull Crk
Trout Lake Crk
Trout Lake
EB, RB
Deep Lake
RB, CT
CT
Cultus Lake
CT, EB
Lake Wapiki
Lake Comcomby
scale 1:95000

Map 6.1

Table 6.2. Fishbearing Streams in the Trout Lake Creek Watershed.

Stream	Class	Fish Species Present	Presently Stocked	Date First Stocked	First Species Stocked *	Natural Population *
Trout Lake	II	RB, EB	Y (1993)	1936 1936 1938	RB CT, EB KO	CT, RB
Skull	II	RB, EB	N	no data	no data	no data
Little Goose	II	EB, CT?	N	1936	no data	no data
Smoky	II	EB	N	no data	no data	no data
Cultus	II	RB, CT?	Y (from lake)	1936 1940	CT, RB MBS	no data
Meadow	II	RB	N	1936 1940	CT RB	no data
Mosquito	II	RB, EB (below falls) EB (above falls)	Y (from lake)	no data	no data	no data
Steamboat	II	RB,EB	N	no data	no data	no data

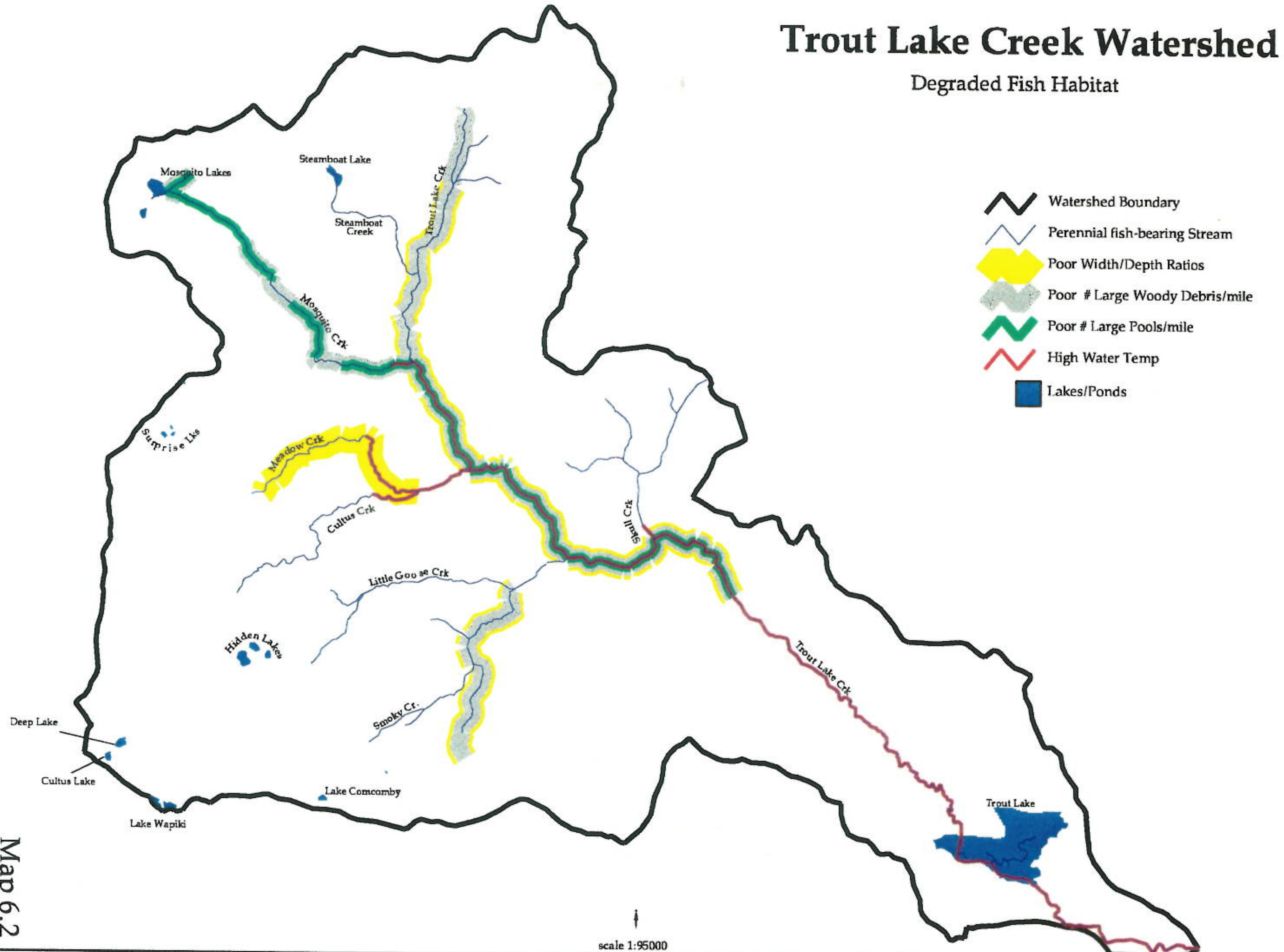
CT=Cutthroat trout, RB=Rainbow, EB= Eastern Brook, MBS= Montana black spotted (Cutthroat)
KO=Kokanee, CT?=unsure if population still exists
* From Washington State Historical Fish and Game Records (it is uncertain if "natural" means the indigenous species, or if successful reproduction of this species is occurring).

Fish Habitat in Streams

Seven of the ten major fishbearing streams in the watershed have been surveyed for fish habitat conditions. North Fork Trout Lake Creek, Steamboat Lake Creek, and Grand Meadows Creek have not been surveyed. Results of these surveys as compared to the REAP RNC's and PIG DFC's are displayed in Table 6.3 and Map 6.2. These are weighted by reach length for the entire stream. Spawning habitat appears to be adequate in all fishbearing streams.

Trout Lake Creek Watershed

Degraded Fish Habitat



Map 6.2

The poor stream habitat areas of concern include:

Concern Condition	Stream Name	Location (stream mile)
- Lack of Large Pool Habitat	Cultus	3.9-5.5
	Mosquito	0-0.8, 1.0-2.0, 2.4-4.7
	Trout Lake Creek	9.9-16.1
- High stream Width to Depth Ratios	Trout Lake Creek	9.9-19.2
	Smoky	0-3.0
	Meadow	0-1.9
- Low # pieces of Large Woody Debris per Mile (>24" dbh, >50'long)	Trout Lake Creek	9.9-21.0
	Smoky	0-3.0
	Mosquito	0-3.0, 3.6-4.7
- High Water Temperature*	Trout Lake Creek	8.5-16.1**
	Mosquito	0.5
	Cultus	0.2, 1.3
	Skull	0.2
	Meadow	1.0

* Max/Min. thermometer sites.

** Forest Service land locations; temperatures are most likely as warm or warmer below FS boundary.

Resident Fish in Lakes

Table 6.4 displays the sixteen fishbearing lakes in the watershed, the size of each lake, whether it is located within Indian Heaven Wilderness, fish species present, current stocking practices, earliest recorded date and species of first stocking, fishing pressure, tributary drainage, and occurrence of natural reproduction. Lake location and fish species is displayed in Map 6.1. All of the lakes have been stocked since the 1920 and 1930's. Species stocked include: rainbow, brook, cutthroat, and brown trout (*Salmo trutta*).

Fish Habitat in Lakes

Ten of the sixteen fishbearing lakes in the watershed were surveyed for water quality, fish habitat, fish populations, and food availability during the summers of 1991-1995. The surveyed lakes include: Comcomly, Cultus, Deep, Hidden #1, #2, and #3, Mosquito, Little Mosquito, Steamboat, and Wapiki. Cultus and Wapiki lakes are located in the Indian Heaven Wilderness area. All of these lakes contain adequate water quality, productivity, nutrients, and rearing habitat, with the exception of pH in Deep and Cultus lakes (Table 6.5). These readings however are suspected to be false due to incorrect meter calibration. Conductivity values were low in all lakes except Mosquito, Little Mosquito, and Steamboat indicating low productivity due to low amounts of total dissolved solids. All temperatures were in the 12 hour tolerance levels for trout (25 C). Spawning habitat is not adequate for successful fish reproduction in most of the lakes surveyed, therefore they would not contain fish unless they were continually stocked. The lakes with successful spawning occurring include: Mosquito, Steamboat, and Trout Lake. All lakes with the exception of Trout Lake reside at high elevations (> 3800 ft.) with short growing seasons. Movement of stocked fish out of lakes into tributaries has not been determined. Lakes in the watershed which have not been surveyed include the five fishbearing Surprise Lakes, and Trout Lake, which is not on Forest Service land.

