# Chapter 2 - Conditions and Trends

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# Aquatic Ecosystem

## *Overview*

The Suiattle River is the largest tributary (nearly 60 miles in length, 343.7 square miles in size) of the Sauk River. The Suiattle River originates from two prominent glaciers (Honeycomb and Chocolate glaciers) on the northeast slopes of Glacier Peak. At 10,528 feet, Glacier Peak is the more prominent of several northern Cascades mountain peaks.

The Suiattle River is currently mapped as two fifth-field watersheds in the revised watershed layer for the Mt. Baker-Snoqualmie National Forest (the Lower Suiattle River, below Downey Creek, and the Upper Suiattle River). The ten subwatersheds ($6^{th}$-field hydrologic units) of the Suiattle watershed delineate the major tributaries of the Suiattle River. Under the old watershed system (pre-2003), the Suiattle was mapped as three fifth-field watersheds.

There are 2,210 miles of mapped (GIS) streams within the Suiattle River watershed resulting in an average drainage density of 6.8 miles/square mile (National Forest System lands only).

## *Hillslope Processes*

### Geology

The geologic bedrock material as well as structural features (faults, folds, etc.) within the Suiattle River watershed is very characteristic of the North Cascades complex structure and has a dramatic effect on hillslope processes and sensitivity of the landscape to management activities.

Much of the original physical characteristics and appearance of the bedrock material originated from ocean floor sediments. This has been altered (primarily through heat and pressure) to various forms of metamorphic bedrock material. Sixty-five percent of the bedrock units within the watershed consist of metamorphic types: gneiss and banded gneiss (11%), orthogneiss (5%), granodiorite and quartz diorite (18%), heterogeneous metamorphic rocks (8%), and schist (23%).

Schist is relatively weakly metamorphosed sedimentary rock that weathers rapidly and is often highly fractured. Within the Suiattle River watershed, a broad band of high-grade schist spans an area from lower Tenas Creek in an arc to the southeast to Lime and Milk Creeks. Low-grade schist is common in Grade Creek and on the north slopes near the mouth of the Suiattle River. Timber harvest and road construction on these landforms has resulted in numerous hillslope failures and road problems (Roads 1610, 2642, 2660, 2661, 2680, 2540, and 2550).

Landforms and slope and channel processes are greatly influenced by the volcanic and glacial history and by the presence of the Straight Creek fault across the western portion of the watershed.

During the last ice age (approximately 15,000 years ago), western Cascade rivers were blocked repeatedly by ice that extended down and carved out the Puget Sound. During these ice dam periods, fine, clay-based sediments deposited in the river valleys where water impounded behind the ice. The lower Suiattle River valley and mouths of tributary streams were covered in this lacustrine clay.

As the glaciers receded, coarse glacial outwash was deposited over the lacustrine clay. These strata produce unstable hillslopes because water moves rapidly through the glacial outwash, but slowly through the lacustrine clays. Water thus perches on top of the clay and creates pressure in the spaces between the less cohesive outwash material, leading to unstable slope conditions. Lower slopes and valley terraces that have this layering are highly unstable. These areas are clearly evident along Road 26 on the high Suiattle River terraces. The road surface is irregular and in some areas the face of the terrace is actively failing.

After the glaciers retreated, the stream network incised into the landscape and various glacial deposits. The result is a common landform, especially in the tributaries, known as the inner gorge. The inner gorge slopes are very steep, and in many cases, very unstable. Inner gorges are characteristic of Grade/Big, Straight, Buck, Downey, and Sulphur Creeks.

The Straight Creek fault is the most significant structural element in the analysis area. This fault is a major structural feature that extends well beyond the Suiattle River watershed. The fault crosses the Suiattle River at Straight Creek (the namesake for the fault network). Rocks along the fault have been mechanically altered and weakened by movement of the fault. The most unstable areas subwatersheds are Grade and Straight Creeks, that are directly on the fault. East of the fault, alteration affects primarily granitic rocks that weather to coarse textured, sandy soils with low water retention. Circle Creek and the east side of Straight Creek display particularly unstable, altered gneiss. West of the fault, rocks are derived from seafloor sediments, that weather to finer textured soils. Grade Creek and the west side of Straight Creek display high instability.

The Suiattle River turns abruptly northward at the fault and follows the weaker rocks along the fault before turning west again downstream of Big Creek. The Suiattle River has down cut more in the weakened rocks at the fault and has exposed the lacustrine sediment deposits. The layering of the lacustrine and glacial outwash materials is evident in the high terraces along Road 26.

## *Glacier Peak*

Information for the following description was obtained primarily from U.S. Geological Survey Fact Sheet 058-00, 2000.

Since the last ice age, Glacier Peak has produced some of the largest and most explosive eruptions in the state! Glacier Peak and Mount St. Helens are the only volcanoes in Washington State that have generated such large explosive eruptions. About 13,100 years ago, Glacier Peak generated a sequence of nine tephra (molten rock fragment) eruptions within a period of less than a few hundred years. The largest ejected more than five times as much tephra than the May 18, 1980 eruption of Mount St. Helens.

These eruptions generated dozens of lahars (mudflows) from Glacier Peak that inundated the valley floors of the White Chuck, Suiattle, and Sauk Rivers. Lahars then flowed down both the North Fork Stillaguamish and Skagit Rivers to the sea, covering much of the Skagit and Stillaguamish River deltas with several feet of mud. After this eruptive period, the Sauk River abandoned its North Fork Stillaguamish course at Darrington and began flowing north into the Skagit River as it does today.

About 5,900 years ago and 1,800 years ago, eruptions generated lahars that again flowed down the Sauk and into the Skagit River to the sea. More recent, smaller eruptions within the last 1,800 years produced lahars that extended part way down the Suiattle River to approximately Straight Creek.

These lahar deposits infilled valleys and covered the lacustrine and outwash deposits. Subsequent erosion by streams results in steep inner gorges at the mouths of smaller streams and deep terraces along the mainstem Suiattle River. The inner gorge slopes and terraces are prone to failure due to the high and variable pore pressures caused by the layered coarse and fine deposits. A characteristic chronic river terrace failure is near milepost (MP) 6 on Forest Road 26.

## *Soils*

Soil productivity within the Suiattle River watershed is quite variable and corresponds with elevation, slope steepness, and parent material. Approximately one-third of the watershed consists of rock outcrop and talus slopes. Sulphur Creek is nearly half rock outcrop. These conditions are most prevalent within the steeper sloped, higher elevations where retreat of glaciers and loss of snowfields in the last 100 years has left considerable exposed bedrock. Runoff is very rapid from these areas.

Soil development and productivity is much higher within the valley bottoms and lower toe slopes where soils have developed from material that include, glacial till and drift, residuum and colluviums, and alluvium. Deposits of glacial till and interbedded glacial lacustrine materials (existing primarily within the lower valley floor) develop unique soil structural and textural characteristics that influence soil drainage characteristics. As discussed above, these characteristics can cause slope instability.

## *Erosion and Mass Wasting*

No comprehensive landslide inventory has been completed for the Suiattle River watershed analysis area. Kari Paulson looked at mass wasting changes related to management activities in the Skagit River for the Skagit System Cooperative (Paulson 1997). Included in her mass wasting data set and analysis is the Lime Creek subwatershed. The analysis showed that:

- Inner gorge landslides have the highest sediment delivery ratio
- High-grade metamorphic rocks have a failure rate less than half that of low-grade rocks and deep glacial deposits
- Slopes in high-grade rocks tend to be steeper than in low-grade rocks which increases the probability that a shallow-rapid landslide will trigger a debris flow, although failure rates are much lower in high-grade rock types
- Land-use intensity was generally higher on deep glacial deposits and low-grade metamorphic rock units (probably because slopes are less steep).
- Road-related erosion rates were from 5 to over 4,500 times greater than for mature forest. The highest rate is due to the extremely high road-related failure rate in Lime Creek. (This road has been decommissioned.)
- Higher sediment delivery from immature forest in high-grade areas suggests that high-grade metamorphic areas are more sensitive to vegetation removal than areas dominated by low-grade metamorphic and sedimentary rocks.
- Although road-related failures deliver a large amount of sediment on a volume per acre road prism basis, they contribute less total sediment than failures initiated in either mature or immature forest.
- Although inner gorges occupy only 2 to 24 percent of the landscape, a majority of all sediment delivered to streams by mass wasting comes from this landform.

Areas described as S-8 or J-8 have been identified within the analysis area. Areas identified as J-8 are usually very steep, rocky areas that would represent extreme difficulties for reforestation. The S-8 areas are prone to landslide or mass wasting activity. No S-8 or J-8 areas have been identified within the wilderness area in the upper portion of the watershed. Within the lower Suiattle River, below Downey Creek, there are approximately 2,210 acres of S-8 and 8,460 acres of J-8. It is quite likely that S8/J8 acreage does actually exist within the upper Suiattle River, but no further inventory has been accomplished within the watershed.