Table 6.5. Lake survey data for lakes in the Trout Lake Creek Watershed (1991-1995).

Lake Name	Elev.	Water Temp. C surf./bottom	Max. Depth (ft)	Ave. Depth (ft)	pH	Diss. Oxygen surf./bott.	Conductivity m/mhos/cm	Alkalinity	Riparian Area Degraded
Comcomly	4260	14.8/14.8	7.6	3.2	6.3	8.0/8.3	4.6	51.07	No
Cultus	5320	15.7/15.7	8.3	no data	5.1*	7.1	5.9	no data	No
Deep	5087	16.8/16	23.2	no data	5.2*	7.5	4.2	no data	No
Hidden #1	4080	18.5/17	4.9	2.2	6.4	7.5/7.6	5.1	62.37	No
Hidden #2	4080	18/19	6.1	3.3	6.4	7.8/9.2	5.3	62.37	No
Hidden #3	4080	16.8/16	7.5	4.5	6.6	14/12.5	6.8	72.76	No
Mosquito	3890	11.0/10	8.90	no data	7.2	9.2	27.1	no data	Yes
Little Mosquito	3890	14/14	7.9	no data	7.5	8.5	31.8	no data	No
Steamboat	3960	18/16	10.3	no data	8.3	8.2	28.5	no data	Yes
Wapiki	5560	14.5/7.5	26.2	no data	6.8	7.8/7.8	5.4	no data	Yes

*readings are suspected to be false due to incorrect meter calibration

Some degradation of the riparian area from human use is occurring at most of these lakes due to camping and day usage along the lake shorelines. Five lakes have degradation occurring which is severely impacting the riparian area and may be degrading the water quality of the lake. These lakes include Mosquito, Steamboat, Wapiki, and Surprise Lakes 1 and 2. Continual camping by the Yakima Indian Nation occurs throughout the summer along the shorelines of the Surprise Lakes. The road to Little Mosquito Lake is excessively rutted and eroded, contributing sediment to the lake. Mosquito Lake is heavily utilized and has no toilet facilities. A need exists for these facilities for protection of aesthetics and water quality. The Mosquito Lake dam which enables the marsh to be a lake is in need of repair, and was determined unsafe in 1992 by forest engineers. A crack exists in the concrete dam, and water is also being routed around the edge of the dam.

Data sources

- Lake survey reports, Mt. Adams Ranger District, 1991, 1992, and 1995.
- Stream survey reports, Mt. Adams Ranger District.
- Columbia River Anadromous Fish Policy Implementation Guide, R-6 Columbia River Basin Forests Anadromous Fish Habitat Desired Future Conditions, 1992.
- Water Quality Monitoring Results, White Salmon River Assessment and Enhancement Project, Mt. Adams Ranger District and Underwood Conservation District, 1993.
- Washington State Fish and Game Stocking Records for Columbia National Forest (archeology files at the Forest Headquarters and Mt. Adams District).
- Washington Department of Fish and Wildlife fish stocking records, Olympia, WA.

Chapter 3.7
Species and Habitats, Terrestrial

Trout Lake Creek Watershed Analysis

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Chapter 3.7

Core Topic: SPECIES AND HABITATS WILDLIFE MANAGEMENT

Historic Conditions

Late Sere Community

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

Early Sere Community

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

Snag Community

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

Existing Conditions

The wildlife community of the Trout Lake Creek watershed is as diverse as the watersheds vegetation and topography. A thorough assessment of species presence, distribution, abundance and condition is lacking. Documented sightings of wildlife are quite sparse for all the lower end of the watershed, at Trout Lake marsh where observations have been informally acquired and recorded for a bit over sixty (60) years. In a March 1996 report of wildlife activity at the lower end of the watershed (Hayward and Young, 1996) identified fourteen (14) orders of avifaunal species. The authors reviewed records from several community naturalists dating back to 1934 which showed a species richness as high as 150. More recent observations (1992-1996) documented 138 species. Most of the species present at the lower end of the watershed are expected to also make use of the mid and upper watershed during some portion of their life.

Stand Distribution

Stand area and number of stands is used to assess habitat fragmentation. Table 7.2 summarizes stand distribution for the watershed. The following TYPE terms are used in the table: LTSS=larget tree single story conifer forest, Lt.For.=conifer forest at least 9"DBH and with a canopy closure of at least 40%, WFP=water, flood plain, small=conifer forest 9-20.9" DBH, LTMS=large tree multistoried conifer forest at least 21" DBH, WM=wet/mesic areas, POLE=5-8.9" DBH, SEEDSAP=conifer forest plantation with tress less than 5"DBH.

Table 7.2: Stand size distribution for Trout Lake Creek watershed.

TYPE	STANDS	ACRES	% BASIN	AVG. Stand	MAX. Stand	Min. Stand
DryMdw.	1	1	0.00%	1	1	1
LTSS	2	17	0.04%	8	16	1
Lt.For.	4	45	0.10%	11	14	6
ADMIN	5	1,126	2.53%	225	1,040	0
WFP	28	106	0.24%	4	29	0
SMALL	42	13,778	30.90%	328	6,875	0
LTMS	47	13,184	29.57%	281	8,791	0
ROCK	82	1,152	2.58%	14	484	0
WM	108	1,658	3.72%	15	438	0
POLE	152	8,356	18.74%	55	1,161	0
SEEDSAP	175	5,161	11.57%	29	315	0

POLE and SEEDSAP stands outnumber other types of stands. In terms of total acreage, the SMALL and LTMS types dominate the landscape. Note that the average stand sizes differ between the dominating types: smaller POLE/SEEDSAP and larger SMALL/LTMS. The POLE/SEEDSAP condition reflects the historic timber harvest regime of 40 acre project areas. These POLE/SEEDSAP sites are most frequently present in the mid to lower elevations of the watershed. The larger sized, 250 ac. plus POLE sites are naturally occurring stands in the mid to higher elevations, especially Indian Heaven Wilderness. The SMALL/LTMS condition forms the context within which the POLE/SEEDSAP sites occur and reflect timbering and the historic fire disturbance regime. Fire is expected to have generated a landscape mosaic of high acreage in a few large area stands along with lesser acreage in numerous small (<25 ac.) area stands. The successional stage of the small or large areas was dynamic varying from SEEDSAP through LTMS. Stand replacement fires of several thousand acres frequented (400-600 year cycle) this landscape (see Appendix A, Fire History).

Snags

Table 7.3 summarizes the five stages of snag development and condition.

Table 7.3: Snag attributes by decomposition stage (1-5). Modified from USDA 1985 pg. 136.

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

The 33 known caves are concentrated in the central portion of the landscape and reflect the historic geologic basalt flows which created them. The apparent disjointed and self-contained nature of these cave systems indicates the high likelihood that they each might be functioning as isolated ecosystems. This isolation influences genetic drift and inbreeding sufficient to lead to speciation.

Historically, cave openings were seen and used as convenient holes to be filled. As such, some received varying amounts of logging debris, garbage and heavy equipment petroleum products. In some places, caves have been collapsed as heavy equipment operated over them causing the cave ceiling to fail. Physical changes in the cave result in different humidity levels, air movement regimes, energy transport into the cave system, and accessibility to wildlife. An increasing force is that due to cave exploration which can disrupt rest, reproductive and foraging activities of bats in particular. Recreational activity can also introduce toxic chemicals in the form of spent batteries. The environmental changes, including harassing disturbance, are at times detrimental to wildlife such as amphibians, arthropods, and bats.

Of noteworthy attention is the fact that Townsend's big-eared bat, a sensitive species, is known to roost, hibernate and raise young in the cave system of this watershed. Perkins (1992) reports that the largest concentration of big-eared bats in eastern (east of the Pacific crest) Washington is located on and adjacent to the Mt. Adams RD. The 1992 report disclosed a population size of 253 individuals across seven (7) sites and that the population trend between 1983 and 1990 was a 31% increase.

Deadhorse Cave will serve as an example of the uniqueness of the cave system in this watershed. This cave well demonstrates the intricate, complex and vaguely understood character of cave habitats in the Trout Lake Creek watershed. The cave is now considered one of, if not the longest, basalt type cave in North America. Nixon S.E. (Northwest Science, Vol. 49, No. 2, 1975) described the cave. The cave's lower entrance is a sink which was formed when parts of the ceiling collapsed. The upper entrance, an airhole, is located approximately 1,000 ft. uphill from the lower entrance. Numerous lava features are present: multiple passage levels, stalactites, extensive breakdown, and laval seals. Numerous pools of water are in the cave, some arising from springs and some formed by water dripping from the ceiling and seeping from the walls. It is this amount water seepage that is responsible for the high cave humidity. The central portion of the cave contains a stream and a spring fed pool. Nixon described Deadhorse Cave and four cave organisms with varying degrees of cave adaptations. He described four (4) unique species collected:

Table 7.6: Unique species documented as present within Deadhorse Cave.

PHYLUM	CLASS	ORDER	FAMILY	GENUS	SPECIES	RACE
Arthropoda	Crustacea	Amphipoda	Gammaridae	*Stygobromus*	*elliotti*	Holsinger
Arthropoda	Diplopoda	Chordeumida	Conotyliidae	*Troglotyla*	*skamania*	Causey
Arthropoda	Insecta	Orthoptera	Grylloblattidae	*Grylloblatta*		
Platyhelminthes	Turbellaria	Tricladida	Planariidae	*Polycelis*	*coronata*	Girard

* The *Stygobromus* lack eyes and pigmentation and is one of 18 species from western N.America, all found in caves or cave-like, freshwater habitats such as seeps and wells.
* The *Troglotyla* is a relatively large conotyloid millipede without pigmentation. This species has been found only in caves of the Mt. Adams area and the sample(s) from Deadhorse Cave is used as the type specimen.
* The *Grylloblatta* have small eyes, live mainly in caves or under rocks in cool habitats, usually at high altitudes, have a thysanuriform body shape and is light yellow in coloration.
* The *Polycelis* is a freshwater flatworm unique in that it is the only the fourth genus of the Planariidae family to be found in a cave. Body pigmentation is lighter, the eye spots fewer in number, and the auricles less pointed in the cave form than in the surface species.

In a letter dated 3-19-96, J.Nieland (USDA Forest Service, Cave Mgt. Specialist) provided the following key points relative to this cave.

* Cave contains at least two (2) unique invertebrates found nowhere else.
* Listed as a threatened habitat in need of protection during the late 1970s.
* Recognized by cave biologists as containing the most diverse population of cave adapted organisms (many aquatic types) found in any cave in N.America.
* Especially unusual in that a perennial stream emerges in the cave and flows through the cave.

Demographic assessment of the MIS members is essential to accurately reporting on the condition and trend of the wildlife community.

Threatened, Endangered or Sensitive Wildlife Species

NORTHERN SPOTTED OWL

Approximately 50% (22,350 ac.) of the watershed is considered to currently function as Nesting, Roosting, Foraging (NRF) habitat. About 11% (4,900 ac.) has the potential of developing into NRF habitat within the next 50-75 years. This array of habitat currently supports twenty-six (26) known pairs of spotted owls. Fifteen (15) of these pairs have their nest/roosting site within the watershed boundary; the remainder are outside but their home range is considered to extend into the watershed.

A discontinuous data set for the period of 1978-1995 was reviewed to assess the history and condition of spotted owl activity in the watershed. The data indicates stronger nesting seasons during 1990 and 1994. In addition, a trend of a higher proportion of non-paired to paired sites also appeared. It is important to note that survey and monitoring efforts have been inconsistent across the watershed and as such not all sites have received equal attention, hence the inconsistent data set. The data set still has value in the form of trends and in tracking of within year events. Since 1990, surveying and monitoring intensity and extent has increased resulting in more data points from which to infer changes.

As part of an interagency demographics study between the USDA Forest Service and the National Council of the Paper Industry for Air and Stream Research (NCASI), found some (11) of the spotted owls in this watershed have been marked with unique leg bands. Preliminary findings show that fledglings from this watershed are emigrating to the Lewis River and Yakima River watersheds. During September 1995, fledglings from the Hidden Lakes area were documented as having dispersed about 15 miles north-east to the Takhlakh Lakes area. A 1992 fledgling from the Cakey Butte spotted owl activity center was found nesting about 40 miles east within the Yakama Indian Reservation possibly becoming the eastern most spotted owl nest site in the state of Washington.

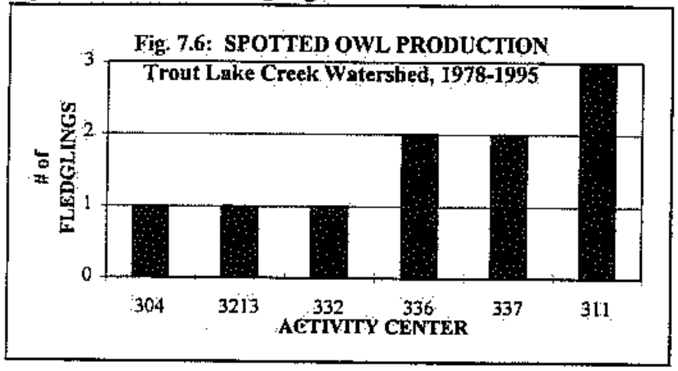
ACTIVITY CENTERS

About 43% (19,187 ac.) of the watershed has been intensively surveyed for northern spotted owl over the last five years. It is likely that 75% of the spotted owl sites in this watershed have been located. Twenty-six (26) spotted owl activity centers are either completely or partially contained within the Trout Lake Creek watershed. For an activity center to be considered as being within, as opposed to overlapping into the watershed, the owl's nest or nesting season roost site must be known. Of the twenty-six activity centers, eleven (11) overlap into the watershed, fifteen (15) are within.

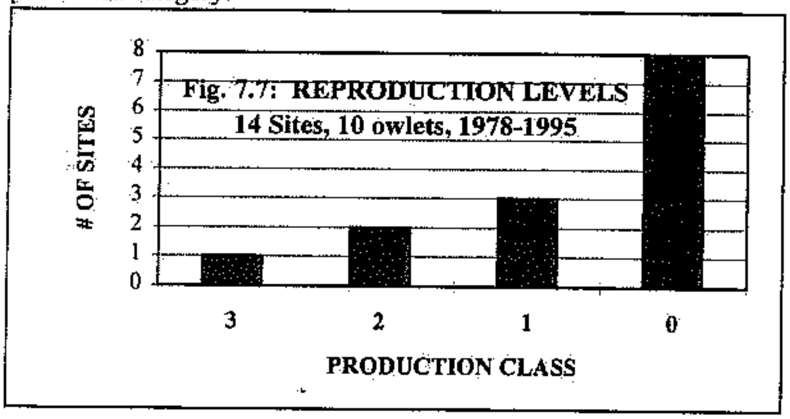
Overlapping into watershed: 312, 315, 329, 335, 3005, 3006, 3007, 3015, 3110, 3214, 3225.
Within watershed: 304, 310, 311, 314, 331, 332, 333, 336, 337, 3017, 3026, 3118, 3213, 3216, 3219.

Number of Owls

During the period 1978-1995, about eighty-six (86) spotted owl observations have been documented at the 15 activity within the watershed. (Multiple observations during the same nesting season were counted only once.). The average spotted owls per site per year was 0.41 indicating a low detection of owls at the activity centers. The low detection is a combination of limited sampling effort and spotted owl detectability. Ten (10) fledglings were documented with eight (8) of these records occurring during 1992-1995. Average production rates, overall and greatest 4-year period, for the 15 centers over the 17 year period is 0.07 and 0.14 respectively. Three sites are documented as being the most productive: 311, 336, 337. These three sites account for 70% of the documented reproduction of ten fledglings.