Snow and debris avalanche chutes are a common feature in this analysis area. Most of the very large avalanche chutes that originate high on the ridges appear to be recovering or stabilizing. They are covered in alder and small conifer trees and do not appear to have recent activity. These chutes were probably associated with persistent snowfields that once covered most of the ridges. Over the last 100 years, most of these snowfields have disappeared, leaving exposed bedrock. These outcrops and associated avalanche chutes are common in upper Downey, Sulphur, and Milk Creeks, but do not now appear to be generating large amounts of sediment.

### Trends

Road construction techniques until the 1970s included sidecast road fills. These fills are susceptible to failure under high moisture conditions. Insufficient road maintenance and road drainage improvements will elevate the risk of accelerated road surface soil erosion. Inadequate or insufficient road drainage will increase the risk of mass failure of road cut and fill slopes.

### Opportunities

The Skagit River System Cooperative has secured funding for road inventories to validate roads with the highest risk of failure and the highest likelihood of impacting aquatic habitat. This information will be available to establish road stabilization and decommissioning priorities.

## Hydrology

### Precipitation

Precipitation in the Suiattle River is much like the Sauk and White Chuck Rivers. Snow dominates the winter precipitation above 3,500 feet; spring and fall are rainy; and July and August are typically dry. While the high elevations in the watershed develop deep snow during the winter season, the valley bottom up to about Downey Creek is dominated by rain throughout the year. Snow may cover the entire analysis area for short periods when cold weather systems cross the area. The transitional rain and snow zone is a narrow band in the analysis area. Snow persists well into June and July at the higher elevations. Annual precipitation varies from about 78 inches near the mouth of the Suiattle River, to 150 inches around Spire Point at the head of Downey and Sulphur Creeks, to 170 inches at Glacier Peak.

### Runoff

There is no active stream gauge on the Suiattle River, however there is a gauge (USGS Gauge Station No. 12189500) on the Sauk River, near Sauk. This gauge is eight miles downstream of the Suiattle River and has a record from 1911 to the present (76 years). The Suiattle River was gauged at three locations for short periods of time: Below Lime Creek (12188000), 1921-1922; Above Big Creek (12188400), 1971-1980; and near Mansford (12189000), 1938-1950. A gauge was operated in Big Creek (12188500) from 1943 to 1947. These gauge records were not reviewed for this analysis.

The hydrograph shape of the Suiattle River can be inferred from the Sauk River. Peak flows often occur in response to winter rain-on-snow storms, which are characterized by heavy precipitation and rapid low-elevation snowmelt resulting from high freezing levels. Peak flows such as November 1990 and February 1996 resulted from heavy precipitation and low elevation snowmelt. The flood peaks of October 2003 were somewhat different (see discussion below) because the snow and ice that melted were at much higher elevations. There was no low-elevation snow that contributed to the runoff. Rainfall was very heavy.

Spring snowmelt accounts for other high flows when temperatures rapidly increase in April and May. Only 16 of the 76 years of peak flow data for the Sauk River exhibited peak flows as a result of spring snowmelt from March through June.

Glacier melting during the summer maintains a high discharge rate, compared to non-glacial streams. Rapid melting of the Chocolate Glacier during hot summers causes the Suiattle River to run very turbid. This silt is noticeable all the way to Puget Sound since it enters the Skagit River when discharge there is too low for significant dilution.

The high amount of exposed bedrock along the higher elevations, the high stream density, and steep slopes and streams in the Suiattle River contribute to rapid (flashy) runoff. The watershed, however, is not subject to high intensity thunderstorms, and under most storm patterns, the higher elevations do not contribute to rain-on-snow runoff.

## Rain-on-Snow

As mentioned above, a portion of the Suiattle River is in the transitional snow zone. This is the zone, usually described as elevations between 1,500 and 3,000 feet, where snow accumulates during colder winter storms. Subsequent warmer storms bring rain and wind that may completely melt the snow in this zone. These rain-on-snow storms typically produce the largest floods on rivers on the west side of the Cascades.

The State of Washington Department of Natural Resources has defined five zones relative to rain-on-snow (Table 2-1) (Brunengo et. al. 1992). The middle zone is the "rain-on-snow" zone (ROS). The other four zones are highland (HL), snow-dominated (SD), rain-dominated (RD), and lowland (LL). The only zone not represented in the Suiattle River is the lowland.

**Table 2-1 Distribution of Precipitation Zones in Suiattle Watershed**

Percentage of subwatershed in the precipitation zones as defined by Brunengo et. al. 1992. Key: HL = highland , SD = snow-dominated, ROS = rain-on-snow, RD = rain-dominated, and LL = lowland.

| | | **Percent of subwatersheds in Precipitation Zones** | | | | |
|---|---|---|---|---|---|---|
| **Subwatershed Name** | **Subwsd Number** | **HL** | **SD** | **ROS** | **RD** | **LL** |
| Suiattle River Headwaters | 171100060201 | 98 | 2 | | | |
| Suiattle River/ Miners Creek | 171100060202 | 87 | 13 | | | |
| Sulphur Creek | 171100060203 | 83 | 15 | 2 | | |
| Downey Creek | 171100060204 | 74 | 20 | 6 | T | |
| Suiattle River/Milk Creek | 171100060205 | 63 | 25 | 12 | T | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Lime Creek | 171100060301 | 80 | 18 | 2 | T | |
| Buck Creek | 171100060302 | 66 | 22 | 10 | 2 | |
| Suiattle River/Circle Creek | 171100060303 | 41 | 28 | 17 | 14 | |
| Big Creek | 171100060304 | 55.5 | 25.5 | 14 | 5 | |
| Lower Suiattle River/Tenas Creek | 171100060305 | 22 | 22 | 17 | 39 | |
| Analysis Area | | 66 | 18 | 8 | 8 | |

Only eight percent of the Suiattle River watershed is within the zone titled "rain-on-snow," present as a very narrow band in the lower third of the watershed. Most flood-producing storms are associated with freezing levels up to 7,000 feet, or more. This makes it probable that rain and snowmelt contribute to flooding from both the snow-dominated and rain-on-snow zones. The Suiattle River has a relatively low amount of these zones (8 and 18 percent, as shown in Table 2-1 Distribution of Precipitation Zones in Suiattle Watershed) and, therefore, is not as prone to rain-on-snow floods as are other watersheds with a higher proportion of these zones.

## Vegetation Disturbance

Vegetation disturbance, as referred to in this watershed analysis, is the removal of forest canopy by fire or timber harvest and roads. Changes in a forest canopy can contribute to rain-on-snow effects by altering the processes that accumulate and melt snow (Coffin and Harr 1992). Openings in the forest canopy collect more snow during snowstorms. These same openings allow more wind movement across the snow during rain-on-snow storm events that contributes to more rapid snowmelt. In this way, forest management can contribute to higher rates of snowmelt during rain-on-snow events.

The current vegetation disturbance level for the entire Suiattle River watershed is low. The vegetation disturbance model to calculate percent disturbance for all the subwatersheds, however, was not run for this analysis.

Vegetation disturbance prior to the 1900s was by fire. As in other portions of the Sauk River, major stand-replacing fires occurred around 1300, 1508, and 1701. Large areas of the Suiattle River burned during those periods. A fire in 1834 burned much of the Suiattle river valley and lower hillslopes up to Downey Creek.

Much of the watershed upstream of Buck Creek is in the Glacier Peak Wilderness and was not entered for timber harvest. With the exception of recently exposed areas and avalanche chutes, most of the forest in the upper watershed is 200 to 300 years old.

The private lands downstream of All Creek have been harvested repeatedly. These lands are in the rain-dominated precipitation zone where they have minimal effect on rain-on-snow runoff.

On National Forest System land, timber harvest and road construction since the early 1930s has been confined to the main Suiattle valley and lower side slopes up to Sulphur Creek. Harvest of the old forests on the productive river terraces often included tree removal to the riverbank. Many of these forest stands are now 50- to 60-year old second growth.

During the 1960s, 1970s and 1980s, harvest restrictions in Roadless Area Review Evaluations I and II led to intensive timber harvest and road-building in Grade, Tenas, Conrad, and All Creeks, with significant excursions into Circle, Lime, and Straight Creeks.

Many of the harvest units and roads built for timber harvest were located in the prominent rain-on-snow zone and involved unstable hillslope locations (see Geology above).

Rain-on-snow effects from management activities have probably not been significant in the mainstem Suiattle River. However, some of the tributaries, such as Tenas, Straight and All Creeks may have experienced increased rain-on-snow runoff in the 1970s and 1980s. Most of these timber stands have re-established to the degree that rain-on-snow effects have diminished. However, the effect of roads on watershed processes continues.