Reproduction has not been documented at most of the activity centers. It may well have occurred but the extent is unknown. The following chart groups spotted owl activity centers according to the number of young produced. As an example, a single fledgling has been produced at three sites, triplets at one site. Most sites fall within the zero production category.



Habitat Connectivity

Approximately 55% of the watershed is in a non-intensive timber harvest land allocation. Such areas include Riparian Reserve, mapped and unmapped late successional reserve, wilderness etc.. The least restricting amount of Riparian reserves constitutes about 23.5% (10,494 ac.) of the watershed and of this acreage, about two-thirds (6,561 ac.) is in a late sere (small or large tree multistoried conifer forest) condition. About 7.1% (3,180 ac.) is in wildlife special (IX) or late successional reserve (LS). Wilderness constitutes about 7.6% (3,393 ac.) of the watershed. These non-harvest areas appear sufficiently well distributed across the landscape as to provide a high degree of potential dispersal avenues.

It is important to note that systematic surveys and evaluation of the wildlife community within the non-harvest areas has not been accomplished. As such, it is professional judgment which is being exercised in predicting that harvested areas, matrix, will be recolonized by individuals from and through the non-harvest areas.

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

Habitat Definitions

Habitat definitions and the computerized query definitions used to identify habitat within the Trout Lake Creek watershed follow.

Optimal Cover

Multiple canopies (herbaceous, shrub, sub-canopy, overstory). Overstory canopy ability to intercept and hold a substantial amount of snow yet with dispersed, small (1/8 ac.) gaps. Dominant trees usually ≥21" DBH, at least 70% canopy cover, and are in a large sawtimber or old-growth stand condition.

Query: Coniferous stands with ≥2 tree layers
≥71% canopy cover. Tree size of at least small trees (9-20.9" DBH)

Thermal Cover Habitat

At least 40' in height. Overstory canopy ≥70%.
At least the closed sapling-pole stage of development.

Query: Coniferous vegetation with >1 tree layer, ≥71% canopy cover
Tree size range from mixed poles (5-8.9" DBH) and small trees (9-20.9" DBH) to giant trees (>47" DBH)

Forage Habitat

Vegetated areas with less than 60% canopy cover of trees and tall (> 7') shrub. Includes the grass-forb, shrub, and open sapling-pole stand conditions and may include some older stands that have been thinned. In a managed forest, the primary forage areas are those that have had all or most of the forest canopy removed.

Query: Stands with shrubs, meadows, or conifers and hardwoods having less than 40% canopy cover and a tree size ranging from seedling (<1" DBH) to mixed seedlings/saplings (1-4.9" DBH).

Hiding Cover Habitat

Any vegetation capable of hiding 90% of a standing adult deer or elk at ≤200'. Includes shrub stands and all forested stand conditions with adequate tree stem density or shrub layer to hide animals. Topographic features can also provide hiding cover.

Query: Coniferous or hardwood stands with at least 41% canopy cover
Tree size ranging from saplings to poles (5-8.9" DBH).

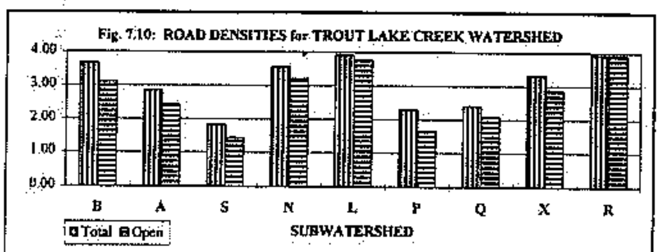
wolves as well as zoo kept wolves and found that the former had more frosting on the fur and the latter not as healthy looking.

Potential for Interaction Between People and Wolf

The potential for human-wolf interaction is estimated to be a function of road density, especially open roads. As road density increases, so does the likelihood that contact would occur between humans and wolves. Road densities in excess of 2 miles per square mile are considered to likely result in wildlife harassment. The adjacent Table summarizes open road densities (mi./sq.mi.) by subbasin. Most (8 of 9) subbasins within the watershed have >2 mi./square mile of existing roads. Total road densities range from 1.83 to 3.93 mi./square mile; open densities from 1.43 to 3.93. Open road density is lower than total density though only one additional subbasin is below the threshold.

Table 7.9: Open Road Densities, Trout Lake Ck. Watershed

WSU	Total	Open
B	3.67	3.10
A	2.86	2.42
S	1.83	1.43
N	3.55	3.21
L	3.91	3.76
P	2.30	1.66
Q	2.41	2.10
X	3.32	2.89
R	3.93	3.93
AVG.	3.09	2.72



One large area with low potential for human-wolf interaction is present: Indian Heaven Wilderness (50% within this watershed). This area contains a prey base for gray wolf and could support an undetermined wolf population size.

PEREGRINE FALCON (*Falco peregrinus*)

Potential eyrie sites within this watershed appear low and would most likely be Sleeping Beauty, Steamboat Mountain and or Bird Mountain in Indian Heaven Wilderness. No peregrine falcon sighting records were located. Specific surveys for this species were not conducted. Prey base is likely not limiting in this watershed.

AMPHIBIANS

As a function of a wide distribution and interconnectivity of wetlands, the amphibian community is believed to diverse and well distributed. Some of the distinct occurrences involve large scale (thousands of young) western toad reproduction at Mosquito and Hidden Lakes, and spotted frog activity along the main stem of Trout Lake Creek. Eight (8) herptilian species have been documented as being present within the Trout Lake Creek watershed. The Washington Department of Fish and Wildlife "Heritage Data" and the Gifford Pinchot NF Wildlife Sightings database were reviewed. The database records included the following species: Pacific tree frog (*Pseudacris regilla*), Cascades frog (*Rana cascadae)*, tailed frog (*Ascaphus truei*). Personal knowledge includes garter snake (*Thamnophis ordinoides*), spotted frog (*Rana pretiosa*), and western fence lizard (*Sceloporus occidentalis*).

trees, coarse woody debris, riparian habitat. Diversity within logged areas may increase because of the plantings of diverse plant species, pre-commercial thinning which favors minor species components, use of more varied tree spacing, and maintenance of existing low tree stocking microsites.

Non-harvest areas would include Riparian reserves (a combination of adjoining aquatic, edge and upland habitats) Late Successional Reserves, wildlife tree retention areas, Wilderness, Research Natural Areas.... Late successional forest habitat is expected to remain primarily in these non-harvest areas. This quantity and distribution of late successional forest habitat in non-harvest allocation is considered likely sufficient in area and connectivity to maintain the animal community composition within the historic range of variability and, as indicated by habitat capability levels for Management Indicator Species, may even occur at higher levels than exist today. Within these non-harvest areas, diversity in successional stages is likely dependent on use of a managed disturbance force such as fire. In the absence of disturbance, successional diversity is expected to be dominated by the later stages. Habitats such as the extremely limited oak woodlands in the vicinity of Cakey Butte and upland meadows would be lost from the landscape as conifers advanced their dominance via succession.

The effectiveness of habitat connectivity is professional opinion. It is essential that monitoring be conducted to measure population interaction, e.g. genetic interchange, across the landscape. Isolated populations would be considered most at risk of localized extirpation and could receive special management attention for its protection and maintenance. Expected dispersal corridors could be monitored to assess their use by dispersing individuals.

Because of the recognized detrimental effects of excess roading a net increase in road density within the watershed as a whole is not expected. Some areas, e.g. deer/elk winter concentration areas, will likely see a decrease in open road density. Furthermore, as a function of low and or decreasing road maintenance funds, road use will likely decrease as road quality (potholes, crowding by vegetation, rocks/boulders, logs, branches) declines. New road construction is expected to occur predominantly outside of unique habitats such as wetlands, caves, and meadows. Collisions between wildlife and vehicles are considered proportional to vehicular speed and volume. As such, declines in road maintenance are expected to reduce the number of collisions between wildlife and vehicles.