## *Streams*

The Suiattle River is very dynamic due to the geologic and management history of the watershed. The Cascade Mountain uplift and subsequent valley glaciation modified by eruptions of Glacier Peak has resulted in steep and incised channels. Nearly 80 percent of the mapped streams are extremely steep (greater than 21 percent gradient) (Table 2-2). Only seven percent of the stream channels are two percent or less in gradient. These low gradient reaches generally represent the best spawning and rearing habitat for fish species, although reaches up to 20 percent gradient support some fish species.

This discussion of streams is limited to the mapped stream channels on the MBS Forest geographic information system's (GIS) stream cover. For the Suiattle River, this does not include streams outside the National Forest boundary. There are approximately 12.5 miles of the mainstem Suiattle River, and many miles of tributary channels, downstream of the National Forest boundary.

With over 90 percent of the streams being five percent gradient or steeper, the stream energy for sediment transport through the stream network is high. Most sediment is readily transported from the steep tributary streams to the Suiattle mainstem channel. The high energy of the streams is capable of severe streambank erosion during floods (see October 2003 Flood). Erosion of the toe slopes along inner gorges and the base of high river terraces has caused mass failures of glacial and mudflow deposits.

Of the 156 miles of 0 to 2 percent gradient streams, 67 miles are for channels that are Class 1 or Class 2. These channels represent a large amount of habitat and are considered the most valuable and usable anadromous fish habitat. Other low-gradient channels, or sections of channels, may be inaccessible for anadromous fish due to barriers such as a steep reach or cascade. Many more miles of habitat are present in the analysis area in higher gradient channels (approximately 285 miles of stream 3 to 20 percent gradient). Much of this habitat only represents migratory and rearing habitat rather than spawning habitat. The reliability of the Stream Class designations on the Forest is relatively low with little to no validation.

**Table 2-2 Miles of Stream Channel by Gradient Class and Percent**

Gradients calculated from 10 m digital elevation models (DEMs). Only includes National Forest System lands.

| Watershed | Stream Gradient Class | Stream Miles | Percent of Streams in Subwatershed | Percent of Streams in Suiattle River Analysis Area |
|---|---|---|---|---|
| 1711000602 (Upper) | 0-2 | 78.5 | 5.8 | 3.5 |
| | 3-4 | 24.6 | 1.8 | 1.1 |
| | 5-10 | 60.4 | 4.5 | 2.7 |
| | 11-20 | 102.7 | 7.6 | 4.6 |
| | 21+ | 1084.9 | 80.3 | 49.1 |
| Watershed Total | | **1351.1** | | |
| 1711000603 (Lower) | 0-2 | 78.0 | 9.1 | 3.5 |
| | 3-4 | 22.6 | 2.6 | 1.0 |
| | 5-10 | 40.4 | 4.7 | 1.8 |
| | 11-20 | 63.2 | 7.4 | 2.9 |
| | 21+ | 654.8 | 76.2 | 29.6 |
| Watershed Total | | **859.0** | | |
| Analysis Area Total | | **2210.1** | | |

## *Sediment*

The Suiattle River carries a high sediment load, obvious to the causal observer during the summer when the river frequently runs brown. No sediment quantities were calculated for this assessment; however, several characteristics can be discussed in relation to erosion and sediment in the watersheds.

The "brown color" of the sediment in the Suiattle River is from the release of sediment from the Chocolate Glacier and erosion of lahar deposits high in the watershed. Most of this sediment is fine-grained silts and clays (glacial flour). Estimates of the size fraction of glacier-derived sediment (Westbrook 1988) suggests that only 10 percent of the sediment is coarse (sands and larger). The natural sediment load, therefore, is mostly fine material that flushes downstream into the Sauk River or settles out in calm off-channel areas.

Sediment from road failures, mass failure of in-filled hollows of glacial drift, and erosion of glacial till terraces contains a much higher percentage of coarse sediment. The high gradient channels flush this coarse sediment to low gradient reaches and the mainstem Suiattle River where it disrupts the natural balance between sediment and discharge. The river reacts in a number of ways that includes forming large gravel bars that force the river channel to migrate around them, increase channel gradient, by cutting off meanders, in order to transport the sediment, and depositing sediment "plugs" at the head of side channels and de-watering them. Streambank erosion also contributes a higher amount of coarse sediment.

"Processing" of sediment that enters the Suiattle River from channel and hillslope erosion determines the amount of sediment reaching the Sauk River in any flow event or for the year. During very high floods, like the October 2003 flood, some sediment is deposited on higher portions of the floodplain where it will remain for long periods of time. Other sediment is moved to one of the major depositional areas along the mainstem (probably variable depending on number and size of wood jams) where it forms the more active portions of the floodplain and gravel bars. Smaller amounts of sediment are trapped behind large wood jams where it remains as long as the jam is stable (1-10 years). In each high flow event, some of the sediment from the depositional areas or wood jams is transported to lower depositional areas or to the mouth of the river where it may reside in the sediment fan for a short period or carry into the Sauk River for additional "processing".

Sediment, including coarse sediment, has been a natural feature of the Suiattle River. Management activites have changed the amount of coarse sediment and the timing of sediment delivery such that the river must create a form that is in equilibrium with the new sediment load. This process can take many decades.

## Riparian Structure and Condition

A limiting factors analysis for the Skagit River concluded riparian conditions in the Suiattle River are predominantly good (Smith 2003). The percentage of impaired riparian reaches along the Suiattle River ranges from only 0 to 18 percent (Beamer et al. 2000). The Tenas, Lime, and Buck/Downey/Sulphur WAUs, where most of the anadromous salmonid production is, all have near or above 90 percent functional riparian stream lengths (Beamer et al. 2000). The Tenas and Buck/Downey/Sulphur WAUs also have greater than 70 percent conifer in their riparian buffers (Lunetta et al. 1997). The upper Suiattle WAUs, Image Lake and Chocolate Glacier, are both classified with nearly 100 percent functional riparian (Beamer et al. 2000). Impaired areas within the Suiattle are uncommon, but some are scattered along the middle reaches of the mainstem Suiattle River (Beamer et al. 2000).

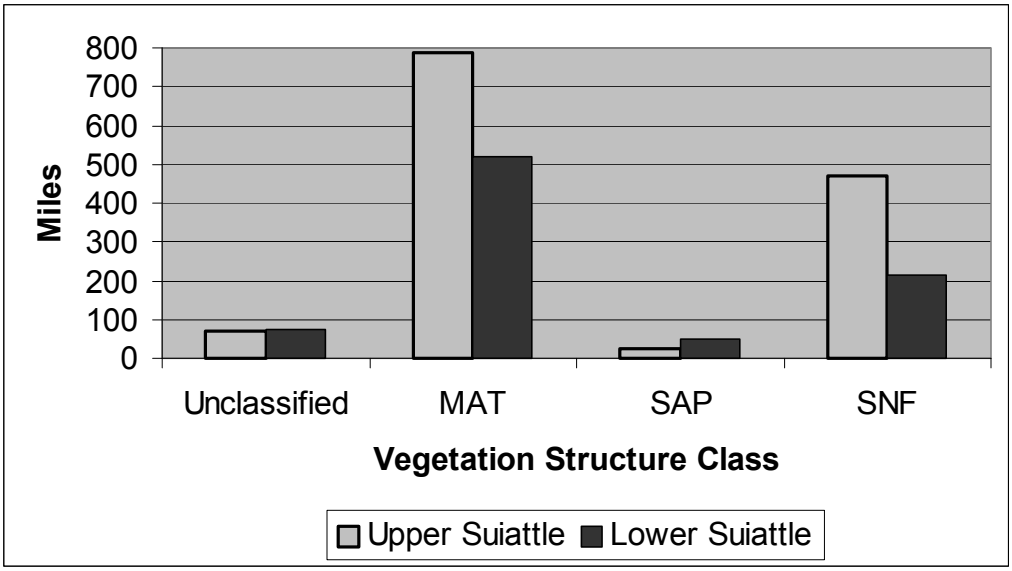
Streamside conditions are important for aquatic habitat diversity and water quality protection (Roni et al. 2002). Streamside vegetation creates shade for temperature control and filters overland flow to eliminate or reduce the amount of sediment that enters the stream. Large trees eventually die or are blown over or undercut by the stream and become large woody material in the channel or on the floodplain. This large material creates storage areas for sediment, provides channel structure that distributes stream energy, and produces channel form and complexity that provides valuable habitat features. The root systems of vegetation bind soil particles together, reducing bank erosion and thereby the amount of sediment introduced to streams.

The structure of the Riparian Reserves, used in the context of this watershed analysis, is an indicator of how well the existing riparian conditions fulfill important functions of:

- providing shade
- supplying large woody material
- filtering pollutants
- providing critical elements for bank stability

The high ridges of the Suiattle River watershed have large unvegetated or non-forested vegetation types. This creates the situation where a large number of small, first-order streams are non-forest types and therefore do not have riparian reserves that offer the values listed above. Most of the streams in the watersheds flow through mature forest types. There is only a minor amount of the stream channels that are bordered by forest types composed of sapling or immature vegetation (Figure 2-1). This analysis does not include streams outside the National Forest boundary.

**Figure 2-1 Riparian Structure Classes for Suiattle Watershed**




Key: MAT = mature, SAP = sapling, SNF = small non-forest, IMM = immature. In National Forest System lands only.

With most of the small non-forest structure being along the first- and second-order streams, there is little or no shade or large wood cover on the small streams in the alpine areas. However, there is an abundance of mature trees below the alpine zone to provide shade to maintain water temperature and supply large woody material. This analysis is not detailed enough to determine how much of the small, non-forest types are from alpine areas versus harvest units, however, most of the timber harvest is 20 or more years old. Any harvest in the last ten years would have included the designation of Northwest Forest Plan Riparian Reserves for the protection of water quality and riparian functions.

The small, non-forest areas have a high rate of bank erosion due to a lack of trees on steep, high-energy channels, and a high incidence of solar radiation. Many of the first order streams in the alpine areas are flowing across bedrock. While stream temperature data are lacking, the high incidence of solar radiation in these areas could cause warm water temperatures of streams.

There are areas in the lower watershed where mature vegetation is lacking along streams, especially downstream of the National Forest boundary. These are areas of more recent timber harvest and include, on NFS lands, Grade and Tenas Creeks. Other locations are along smaller, and intermittent streams.

Overall wood recruitment potential in the watershed is high. This was dramatically displayed in the October 2003 flood. The small areas that lack older riparian vegetation should not affect overall wood recruitment.

Bank stability concerns are greatest where young, or no vegetation, coincides with highly erosive soils. There are approximately 20 miles of stream channels in the Suiattle River where erosive soils and sapling vegetation occur, and 64 miles where non-forest and erosive soils coincide (Table 2-3). Most of these areas are along Class 4, intermittent, streams in the upper watershed. However, there are areas along the lower Suiattle (Class 1 and 2 streams) where young vegetation and highly erosive soils coincide. These areas are of heightened concern for streambank erosion.

**Table 2-3 Miles of Stream With Highly Erosive Soils**

By riparian structure class, stream class, and subwatershed. Suiattle Watershed Analysis area. Source: MBS GIS vegetation layer.

| | | Miles of Stream with Highly Erosive Soils | | | |
|---|---|---|---|---|---|
| Watershed | Stream Class | Small, Non-Forest | Sapling | Mature | Unclassified |
| 1711000602 (Upper) | 1 | 1.88 | 0.09 | 16.24 | 0.00 |
| | 2 | 0.82 | 0.16 | 5.39 | 0.03 |
| | 3 | 11.54 | 0.33 | 40.72 | 1.03 |

| | | | | | |
|---|---|---|---|---|---|
| | 4 | 47.44 | 0.70 | 24.13 | 5.27 |
| | Unclassified | 0.03 | 0.00 | 0.03 | 0.01 |
| Subtotal | | **61.71** | **1.28** | **86.51** | **6.34** |
| 1711000603 (Lower) | 1 | 0.03 | 0.07 | 0.39 | 0.00 |
| | 2 | 0.07 | 2.06 | 9.90 | 0.00 |
| | 3 | 1.36 | 15.26 | 58.42 | 0.24 |
| | 4 | 0.32 | 1.43 | 8.84 | 0.00 |
| | Unclassified | 0.0 | 0.00 | 0.03 | 0.00 |
| Subtotal | | **1.8** | **18.82** | **77.58** | **0.24** |

The upper Suiattle watershed (the Suiattle headwaters and Miners Creek subwatersheds in particular) contains most of the unstable soils in small, non-forest types (Figure 2-2). This accounts for the high incidence of scoured debris avalanche chutes in the upper portions of the analysis area. The lower watershed contains nearly all the sapling vegetation and highly erosive soils combination along streams. Subwatersheds of particular concern are Suiattle River/Circle Peak and Big Creek.

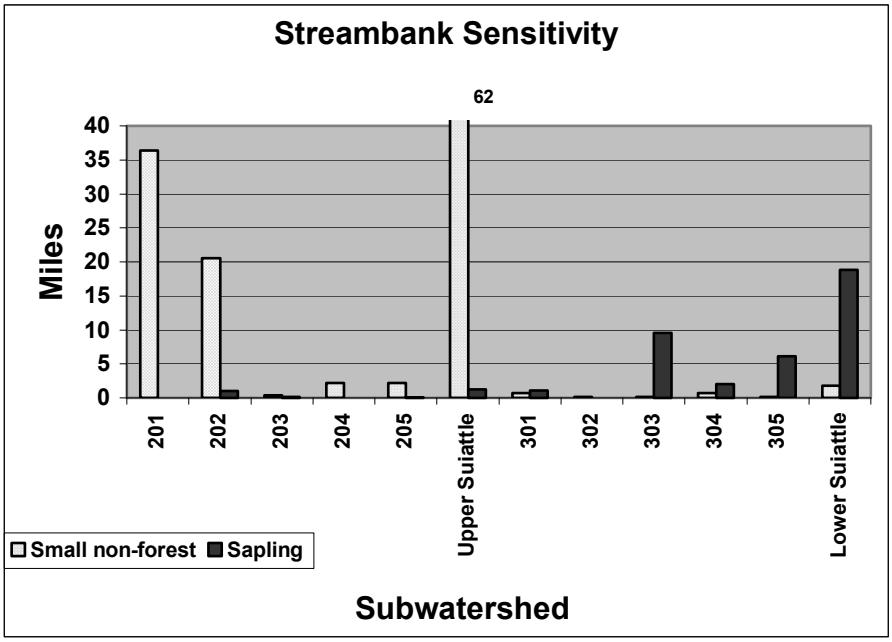



**Figure 2-2 Streambank Sensitivity**

Units in miles of stream in the Suiattle River watersheds that have erosive soils and young or no vegetation on the streambank. Source: MBS GIS Vegetation Layer.

Stream reach stability ratings from a stream survey in 1982 indicate fair to poor streambank stability along the Suiattle mainstem from RM 12 to RM 27. Although these ratings (Pfankuch 1975) have not been calibrated, they are useful for documenting relative channel stability. The greatest instability was noted from Harriet Creek to just upstream of Lime Creek.

**Table 2-4 Channel Stability**

Results from a 1982 Level 2 stream survey of the Suiattle River.

| Stream Name | Survey Date | Reach (R) River Mile (RM) | Stability Score | Rating |
|---|---|---|---|---|
| Suiattle River | 1982 | R1, RM 12.44 to 12.91 | 94 | Fair |
| | | R2, RM 12.91 to 13.44 | 88 | Fair |
| | | R3, RM 13.44 to 13.90 | 81 | Fair |
| | | R4, RM 13.90 to 14.37 | 93 | Fair |
| | | R5, RM14.37 to 14.86 | 97 | Fair |
| | | R6, RM 14.86 to 15.39 | 93 | Fair |
| | | R7, RM 15.39 to 16.05 | 89 | Fair |
| | | R8, RM 16.05 to 16.58 | 78 | Fair |
| | | R9, RM 16.58 to 17.11 | 81 | Fair |
| | | R10, RM 17.11 to 17.52 | 97 | Fair |
| | | R11, RM 17.52 to 17.88 | 98 | Fair |
| | | R12, RM 17.88 to 18.62 | 101 | Fair |
| | | R13, RM 18.62 to 18.99 | 92 | Fair |
| | | R14, RM 18.99 to 19.66 | 91 | Fair |
| | | R15, RM 19.66 to 20.02 | 98 | Fair |
| | | R16, RM 20.02 to 20.58 | 86 | Fair |
| | | R17, RM 20.58 to 20.99 | 133 | Poor |
| | | R18, RM 20.99 to 21.77 | 112 | Fair |

| | | | | |
|---|---|---|---|---|
| | | R19, RM 21.77 to 22.36 | 111 | Fair |
| | | R20, RM 22.36 to 22.71 | 108 | Fair |
| | | R21, RM 22.71 to 23.33 | 106 | Fair |
| | | R22, RM 23.33 to 23.88 | 87 | Fair |
| | | R23, RM 23.88 to 24.29 | 87 | Fair |
| | | R24, RM 24.29 to 24.63 | 84 | Fair |
| | | R25, RM 24.63 to 25.24 | 90 | Fair |
| | | R26, RM 25.24 to 25.96 | 92 | Fair |
| | | R27, RM 25.96 to 26.57 | 83 | Fair |
| | | R28, RM 26.57 to 27.12 | 93 | Fair |

## Wetlands

Wetlands are a relatively common feature in this glaciated landscape. Soils derived from glacial till and interbedded glacial lacustrine materials create highly variable soil drainage characteristics. Fine textured layers with low permeability obstruct subsurface water drainage. Wetlands result from perched water tables on the benches and low permeability areas in the valley bottoms.