Projects Likely To Affect Future Condition

Timber harvest is likely the most active (by intensity and frequency), force to influence the future condition of this landscape. Harvest and replanting prescriptions can facilitate attainment and maintenance of the desired future condition by aggregating project sites to create 200-300 acre contiguous, similar-aged stands. Current practice of replanting with diverse species improves post-harvest diversity.

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

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

A through access system for motorized traffic maintains at less than two miles per square mile (mi. sq. mi.). Provide non-motorized (hiking, bicycling, animal transport...) evenly across the landscape at a two to three (2-3) mi. sq. mi. density. Repair high sediment yielding access routes. Allow motorized access in less than fifteen percent of the deer and elk winter range. Install and maintain travel control devices.

the Steamboat RNA Managment and Monitoring Plan, and will take an interdisciplinary approach, including heeding areas of concern delineated in this document. In general, grazing is inconsistent with RNA objectives.

Research is ongoing in the RNA. This research is overseen by the district RNA coordinator and approved by the Pacific Northwest Research Station Director of the US Forest Service. Current research involves amphibians and long-term site productivity.

Chapter 3.8
Stream Channel Assessment

Trout Lake Creek Watershed Analysis

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Chapter 3.8

Core Topic: STREAM CHANNELS

Issue Statement

Stream channels are the integrating features of a watershed that reflect a combination of the riparian and upslope watershed conditions, and the geomorphic channel type. Conditions within stream channels are important because these areas comprise the habitat for fish and other aquatic species that rely on fluvial systems. Channel conditions, combined with riparian condition can strongly affect water quality and the microclimate for riparian dependent species. Upslope conditions can indirectly affect channel condition by influencing the rate, timing and quantity of water delivered to the stream. Because of the interactions of the stream with the riparian area and linkages with upslope processes, any activities or disturbances occurring in the watershed have the potential to affect conditions in the stream channels and associated riparian areas.

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

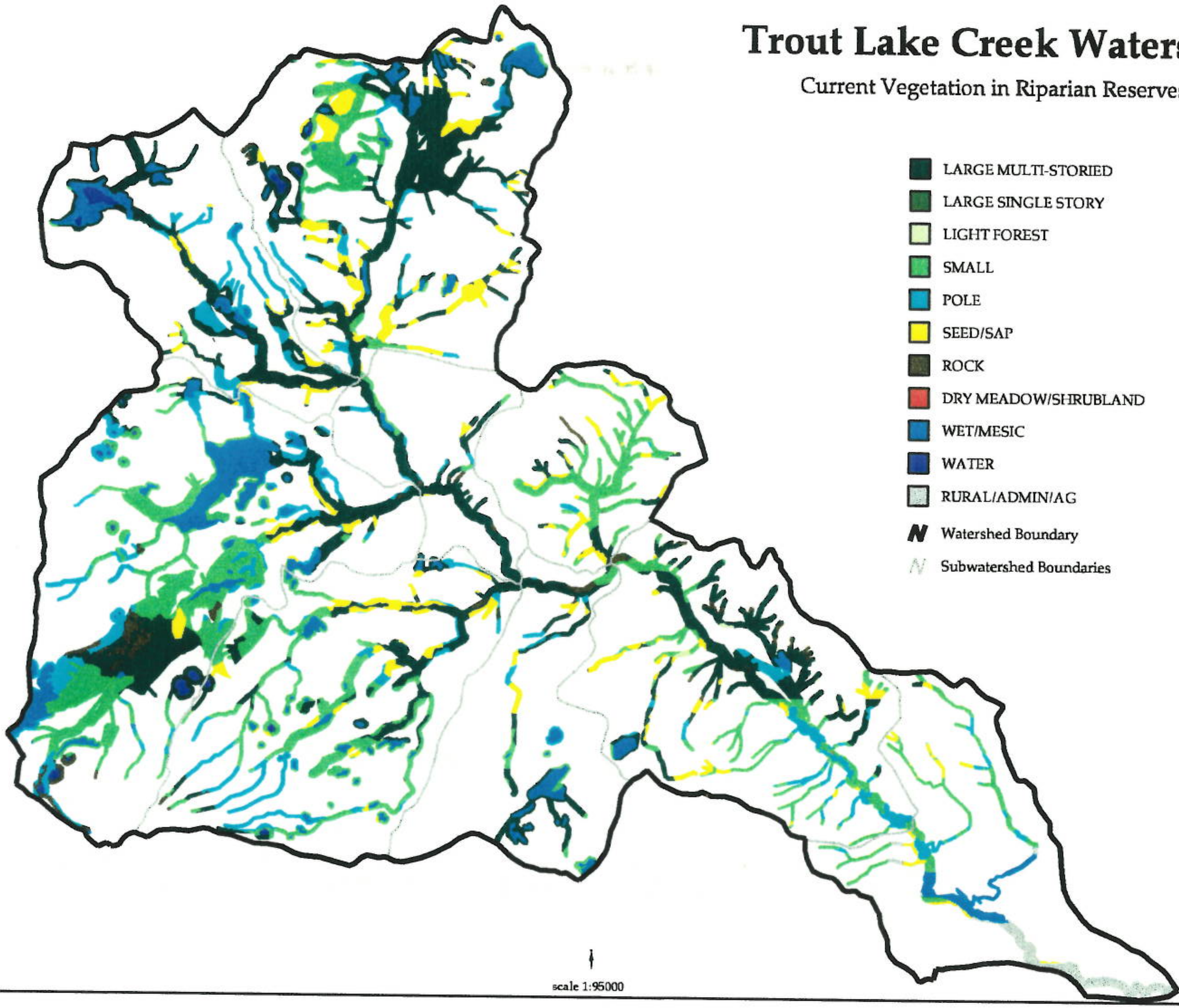
Historic Conditions

Historic riparian and channel conditions can generally be indexed to large scale upland disturbances or to local disturbance in the riparian area. Because of the relatively stable nature of the Trout Lake Creek watershed (see Mass Wasting section in this report), fire and flooding were probably the dominant factors affecting channel condition and channel change over time, aside from the very infrequent but large scale geologic/volcanic events. Large-scale fire indirectly affected channel conditions by reducing forest cover and thus influencing peak streamflows (see Hydrology section in this report), but also had a direct effect on conditions in the riparian area when it burned riparian vegetation. Flooding plays an important role in channel condition, but may have greater effect when flood frequency or magnitude is increased (i.e. following large scale vegetative removal) and when mature riparian vegetation has been eliminated or reduced.

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

Trout Lake Creek Watershed

Current Vegetation in Riparian Reserves



Map 8.1

harvested stream reaches as well, since in previous decades, timber harvest contracts would have included provisions for stream cleanout of woody debris.

Table 4.1 also shows the percent of the riparian area in each subwatershed in late seral condition compared with the "range of natural" described in REAP. Percent of the riparian reserve in late seral condition provides an indication of the amount of the riparian area where there are large well established root systems, and a high degree of large woody debris recruitment potential. At a very coarse level, subwatersheds with a high percent of late seral vegetation in the riparian area would suggest a lower potential for concerns related to future recruitment of large woody debris, and may suggest areas of greater stream channel stability.

Currently, three of the nine subwatersheds are below the "range of natural" condition for late seral vegetation in the riparian area. A large fire that burned much of the Smoky Creek, Little Goose, and Cultus/Meadow Creek subwatersheds in the early-to-mid 1900's is in large part responsible for the expanse of mid-seral vegetation (and lack of late seral) in those areas. But across the Trout Lake Creek watershed, timber harvest in riparian areas—including both selective harvest and clearcutting has been an important factor in removing the late seral component from riparian areas. Current seral class of vegetation on riparian areas of the watershed is shown on Map 8.1.

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. Higher gradient channels can be primary sediment source areas as well as providing rapid transport of sediment to downstream reaches. Major disturbance processes in these channels typically include avalanches, debris torrents, and other forms of mass wasting. Lower gradient stream reaches are typified by deposition of sediments delivered from upstream or upslope processes. This alluvial material is much less resistant to erosion and bank cutting than the large boulder and bedrock that commonly dominate higher gradient reaches, so changes in channel geometry or shifting of channel locations may be more common in these reaches. Because of the predominance of finer grained streambed and bank materials, these reaches rely heavily on streambank vegetation and large woody debris for channel stability.