The National Wetlands Inventory (NWI) identifies numerous small wetlands in the Suiattle watershed. Many of these mapped wetlands are open water lakes, but the larger acreages are riverine wetlands. Most of the Suiattle River from All Creek to Sulphur Creek is bounded by wetlands. Many of these are associated with old river meanders and side channels within the diverse floodplain and river valley. Most of the tributaries have no mapped wetlands, however large wetland complexes are mapped in Miner's Creek and the Suiattle River upstream of Miner's Creek.

These wetlands are important for moderating runoff generated by rain-on-snow storms and retaining water within the floodplain for release later in the year. The wetlands also provide habitat for a variety of plant and animal species.

Timber harvest has removed the forest from some wetlands and altered the environment. These wetlands will eventually re-forest, but there are some opportunities for wetland restoration in the area (one such proposal accompanied the White Chuck Road relocation in 2001).

## ***Water Quality***

One of the concerns identified in Chapter 1 is the protection or maintenance of the high water quality of the Suiattle River. Very little water quality information was obtained during this assessment. Two small hydroelectric project studies, one for Big and Grade Creeks (Hydro Energy Development Corporation 1993) and one for Lime Creek (White Chuck Water Company 1982) collected water quality for two years each. No other recent water quality information was obtained for this assessment, and it is assumed the water quality has not been tested in any rigorous way.

### *Streams*

Water quality concerns relate to the beneficial use of the water that, under the Washington Department of Ecology State Water Quality Standards (Washington Department of Ecology 1997), is for spawning and rearing habitat for anadromous fish, including bull trout. High water quality is also important for a host of other riparian-dependent species and amphibians.

The Suiattle River is not listed on the 2002/2004 Water Quality Assessment [303(d)] of the status of water bodies (Washington Department of Ecology 2004, website). There could be water quality impairments, but there are no data that indicate a problem exists.

Wilderness Rangers sampled the Suiattle River and Dusty Creek in 1971. At that time the water temperature was cold (less than 50ºF of 10ºC) and turbidity was low (unpublished data, unknown quality control). Conductivity ranged from less than 25 to 47 (units not specified).

There are no known water quality impairments to the Suiattle River. The river, however, is laden with glacial silt during active glacier melt, and there is a high sediment load from glaciers, unstable soils, and management-related erosion. This sediment influences channel dynamics and morphology as it relates to fish habitat and floodplain processes.

Stream stability information from stream surveys from the 1980s and 1990s is included in the Riparian Condition/Structure section of this document.

### Temperature

No recording thermograph water temperature data were found for this assessment. Spot temperature data from Forest Service stream surveys generally show water temperature to be in the 40s Fahrenheit (4ºC -10ºC). Sampling in 1991/92 by the Hydro Energy Development Corporation showed a spot temperature of 13.9ºC in Big Creek on June 18, 1992 and 15.1ºC and 13.8ºC in Grade Creek on September 19, 1991 and June 18, 1992, respectively. Otherwise stream temperatures were below 10ºC. The riparian evaluation in this assessment shows that most of the forested stream reaches have mature vegetation to promote shade. Considerable shade recovery should have occurred in Big and Grade Creeks over the last decade, but riparian harvest may have led to increased stream temperatures in these creeks.

Except for the sparsely vegetated alpine areas, the riparian vegetation cover is generally adequate for filtering pollutants, including sediment, from surface erosion processes. Mass wasting events from the inner gorge slopes, however, usually have enough energy to transport through the riparian reserve and deposit large volumes of sediment in the streams.

Much of the sediment that does enter tributary streams in the Suiattle River will generally be transported to the Suiattle River channel, where much of it will be temporarily stored in floodplain and channel features before migrating to the Sauk River. Floods may deposit large volumes of sediment on low terraces where it may reside for many years or decades (or longer) before river erodes the terrace (as was the case in the October 2003 flood). Gravel bars are common features of depositional areas in the river.

### MOA with Department of Ecology

In 2001 the Forest Service Region Six and the Washington Department of Ecology signed a Memorandum of Agreement (MOA) concerning water quality management on National Forest System lands in Washington. The MOA emphasizes road management because roads are recognized as a major contributor to sediment and runoff changes in watersheds with considerable forest management. Under the MOA, the Forest Service will "stabilize" the road system within 15 years. Stabilized means there is minimal sediment from roads entering streams.

Roads are a concern in the Suiattle River watershed since they are lacking maintenance and often located on unstable slopes, as explained in previous sections of this document.

## *Lakes*

There are approximately 50 named lakes in the analysis area and at least 20 unnamed lakes (Table 2-5). Stocking of most lakes has occurred, primarily with cutthroat and rainbow, but also golden trout, Eastern brook trout, and even grayling. Non-native strains were often used. WDFW and the Trailblazers group still stock many of these lakes.

**Table 2-5 Lake Within the Suiattle Watershed**

Identified using the Darrington Ranger District map and Wolcott 1961.

| Name | Name | Name |
|---|---|---|
| Prairie Mtn. Lakes | Kawkawak | Pilot |
| Tupso | Toketie | Downey |
| Bee | Horse | Sulphur Mtn. Lakes |
| Bluff | Indigo | Lookout |
| Cliff | Meadow | Bath Lakes (4) |
| Hyas | Emerald | Cub |
| Chaval | Diamond | Itswoot |
| Crater | Lime | Box Mtn. Lakes (3) |
| Target | Milk | Rivord Lakes (2) |
| Airplane | Woods | Twin Lakes (2) |
| Boulder | Slim | Mica |
| Pear | Bench | Canyon |
| Thornton | Spire | Image |
| White Chuck Lakes (2) | Mule | Unnamed (at least 20) |

## *October 2003 Flood*

After one of the driest summers in western Washington, an early fall storm brought record 24-hour precipitation and flooding to northwest Washington. Seattle broke the record for 24-hour precipitation by over two inches, recording 5.02 inches. Precipitation at the Remote Area Weather Station (RAWS) on Gold Hill recorded 7.62 inches on October 21 and a total of 10.07 inches from October 19 to October 22. Darrington received 6.11 inches on the 21$^{st}$, 8.60 inches between October 19 and 22. Marblemount received 4.42 inches on the 20$^{th}$ , 7.18 inches between October 19 and 22. This was the second storm of the month. The previous storm produced 7.72 inches at Gold Hill on October 16 and 17, 7.15 inches at Darrington and 4.86 inches at Marblemount.

The Sauk River experienced a record flood on October 21 of 107,000 cubic feet per second (cfs) at the gaging station near Sauk (USGS Gauge Station No. 12189500). The previous highest discharge was 98,600 cfs on December 26, 1980.

This flood was unusual in that it was not accompanied by the melting of a low elevation snowpack as is typical of a rain-on-snow event in the western Cascades. No snowpack had developed below 5,000 to 6,000 feet in elevation. This storm appears to have caused a high rate of melt on glaciers of the western Cascades. Watershed response to the heavy precipitation was greatest in watersheds with glaciers, and seemed to be accompanied with large amounts of sediment (from melting glaciers and heavy rain on bare soils exposed by recent glacial retreat). The combined large quantities of sediment and water scoured the main river channels and recruited large amounts of trees (large wood) through bank erosion.

Vehicle access within the Suiattle River was interrupted at MP 14.4 where 200 feet of road was washed away by the river. A temporary bypass was scratched into the hillside. Access was completely cut off at Downey Creek due to scouring of the west bridge approach and across the Suiattle by the loss of the roadway on the south side of the Boundary Bridge on Road 25. The bridge across Sulphur Creek was also threatened by undercutting of the south abutment. Table 2-6 lists the known damages to infrastructure (roads, trails and campgrounds). These are preliminary estimates from a fly-over because ground access has been severed. Additional damage likely exists, but will not be discovered until the summer of 2004.

**Table 2-6 Summary of October 2003 Flood Damage**

| Road # | Road Name | Milepost | Description of Damage | Estimate |
|---|---|---|---|---|
| 25 | South Suiattle | 0.10 | Boundary Bridge south approach gone (lost 100 ft ) | $440,000 |
| 26 | Suiattle | 14.4 | Road washed out 330', affects Huckleberry trailhead | $50,000 |
| 26 | Suiattle | 21.9 | Downey Creek bridge approach washed away | $87,000 |
| 26 | Suiattle | 22.9 | Protective fill around west abutment undermined | $19,000 |
| **Trail #** | **Trail Name** | **Location** | **Description of Damage** | **Estimate** |
| 784 | Suiattle River | Various | Trail washed away or slumping into river, several sections totaling one mile | $70,000 |
| 690 | Milk Creek | Suiattle River | Bridge destroyed, approx. one mile of trail lost | $595,000 |

### *ERFO*

When major storms cause damage to Forest roads, their repair may qualify under the Emergency Relief for Federally Owned Roads (ERFO) program. Migration of the Suiattle River channel has resulted in a number of ERFO-qualified "interactions" with Roads 25 and 26. The most recent occurred in the October 2003 flood when 330 feet of Road 26 washed away at MP 14.4 and abutments to bridges at Downey and Sulphur Creeks were undermined, as described above. A history of ERFO sites for the Forest is being prepared that will include numerous sites along the Suiattle River.

Several roads have a history of chronic problems and show up with repeat ERFO sites. Road problems may be due to road location (unstable ground) or to insufficient drainage features (too few or undersized culverts). Roads that have shown chronic problems (Bill Ross, personal communication) are 2510, 2640, 2642, 2660, 2661, 2680, and 2703.

## *Aquatic Habitat*

The Forest Service is required to address two types of habitat defined by legislation: Critical Habitat and Essential Fish Habitat.

### Critical Habitat

Critical habitat is a term within the Endangered Species Act (ESA). It is defined as an area occupied by a species listed as threatened or endangered within which are found physical or geographical features essential to the conservation of the species, or an area not currently occupied by the species, which is itself essential to the conservation of the species (Magnuson Stevens Act, Section 3). As defined in the ESA, "conservation" means any and all methods and procedures, and the use of those, needed to bring a species to recovery—the point at which the protections of the ESA are no longer needed.

Critical habitat is determined after taking into consideration the economic impact it could cause, as well as any other relevant impacts. The Secretary of the Interior or Secretary of Commerce may exclude any area from critical habitat for their pertinent species if the benefits of exclusion outweigh the benefits of inclusion, as long as the exclusion would not result in the extinction of the species.

The USFWS has postponed a proposed rule for Puget Sound bull trout critical habitat until sometime in fiscal year 2004, and NOAA Fisheries (also known as the National Marine Fisheries Service [NMFS]) is currently reassessing designated critical habitat for Chinook.

## Essential Fish Habitat

The Sustainable Fisheries Act of 1996 amended the Magnuson-Stevens Fishery Conservation and Management Act to require federal agencies to consult with the National Marine Fisheries Service for activities that could adversely affect "essential fish habitat" (EFH) for fish species managed by the Pacific Fishery Management Council (PFMC). Essential fish habitat is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (Magnuson Stevens Act, Section 3). Chinook, coho, and pink salmon are the predominant species caught and managed under the PFMC's salmon management plan.

Aquatic habitat is assessed below at two scales: the watershed and the reach. Both scales are important for understanding the status of fish and other aquatic habitats in the analysis area.

### *Watershed-scale assessment*

The Suiattle River watershed was preliminarily assessed (Doyle 1999a) to determine baseline conditions of fish and fish habitat indicators for Chinook and bull trout, per criteria established in the USFWS Matrix of Diagnostics/Pathways and Indicators (USDI USFWS 1998). The objective of the matrix is to integrate the biological and habitat conditions to arrive at a determination of the potential effect of land management activities on a proposed or listed species.

The primary fish stocks of concern for this assessment are the Suiattle spring Chinook (one of six Skagit River Chinook populations) and (lower Skagit) bull trout. Of the 23 subpopulation and habitat diagnostic indicators, four indicators (wetted width/depth ratio, disturbance history, riparian conservation areas, and disturbance regime) were identified as "functioning at unacceptable risk" in the lower Suiattle watershed only (see Table 2-7). At the time of the baseline assessment, the Suiattle River was mapped as three fifth-field watersheds, the upper, middle and lower. Several indicators were "functioning at risk".

The integration of habitat indicators rated the lower Suiattle River as functioning unacceptably, the middle Suiattle River as functioning at risk, and the upper Suiattle River as functioning appropriately. This assessment identifies several conditions or processes that could be targeted by restoration activities.

Another assessment (Smith 2003) identifies sediment, floodplain condition, large woody material and streambed stability as degraded in much of the lower Suiattle River. The upper Suiattle River rates good for all factors except large wood, spawning gravel quality and streambed stability.

**Table 2-7 Pathways and Indicators for Habitat in Suiattle River**

Excerpts from the environmental baseline assessment (Doyle 1999a). Key: USR = Upper Suiattle River; MSR = Middle Suiattle River; LSR = Lower Suiattle River.

| Pathways and Indicators | Functioning Appropriately | Functioning at Risk | Functioning at Unacceptable Risk |
|---|---|---|---|
| *Water Quality* | | | |
| Temperature | USR, MSR, LSR | | |
| Sediment | USR, MSR, LSR | | |
| Chemical Contaminants/Nutrients | USR, MSR, LSR | | |
| *Habitat Access* | | | |
| Physical Barriers | USR, MSR, LSR | | |
| *Habitat Elements* | | | |
| Substrate Embeddedness | USR, MSR | LSR | |
| Large Woody Debris | USR, MSR, LSR | | |
| Pool Frequency and Quality | USR, MSR, LSR | | |
| Large Pools | USR, MSR, LSR | | |
| Off-channel Habitat | | USR, MSR, LSR | |
| Refugia | USR, MSR, LSR | | |
| *Channel Conditions* | | | |
| Wetted Width/Depth Ratio | USR | MSR | LSR |
| Streambank Conditions | USR, MSR | LSR | |
| Floodplain Connectivity | USR, MSR | LSR | |
| *Flow/Hydrology* | | | |
| Change in Peak and Base Flows | USR, MSR, LSR | | |
| Drainage Network Increase | USR, MSR | LSR | |
| *Watershed Conditions* | | | |
| Road Density and Location | USR, MSR | LSR | |
| Disturbance History | USR, MSR | | LSR |
| Riparian Conservation Areas | USR, MSR | | LSR |
| Disturbance Regime | USR | MSR | LSR |
| *Sub-population Statistics* | | | |
| Sub-population size | USR, MSR, LSR | | |
| Growth and Survival | USR, MSR, LSR | | |
| Life History, Diversity | USR, MSR, LSR | | |
| Genetic Integrity | USR, MSR, LSR | | |
| **Integration of Habitat Indicators** | **USR** | **MSR** | **LSR** |

## *Reach-scale assessment*

### Instream Habitat

Forest Service Region Six Aquatic Habitat surveys (Modified Hankin and Reeves, Level II) have been conducted on several of the tributaries to the Suiattle River during the 1990s (USDA Forest Service 2002, CD-ROM). The purpose of these surveys is to generally characterize aquatic habitat for a stream system, by collecting reach-scale information on habitat features (USDA Forest Service 2002b). The effect of the October 2003 flood on the habitat features of these channels tributaries is unknown, but considerable scour, sediment transport, and woody material recruitment occurred. While a survey of 14.7 miles of the mainstem Suiattle River was completed in 1982, the channel has undergone major changes from floods since 1982.

Side channels of the mainstem and other off-channel habitats are important for both spawning and rearing. The Suiattle River has a wide diversity of off-channel habitats. Floodplain habitat is moderately abundant along the Suiattle River from RM 0 to 4.7 and from RM 9.6 (Tenas Creek) to 22.3 (just upstream of Captain Creek) (Smith 2003). Unfortunately, the same areas with significant floodplain habitat have some alteration of floodplain processes through the encroachment by roads (hydromodification). Floodplain road density is 1.7 miles per square mile of floodplain habitat, which falls into the “fair” category (Smith 2003).

Channel incision has left some of the side channels disconnected from the mainstem except at the highest flows. Significant channel migration has eliminated some side channels and created others. Wood deposition during the October 2003 flow events may have set the stage for creation of new off-channel habitat that may become important for fish.

### In-channel Large Wood

An important attribute of stream and riparian corridors is the distribution and abundance of large woody. In Pacific Northwest streams, large wood plays an important role by influencing channel morphology and thereby creating and enhancing fish habitat (Bisson et al. 1987). Logs and rootwads enter stream channels due to bank cutting, blowdown, and mass wasting. The probability that a falling tree will enter a stream is a function of slope and distance from the channel in relation to tree height (McDade et al. 1990). Pools formed in association with large wood provide deep, low-velocity habitat with cover beneficial for a variety of salmonid species and life history stages. Large wood often traps and stores sediment (affecting sediment transport rates), retains spawning gravels, functions to dissipate energy, and provides thermal and physical cover.

As discussed above, wood recruitment in the Suiattle River is generally high. The last two flood events (1996 and 2003) have shown that wood recruitment can be dramatic. Large accumulations of wood from these floods will have lasting effects on channel dynamics and habitat features for years to come. Removal of the wood in the 1970s and 1980s likely mobilized considerable sediment and allowed for the incision of the mainstem, but that process may be reversed as wood again accumulates in the river.