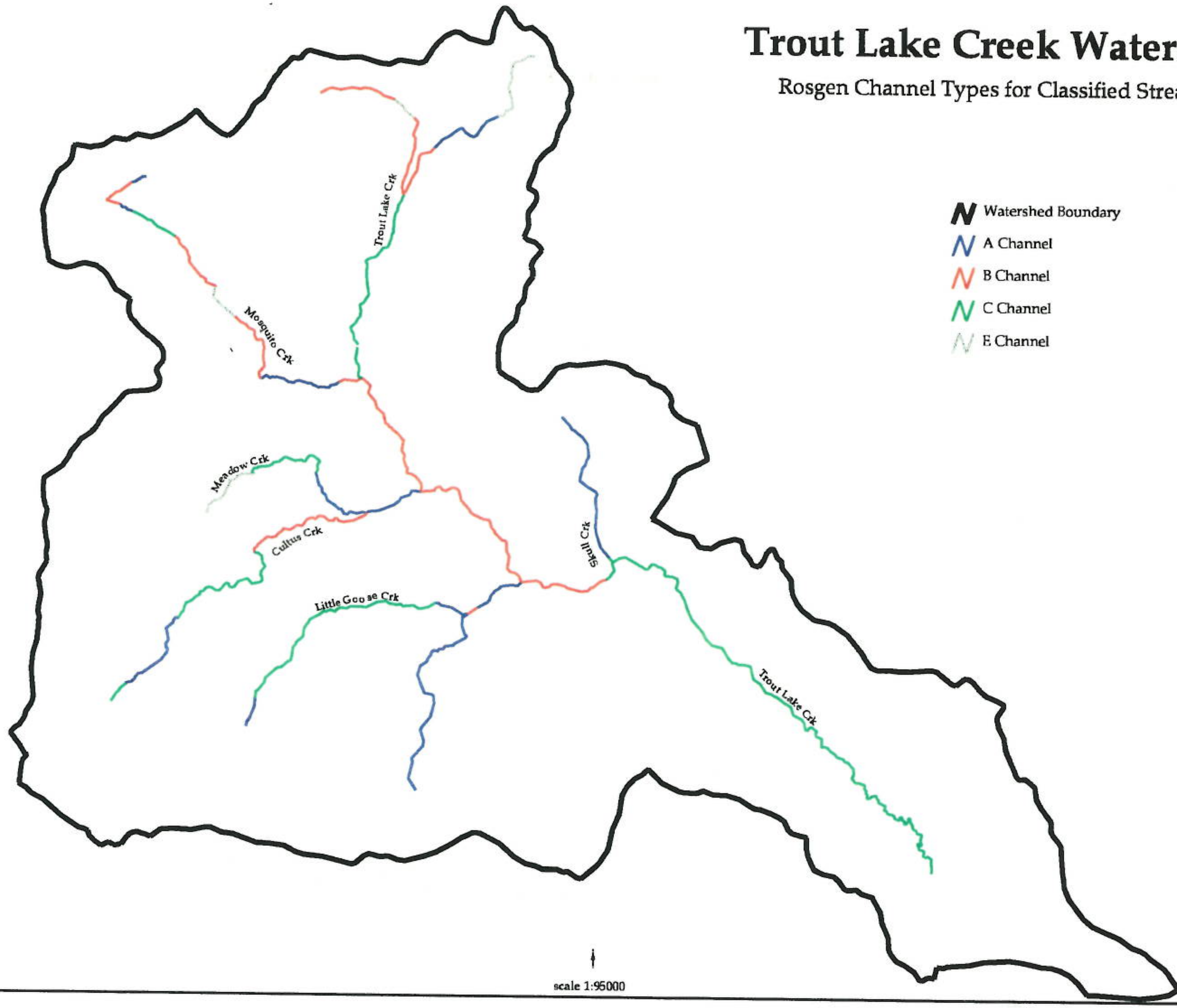
Stream survey information was used to classify all surveyed stream reaches into Rosgen Channel Types (Map 8.2). Most of the major tributaries as well as the mainstem of Trout Lake Creek had been surveyed prior to this assessment using either the Region 6 Level II Survey protocol or the more limited Washington State Department of Ecology method. Stream gradient, morphology and substrate were used along with topographic maps and air photos to make the stream type determination. Due to limited time frames allowed for this assessment, none of the channel typing has been field verified.

The relative proportion of different channel types and their spatial distribution across the watershed is largely a function of the underlying geology and large scale topographic relief of the watershed. Lava flows that once emanated from vents in the Indian Heaven Wilderness area have created a broad, gently sloping topography on the western side of the Trout Lake Creek watershed. Because of the gentle relief of this area, streams flowing from the upper slopes of Indian Heaven toward Trout Lake Creek in many cases have relatively low gradients in their upper reaches. In addition, the benchy topography on these upper slopes has created areas where water collects and forms lakes, meadows or wetlands.

Channel types identified in Map 8.2 are summarized by subwatershed in Table 8.2. In general, the A channels have the highest gradients, and are often source areas for sediment as well as large woody debris. Because both the A and B channel types have relatively higher gradients, these reaches are able to route delivered material to downstream reaches. Rosgen C channels are lower gradient reaches, and represent some of the more sensitive parts of the stream network in terms of response to changes in stream flow, and inputs of sediment or wood. These reaches typically have higher width-to-depth ratios, which leaves them more prone to solar heating because of the higher surface area-to-volume ratio.

Trout Lake Creek Watershed

Rosgen Channel Types for Classified Streams



Map 8.2

It is unknown how much of the changes seen in the air photos can be attributed to the flooding, and how much is a result of the management activities occurring during the same time period. Further complicating the analysis is the fact that during the 1970's, some major instream work was done near these reaches that included removal of large woody debris and sediments from the mainstem of Trout Lake Creek, and re-directing or channelizing the flow of the stream using the dredged gravels as berms or dikes along the stream edge. It is clear however, that some combination of the high flows, the upstream and upslope harvest and roading, and the instream "improvement" projects contributed to substantial changes in the morphology and condition of these reaches of Trout Lake Creek. The flood of 1996 further exacerbated the widening of the channel at the Forest boundary, but in so doing, recruited a number of large trees to the active channel and floodplain. Incorporation of this large woody debris into the channel should begin helping restore the hydraulics and morphology of these reaches.

Data Sources and Confidence Levels

Assessment Tool	Data Source	Confidence
1) Vegetation Seral Class in Riparian Areas		
	Gifford Pinchot N.F. Geographic Information System:	
	-Streams layer	Low/Mod
	-Riparian Reserve layer	Low/Mod
	-Vegetation layer	Mod/High
2) Rosgen Channel Type		
	Region 6 Level II Stream Survey	Mod
3) Air Photo Assessment		
	Mt. Adams R.D. air photos	Mod/High

CHAPTER 4 - SYNTHESIS

The following management concerns are supplemental to, and do not repeat those outlined in the preceding Synthesis Matrix (page 86).