The Forest Service, Pacific Northwest Region, categorizes wood into three size classes. For forests west of the Cascade Mountains the large class (24 inches or greater in diameter and at least 50 feet long) is considered the most beneficial. The recommended amount is greater than 80 pieces of the large class per mile (USDA FS and USDI BLM 1995). While 80 pieces per mile is also supported by USFWS (1998) and NMFS (1996), Doyle (1999b) recommends that the location and complexity of this wood, which varies with channel type and size, also needs to be considered when evaluating large wood and habitat quality.

Downey Creek (Suiattle River) is considered a reference Northwest Cascade stream for desirable wood levels. The lower 6 miles of Downey Creek contained 118 pieces with the above dimensions during a 1993 survey. The range of natural instream wood can be quite variable, as noted by Doyle.

Numbers of large wood per mile for tributaries of the Suiattle River vary greatly (Table 2-8). The numbers listed are the average pieces per mile for all reaches inventoried. These wood counts do not include wood accumulated in jams, which may be the more important indicator for wood in higher gradient streams. Instream wood may have flushed out of Lime and Straight Creeks in the 1990s, as well as other tributaries, but it is accumulating in the mainstem (observations along the river after floods). Wood recruitment and routing are considered to be functioning appropriately.

**Table 2-8 Summary of Level II Stream Survey**

Obtained from SMART.db information contained on "Streambank" CD (USDA FS 2002).

| Stream Name | Year | No. of Survey Reaches | Surveyed Length (ft) | Avg BfWidth/ Depth Ratio | Avg. Percent Pool | Avg. Pools per Mile/>3' per Mile | Avg. Large Wood per Mile | Gradient Avg/ Range |
|---|---|---|---|---|---|---|---|---|
| All Creek | 1996 | 2 | 6,168 | 11.26 | 23.0 | 50.5 / 0.01 | 143.0 | |
| Circle Creek | 1991 | 1 | 1,578 | | < 3 | | 167.3 | 7 |
| Conrad Creek | 1997 | 1 | 3,876 | 9.74 | 5.6 | 23.2 / 0.00 | 9.5 | 2 |
| Downey Creek | 1993 | 6 | 23,664 | | 5.5 | 5.8 / 0.00 | 101.5 | 8 / 3-15 |
| Lime Creek | 1992 | 4 | 22,111 | | 13.5 | 23.6 / 0.00 | 81.2 | 9 / 2-16 |
| Lime Creek | 1998 | 1 | 3,210 | 16.64 | 10.1 | 14.8 / 0.00 | 3.3 | 8 |
| Straight Creek | 1991 | 2 | 5,570 | | 2.0 | 3.8 / 0.00 | 107.1 | 4 / 3-4 |
| Straight Creek | 1996 | 1 | 5,080 | 12.05 | 13.9 | 18.7 / 0.00 | 79.0 | 3 |

### *October 2003 Flood Effects*

The October 2003 floods were of record magnitude. Most of the salmon redds were destroyed by scour of river bed materials during the flood. Mortality is expected to be highest for Chinook and pink salmon and bull trout. Coho and steelhead would have spawned later in the year.

The floods also deposited large amounts of wood in the channels. While the amount of wood that entered the channels has not been quantified, Kincare (personal communication) rafted 16 miles of the river in April 2004 and noted wood accumulations. His report states "From RM 16.5 down to about RM 11 (The Nature Conservancy's Wilcox property at Road Mile 9), there were at least 25 logjams...Many scattered single large logs were present as well…From RM11 to RM8, the gradient increases and only three red cedar logs were counted…Continuing downstream to Derringer Park, RM5, virtually no wood was observed in the river or along the bank…Wood was spotty through RM3.5. From RM3.5 to the mouth, wood is everywhere… In two cases, I observed large logjams several hundred feet off the current channel… At about RM1.5, the left bank was lined with wood for 500'."

The October floods scoured redds and shifted channels significantly. How much habitat was lost or gained has not been quantified. The Suiattle River migrated into the mouth of Downey Creek, eliminating more than 200 feet of clear water habitat. Other major floods altered fish habitat in the watershed as well. Floods affected Sulphur Creek in the 1970's and removed a spawning bar in 1995; fish access into, and use of, portions of Big and Straight Creeks may have been lost during floods in the 1970's due to debris blockages and severe channel scour. Gravel is only now beginning to collect again.

## Pool Habitat

Pools provide important habitat for salmonid rearing, for low flow protection from predators and elevated water temperatures, for winter refuge, and for holding areas for spawning adults. Spawning occurs at pool-riffle transitions, and different fish species utilize pools throughout the year at varying life stages.

Pool frequency (number of pools over a given distance) is a key feature for salmonids and is inversely related to the low flow wetted width of a stream. Pool frequencies for surveyed streams were highly variable, with gross averages ranging from 4 to 51 pools per mile. Pools greater than three feet in depth are of particular value to anadromous fish for resting and rearing. These larger pools were mostly absent in the tributary streams.

Pool area (percentage of habitat in pools) is inversely related to stream gradient. For stream channels greater than 5 percent gradient and bankfull widths less than 49 feet, the Washington Forest Practices Board (WFPB 1997) suggests that less than 20 percent pool habitat is poor. The WFPB does not suggest an upper limit of pool habitat for channels over 5 percent gradient, nor a separate rating for streams with bankfull widths significantly less than 49 feet.

Pool habitat in Suiattle River tributaries is generally less than 15 percent as an average. The greatest percentage of pool habitat (23%) is in the low-gradient All Creek. Low pool area may be a function of high gradients and lack of pool-forming features such as wood. Large substrate may provide pools but the quality may be limited. Pool habitat could likely be better, particularly where past management activities removed wood that helped to stabilize the channel and provided for instream complexity. Managed streams were found to have significantly less pool habitat than unmanaged streams (Peterson et al. 1992).

## Fish Passage

The limiting factors analysis for the Skagit River (Smith 2003) rated the Suiattle River as "Good" (no fish-blocking barriers) and the Tenas/Big WAU as mostly "good" fish access conditions. Two recent fish passage inventories identified a number of blocking culverts on fish-bearing streams. The Forest Service inventory was completed in 2001 and purposely did not inventory roads already reviewed by the tribes. Therefore the complete picture of fish passage barriers requires use of both inventories.

The Fish Passage at Road Crossings inventory conducted by the Forest in 2001and 2002 found 12 culverts in the Suiattle watersheds that constitute fish passage barriers. Two of these culverts ranked as high priority under the Forest ranking system (Doyle 2003). The All Creek crossing on Road 2511 and the tributary to Straight Creek on Road 27 ranked high for upgrade for fish passage, but both are inaccessible until flood repair work is done.

The Skagit River System Cooperative has identified ten anadromous fish barriers in the analysis area (Smith 2003). Four sites are off-forest. Using a GIS-based assessment, the culverts were rated as high, medium, or low priority based on estimates of habitat upstream of the culverts. A fishway on Suiattle Slough near the mouth of the river is considered a high priority barrier for repair by the tribe (Devin Smith, pers. comm.). The other sites are culverts at road crossings. The high priority culvert sites from the tribal assessment are crossings of Marsh Creek.

**Table 2-9 Fish Passage Barriers**

| Road No. | Milepost | Stream | Structure Type/Size (in.) | Habitat Blocked (Mi. est.) | Forest Priority Score |
|---|---|---|---|---|---|
| 25 | 2.05/2.06 | Conrad Creek | Twin Round 72 | 0.3 | 43 |
| 25 | 2.70 | Suiattle tributary | Round 48 | 0.15 | Not rated |
| 25 | 2.94 | Straight Cr. tributary | Round 24 | 0.40 | 40 |
| 25 | 3.04 | Straight Cr. tributary | Round 24 | 0.15 | 67 |
| 2511 | 0.15 | All Creek | Round 36 | 0.40 | 67 |
| 26 | 13.92 | Suiattle tributary | Round 24 | 0.15 | 40 |
| 26 | 14.17 | Suiattle tributary | Round 24 | 0.15 | 40 |
| 2640 | 2.27 | Grade Creek | Arch 144x120 | 0.30 | 30 |
| 2642 | 0.25 | Upper Grade Creek | Round 144 | 0.07 | 30 |
| 2660 | 1.98 | Suiattle tributary | Round 36 | 0.25 | 45 |
| 27 | 3.76 | Straight Creek | Elliptical 120x144 | 0.25 | 49 |

The high to medium priority culverts from both inventories offer several opportunities to improve fish migration and habitat utilization in the watershed.