Management Concerns Common to All Subwatersheds

- many small wetlands are not mapped and may cause shortfall in PSQ
- water temperatures in Trout Lake Creek may be higher naturally than in other watersheds due to the high percentage of meadows and wetlands
- Twin Buttes Goat/Sheep Allotment covers almost the entire watershed on National Forest
- cave inventory, in addition to Cave Management Plan, should be completed for all of South Skill Center
- special forest product harvest need more management; high use areas often conflict with recreation. Forest-wide NEPA document may address concerns found in Trout Lake Creek, but action is needed quickly on controlling camping and garbage
- Road 88, visual corridor, needs to be subtracted from overall PSQ in most subwatersheds
- discrepancies exist in the three levels of PSQ figures generated: Regional, Forest, and District
- road densities over threshold (wildlife and hydrology)
- may be contributing sediment toward the eutrophication of Trout Lake
- Phase II of ATM needs completing
- most of past clearcut harvest was in Rain-on-Snow zone in lower elevation on mainstem of Trout Lake Creek. ARP's that appear to be OK by subwatershed may not accurately depict the peak flow problem
- seasonal pulsation of Trout Lake water level, and resulting wildlife species richness, has been well documented

Mosquito Creek - Subwatershed A

- rich in special forest products, especially boughs, beargrass, and mushrooms
- difficult to reforest (occurs primarily in Mountain Hemlock Zone)
- high retention needed to help reforestation and mitigate peak flows
- abundant and sensitive wetland communities
- high amounts of interior forest habitat and little fragmentation leaves opportunity for larger timber harvest units
- high recreation use at Mosquito Lakes
- part of Steamboat RNA is here
- Pacific Crest Trail buffer of 500 feet may need to be subtracted from PSQ

Headwaters - Subwatershed B

- existing fragmented areas provide preferred opportunity for timber
- campsites and road in Steamboat Lake riparian area
- wet meadows abundant; northeast portion ties into larger wetland complex in Upper Lewis watershed; rare intermediate bladderwort and Alaska yellow cedar occur here.
- difficult to reforest due to frost and high water table
- large amount of recent timber harvest
- large peeled cedar reserve (land allocation 9L): 500 acres
- habitat for peregrine falcon on Steamboat Mt. (see potential wildlife projects)
- Steamboat RNA houses representative and uncommon species and habitat

Skull Creek - Subwatershed L

- high road crossings per mi^2
- Sleeping Beauty, 9L designation, has mountain goats and peregrine falcon habitat
- potential peregrine falcon eyrie
- wolf sightings off Road 223
- lots of laminated root disease, lots of mid-seral stands and regeneration pockets
- lower portion is late-successional and in Rain-on-Snow

Upper Trout Lake Creek - Subwatershed N

- unique rare plant assemblages in riparian area
- steep, rocky, south slopes which are difficult to reforest

Little Goose and Smoky - Subwatershed P

- cold water source for watershed
- Hidden Lakes and Lake Comcomly share lots of recreation and sensitive habitat with richness of species including nesting raptors, toads, red-legged frogs, herons, osprey, and Canadian geese
- Smoky Creek Camp and Little Goose Camp has long historical usage. Smoky Creek CCC Camp is under a special use permit to Mountain View Recreation Club
- some caves here; buffers may affect PSQ
- abundance of wetlands and meadows, more than have been mapped, and buffering will lower PSQ

Deadhorse Creek - Subwatershed Q

- most is in Managed Late Successional Reserve, will manage to protect from stand-replacing fire
- difficult to reforest due to frost zone and high water table

Lower TLC - Subwatershed R

- mostly private land holdings
- <1% late sere in riparian vegetation and diversity of hardwoods is high
- source of noxious weeds
- large wetlands, state may purchase
- Rosgen E channel type
- Apparent bird species composition change in last 40 years - may reflect change in habitat and/or neotropical migratory bird decline
- traditional tule and wapato supply for Native Americans
- Lewis River elk herd winter range
- many water diversions from Trout Lake Creek
- suspected high rate of sedimentation in marsh, lake has shifted position and open water severely decreased (see section at the end of this Chapter addressing probable causes of this eutrophication of Trout Lake)

Cultus and Meadow Creeks - Subwatershed S

- Sawtooth Berry Fields
- part of Indian Heaven Wilderness
- highest potential for unstable soils and geological hazard
- Cold Springs Indian Camp, Traditional Cultural Property - use is present, historic and pre-historic
- Meadow Creek Indian Camp
- Cultus, Deep, and Surprise Lakes
- large mapped wetland complexes and many unmapped wetlands
- one meadow is large wildlife special area (land allocation IX)
- Native American vision quest site on Sawtooth Mountain
- Road 88, visual corridor, needs to be subtracted from overall PSQ -already many openings in this area

Chapter 5
Recommendations, Monitoring, and Potential Projects

Trout Lake Creek Watershed Analysis

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CHAPTER 5 - RECOMMENDATIONS

A. Timber

1. General

- 4.5 Mbf/yr is not unreasonable for the entire watershed, but will not hold to targets for individual subbasins due to limitations listed below in #3 (general targets for watershed 4.5 M meets forest target, region specifies 5.2M)
- See Harvest Scheduling and Potential Vegetation Projects in this Chapter
- Harvest prescriptions in the early part of the decade should emphasize thinning to minimize creation of additional openings.
- Regeneration harvest scheduled this decade should be focused in the upper elevations of the watershed first, to limit further concentration of large openings in the rain-on-snow zone.
-

2. By Subwatersheds

<u>Little Goose</u>

- thin early, cut later in decade
- highest risk of owl habitat loss
- maximize thin, minimize re-gen because of ROS
- Whip sale is in progress
- Could reprioritize and pull other sale up to its place
- Combine with Deadhorse in single sale
- Only re-gen harvests are reliable amounts

<u>Skull Creek</u>

- Bug Sale

<u>Mosquito Creek</u>

- thin and regen in Steamboat Burn

3. Limitations to timber harvest volume:

- Road 88 is visual corridor (VM)
- unmapped riparian/meadow areas
- Threatened, Endangered, and Sensitive species
- Survey and Manage Species
- Caves and cave buffers
- harsh site prescriptions

4. Non-commercially-inspired tree-felling

- LSR - thin to reduce stand replacement hazard -- silviculture, fire, and wildlife; this will be analyzed in LSR Assessment. (See Potential Vegetation Projects, page 96)
- Thin around oak and pine sites to prevent loss of these shade intolerant species
- Precommercial thin in Matrix (See Potential Vegetation Projects, page xx)

B. Recreation

See Potential Human Use Projects, page 100.

5. Cooperatively continue to monitor Trout Lake marsh birds

6. Measure conifer succession rate at meadows in wildlife special allocations as starters, if succession rate is accelerated by decreased natural flooding and fire suppression, plan to reset it

Location: Wildlife Special allocations, IX.

Objective: Maintain meadows in an early to mid stage of development.

Description: Measure conifer encroachment rates and if rate appears accelerated, greater than would likely occur if historic disturbance regimes were still in effect, initiate control actions such as innundation, burning, and or mechanical removal of encroaching conifers.

7. Habitat Connectivity

Purpose/Objective: Determine the degree of genetic interchange and thereby assess the adequacy of dispersal avenues and proximity of reproduction sites. Also provides indications of subpopulation viability and potential for localized extirpation.

Parameters to Monitor: Monitor site and pair tenacity, demographics, and emigration/immigration of the large home range species, e.g. spotted owl, northern goshawk, osprey.

Location and Timing: Watershed wide on a yearly basis for 7-10 years.

8. Evaluate cost and effectiveness of developing peregrine falcon eyries (nest sites) at Steamboat Mt., Sleeping Beauty and Bird Mountain.

9. Measure conifer encroachment rates in meadows within wildlife special allocations. If rate indicates an accelerated loss of this unique habitat, initiate encroachment control actions such as inundation, burning and or mechanical removal of encroaching conifers.

10. Develop a District Cave Management Plan that assesses site sensitivity, degree of recreational use, and biological community. Systematically inventory and record cave community composition and condition. Emphasize Threatened or Endangered, Sensitive, Survey & Manage species (arthropods, lichens, moss, liverworts, wildlife)

11. Develop a wildlife observation platform at Mosquito Lake. The platform would provide landscape and site interpretation, be handicap user friendly, provide boarding/exit access to water borne craft, and facilitate wildlife viewing and fishing.

12. Develop and maintain 0.5 ac. upland forest gaps in which conifer density is low enough as to allow the site to function as an upland meadow (grasses, forbs and shrubs). This measure contributes to landscape diversity and provides a unique, limited habitat.

13. Place nesting structures in the vicinity of wetlands, meadows, and recreation sites. Snags have been selectively removed from the landscape and species like osprey *(Pandion haliaetus)*, bats, and large cavity users could benefit. Nest structure to include tree-top platforms, tree-trunk excavations, boxes, and or artificial "trees" for holding nest structures.

14. Monitor the large home range species, e.g. spotted owl, northern goshawk, osprey, to determine the degree of genetic interchange and thereby assess the adequacy of dispersal avenues and proximity of reproduction sites. Monitor the demographics of the large home range species, e.g. spotted owl, northern goshawk, osprey, to assess their subpopulation viability and potential for localized extirpation.

POTENTIAL WILDLIFE PROJECTS

1. Project Name: Wildlife Observation Platform
Location: Mosquito Lake
Objective: Provide a landscape, ecosystem interpretive site.
Description: The platform would provide landscape and site interpretation, be handicap user friendly, provide boarding/exit access to water borne craft, and facilitate wildlife viewing and fishing.

2. Project Name: Cooperative Wildlife Survey
Location: Trout Lake Marsh
Objective: Develop and maintain a documented record over time of the wildlife community which could serve as a barometer of environmental health.
Description: On a weekly basis, conduct a systematic survey of wildlife species seen and or heard on each side, north and south on alternating weeks. Particular emphasis would be on avifaunal species presence and abundance.

3. Project Name: Cave Resource Inventory
Location: Watershed wide.
Objective: Better understand the cave resource.
Description: Systematically inventory and record cave community composition and condition. Emphasize Threatened or Endangered, Sensitive, Survey & Manage species (arthropods, lichens, moss, liverworts, wildlife,...)

4. Project Name: Cave Management Plan
Location: Watershed wide.
Objective: Assess sufficiency of current management protection of caves.
Description: Develop a District Cave Management Plan that assesses site sensitivity, degree of recreational use, and biological community.

5. Project Name: Upland Meadow Maintenance
Location: Conifer plantations.
Objective: Provide landscape diversity and maintain a unique and limited habitat.
Description: Develop and maintain 0.5 ac. upland forest gaps in which conifer density is low enough as to allow the site to function as an upland meadow (grasses, forbs and shrubs).

6. Project Name: Nests For Wildlife
Location: Vicinity of wetlands, meadows, and recreation sites.
Objective: Restore snag associated nest sites.
Description: Snags have been selectively removed from the landscape and species like osprey *(Pandion haliaetus)*, bats, and large cavity users could benefit. Nest structure to include tree-top platforms, tree-trunk excavations, boxes, and or artificial "trees" for holding nest structures.

HARVEST SCHEDULING

The following displays the preferred scheduling of timber harvest for sub-basins within the Trout Lake Creek watershed. These sales would need to average a total of 4.5 MMBF per year in order to meet the Forest PSQ harvest level or 5.2 MMBF per year to meet the Regional target. The general strategy is to schedule commercial thinning sales early in the decade due to the large amount of mid-successional stands which have not yet been thinned. Much of the regeneration harvest would be done later in the decade in order to focus on the commercial thinning while stands are suitable, plus allow the existing young stands in the rain-on-snow zone more time to recover hydrologically.

1. Skull Creek (L): Currently scheduled as Bug timber sale. Primarily a commercial thinning with regeneration harvest in the laminated root disease pockets. Schedule early in the decade.

2. Mosquito (A): Formerly scheduled as Cosco timber sale (EA was never completed). This sale would be a combination of regeneration harvest plus thinning in the Steamboat burn. Sale area is outside of the rain-on-snow zone. Schedule early in the decade.

3. Little Goose/Smoky (P): Currently scheduled as Whip timber sale. This is a commercial thinning entry since a regeneration harvest has recently been completed in this sub-basin (Blimp sale). Schedule a thinning early in the decade. A regeneration entry will likely be needed toward the end of the decade in order to meet PSQ targets.

4. Dead Horse (Q): A small amount of Matrix allocation is present in the Dead Horse sub-basin which could be combined with Little Goose/Smoky for logistical reasons (very similar forest conditions and close proximity). Schedule a thinning early in the decade as part of Whip sale.

5. Upper Trout Lake Creek (N): Formerly scheduled as Wheel thinning sale (EA never completed). Recommend thinning this decade and deferring regeneration harvest until next decade due to large amount of harvest in the rain-on-snow zone. Schedule harvest in middle of the decade.

6. Cultus/Meadow (S): This sub-basin is primarily small tree stands ready for commercial thinning. Recommend scheduling a thinning sale for the middle portion of the decade.

7. Headwaters Trout Lake Creek (B): A relatively large amount of regeneration harvest has been completed in the last 2-3 years. Schedule a regeneration harvest entry late in the decade, focusing primarily outside of the rain-on-snow zone.

8. Middle Trout Lake Creek (X): This area is entirely within the rain-on-snow zone. Schedule a regeneration sale late in the decade to allow existing young stands to recover hydrologically. On the low elevation south slopes (Grand Fir Zone), look for crown thinning opportunities around Oregon white oak and large ponderosa pine trees to enhance health and vigor.

	8800733	H	0.1	VM,RR	
	8800734	O	0.2	IX	
	8800735	O	0.2	VM,RR	
	8800736	H	0.2	VM,RR	
	8800738	G	0.4	VM,RR	
	8800739	G	0.2	VM,RR	
	8800740	F	0.2	VM,RR	
		Total miles =	2.7		
X	8800707	O	0.4	EM,RR	
	8810010	O	0.2	EM,RR	End of rd only—fill for old bridge
	8810703	O	0.3	EM,RR	
	8810705	O	0.3	EM,RR	
	8810711	O	0.3	EM,RR	
	8810713	O	0.1	EM,RR	
	8810717	O	0.5	EM,RR	
	8810718	O	0.2	EM,RR	
	8810719	O	0.2	EM,RR	
		Total miles =	2.5		
	Grand	Total miles =	23.4		

* ATM DFC Codes:

E = Closed to all but administrative use
F = Allow to close naturally
G = Closed year-round
H = Roads-to-Trails
O = Decommission

7. Name: Little Mosquito Lake Road-to-Trail
   Location: Spur 280 off of Forest Road 8851--access to Little Mosquito Lake
   Objective: Prevent vehicular access, while providing for recreational use
   Description: Designate trail corridor; rip roadbed, aerate soil, imbed rocks, transplant vegetation and implement road closure
   Timing: After July 1, when road is snow-free

8. Name: Sleeping Beauty Road-to-Trail
   Location: FR 8810/040 accessing Sleeping Beauty Trail #37
   Objective: Eliminate vehicular access, while improving trailhead facility
   Description: Designate trail corridor; rip roadbed, aerate soil, imbed rocks, transplant vegetation and implement road closure
   Timing: After July 1, when road and trail access are snow-free

9. Name: Peeled Cedar Site Sanitation
   Location: FR 88, approximately .5 miles south of FR 8851 junction
   Objective: Provide sanitation facilities for visitors
   Description: Install vault toilet at parking area
   Timing: After June 15, when road and trail access are snow-free

10. Name: Langfield Falls Sanitation
    Location: FR 88, approximately .25 miles north of FR 8851 junction
    Objective: Provide sanitation facilities for visitors
    Description: Install vault toilet at parking area
    Timing: After June 15, when road and trail access are snow-free

11. Name: Little Goose Campground Sanitation
    Location: Little Goose Campground on FR 24
    Objective: Replace facilities/meet facility standards
    Description: Remove seven pit toilets and install four vault toilets
    Timing: After July 1, when road and trail access are snow-free

12. Name: Little Goose Horse Camp Sanitation/Upgrade
    Location: FR 24
    Objective: Meet sanitation facility standards and improve horse facilities
    Description: Remove two pit toilets and install one vault toilet. Upgrade two horse-camping sites (repair corrals; install watering trough/faucet)
    Timing: After July 1, when road and trail access are snow-free

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Crosswalk of the Subwatersheds of Trout Lake Creek

TLC1	Headwaters TLC	Subwatershed B
TLC2	Mosquito	Subwatershed A
TLC3	Cultus/Meadow	Subwatershed S
TLC4	Upper TLC	Subwatershed N
TLC5	Skull	Subwatershed L
TLC6	L.Goose/Smoky	Subwatershed P
TLC7	Dead Horse	Subwatershed Q
TLC8	Middle TLC	Subwatershed X
TLC9	Lower TLC	Subwatershed R