**Table 2-10 Anadromous Fish Barrier Identified by Skagit River System Cooperative**

Skagit River System Cooperative (SRSC, previously Skagit System Cooperative - SSC). Culverts inventoried by Washington Department of Fish and Wildlife and SSC. GIS habitat assessment conducted by SRSC and Northwest Indian Fisheries Commission. GIS layer provided by Devin Smith.

| Road Number/Location | Milepost | Waterbody | Type | Tribal Priority |
|---|---|---|---|---|
| | | Suiattle Slough | fishway | Unknown |
| Private | Near end | Suiattle Tributary | culvert | Low |
| Forest Road 26 | 8.7 | Suiattle Tributary | culvert | Medium |
| Forest Road 26 | Approx. 12 | Suiattle Tributary | culvert | Low |
| Forest Road 26 | 13 | Doe Creek | culvert | Medium |
| Forest Road 26 | 13.65 | Suiattle Tributary | culvert | Low |
| Forest Road 26 | 13.8 | Suiattle Tributary | culvert | Low |
| Forest Road 25 | 3.8 | Seed Orchard Creek | culvert | Medium |
| Forest Road 25 | 4.9 | Swamp (Marsh) Creek | culvert | High |
| Forest Road 2540 | 0.15 | Swamp (Marsh) Creek | culvert | High |

## Fish Species of Interest

The Suiattle River provides habitat for fish species listed as Threatened under the Endangered Species Act, listed as "Sensitive" by the Pacific Northwest Region of the Forest Service, and a number of other anadromous and resident fish species.

**Table 2-11 Fish Species in the Suiattle Watershed**

| Name | Scientific Name |
|---|---|
| Chinook Salmon | *Oncorhynchus tshawytscha* |
| Coho Salmon | *Oncorhynchus kisutch* |
| Pink Salmon | *Oncorhynchus gorbuscha* |
| Sockeye Salmon | *Oncorhynchus nerka* |
| Bull Trout/Dolly Varden | *Salvelinus confluentus/ Salvelinus malma* |
| Steelhead/Rainbow Trout | *Oncorhynchus gairdneri* |
| Coastal Cutthroat Trout | *Oncorhynchus clarki clarki* |
| Mountain Whitefish | *Prosopium williamsoni* |
| Sculpin species | *Cottus spp.* |
| Dace species | *Rhinichthys spp.* |
| Threespine Stickleback | *Gasterosteus aculeatus* |
| Salish Sucker | *Catostomus spp.* |

Of all the fish species known to inhabit the Suiattle River, the salmon and char listed in Table 2-12 Fish Species of Interest in the Suiattle Watershed are of the most interest to habitat and species managers such as the Forest Service, the Fish and Wildlife Service, NOAA Fisheries, the local tribes, the Washington State Departments of Fish and Wildlife and Ecology and other fisheries groups and advocates.

The Skagit River basin is the most important salmonid-producing basin in the Puget Sound in terms of abundance, population diversity, and types of habitat (Smith 2003). The eight anadromous salmonid species of the Skagit River comprise approximately 30 percent of all anadromous fish entering Puget Sound. Most of the salmonid populations in the Skagit River are considered native in origin with little influence from non-native introductions.

The Suiattle River populations are a significant contribution to the Skagit River fisheries because of the abundance of habitat, most of which is of relatively high quality when compared to the rest of the Skagit basin.

**Table 2-12 Fish Species of Interest in the Suiattle Watershed**

| Species (Stock) | Status | Primary Utilization | Habitat Limitations and Concerns |
|---|---|---|---|
| Chinook (Suiattle Spring) | NMFS – Listed threatened (3/99)[1]<br><br>SaSI – Healthy (2003) | Suiattle mainstem to ~RM 28.6; spawn in lower reaches of Big, Tenas, All, Straight, Buck, Circle, Lime, Downey, Sulphur, Milk | Floodplain modifications, mobile channel sediments, and natural and road-related sedimentation resulting in general lack of spawning habitat (less than 5 mi); poaching. |
| Coho (Skagit) | NMFS – Candidate (7/95)<br><br>USFS – Sensitive[2]<br><br>SaSI – Healthy (2003) | Suiattle mainstem to ~RM 27.2; spawn and rear in most tributaries. Increasing trend in recent years for returning adults (Skagit coho stock). | Floodplain modification, side channel connectivity, culvert barriers in lower watershed.<br><br>Overwintering habitat (e g., off-channel habitats) |
| Pink (Skagit) | NMFS – Not Warranted (10/95)<br><br>SASSI – Healthy | Mainstem tributaries up to Milk Creek (RM 28.6): Big, Tenas, lower All, lower Boundary, lower Conrad, Straight, Buck, Circle, Lime, Downey, Sulphur, Milk. | Though escapement is increasing, sedimentation (natural and management-influenced) limits spawning habitat. |
| Chum (Sauk Fall) | NMFS – Not Warranted (3/98)<br><br>SASSI – Healthy | Very limited observations document spawning in lower Suiattle to ~ RM 1.6 | Sedimentation (natural and management-influenced) of spawning areas; generally steep gradients |
| Steelhead (Sauk Winter) | NMFS – Not Warranted (8/96)<br><br>SaSI – Depressed (2003) | Presumed spawning in Sulphur and up to Canyon (RM 32.3); documented spawning in many tributaries up to Downey (RM 24.4): lower Big, Tenas, All, Straight, Black, Conrad, Buck, Circle, Lime, Captain, and Downey. | Limiting factors not well-known, likely include lack of off-channel habitats and sedimentation |
| Sockeye (riverine; not Baker R. stock) | NMFS – Not Warranted (Baker River stock in Skagit; 3/99)<br><br>USFS – Sensitive | Mainstem tributaries up to Sulphur Creek (RM 26.3); presumed spawning in lower Tenas, known spawning in lower Buck, Downey, and Sulphur. | Riverine sockeye are not a distinct stock and are not routinely inventoried; limitations have not been determined. |

| Species (Stock) | Status | Primary Utilization | Habitat Limitations and Concerns |
|---|---|---|---|
| Coastal sea-run cutthroat | NMFS – Not Warranted (4/99)<br><br>USFS – Sensitive<br><br>SaSI – Unknown (2000) | Anadromous form known in lower Big, All, Boundary Ck. Pond, Marsh/Swamp, and likely others; resident form in Grade, Canyon, and other tributaries | Limited by steep gradients and lack of low-gradient off-channel habitats. Distribution information is limited. |
| Bull trout | USFWS – Listed threatened (11/99)<br><br>SaSI – Healthy (1998) | Suiattle mainstem to ~RM 42.3; spawn in larger tributaries (Big, Tenas, Straight, Buck, Circle, Lime, Downey, Sulphur, Milk, Canyon, Vista, Miners, Dusty, Small, plus some unnamed) | Population appears robust, though limitations include quantity of large pools and forage, and declining estuarine conditions. |
| Salish sucker | USFS – Sensitive<br><br>WNHP – Critically imperiled | Suiattle Slough, Marsh Pond | Limited data on known distribution |

NMFS = National Marine Fisheries Service; USFS = United States Forest Service (USDA FS 2000); USFWS = United States Fish and Wildlife Service; SASSI = Washington State Salmon and Steelhead Stock Inventory (WDF et al. 1993; WDFW and WWTT 1994); SaSI = Washington Salmonid Stock Inventory (WDFW 1998, WDFW 2000, WDFW and WWTIT 2003 draft); WNHP = Washington Natural Heritage Program (WDNR 2003)

**Table 2-13 Timing of Salmon, Sea-run Trout and Char Freshwater Life Phases**

Early is considered about the first week of the month and late is around the third week of the month.

| Stock | Upstream Migration | Spawning | Intergravel Development | Rearing | Outmigration |
|---|---|---|---|---|---|
| Chinook (Suiattle spring) | March—end Aug | late July—mid Oct | late July—end Feb | Year-round | late Feb—mid-Jun |
| Coho | Aug—Dec | Nov 1—early March | Nov—end June | Year-round | Apr—end Jun |
| Pink | early Jul—Sept | mid-Aug—early Oct | mid Aug—Apr | Freshwater rearing only during outmigration | Mar—May |
| Chum | Oct—mid-Dec | mid-Oct—mid-Jan | mid-Oct—mid-Apr | Freshwater rearing only during outmigration | Mar—mid Jun |
| Steelhead (Sauk winter) | mid-Dec—early Jun | mid-Mar—mid-July | mid-Mar—early Sept | Year-round | mid-Mar—mid-Jul |
| Sockeye (riverine; not Baker R. stock) | Jul—end Sept | mid-Aug—end Oct | mid-Aug—mid-Jun | Year-round | mid-Mar—mid-Jul |
| Coastal sea-run cutthroat | Oct—mid-Mar | mid-Feb—mid-Jun | mid-Feb—mid-Jun | Year-round | end Mar—mid-Jul |
| Native char—Bull trout/Dolly Varden, fluvial/anadromous | May—end Sept | late Sept—end Oct | late Sept—mid-May | Year-round | early Mar—end Jun |

## *Chinook (Oncorhynchus tshawytscha)*

(Federal Threatened species, Puget Sound Evolutionarily Significant Unit [ESU], March 1999)

Chinook in the Suiattle River comprise the Suiattle spring Chinook stock, and are managed as part of the native Sauk River spring Chinook stock. Though occasionally observed spawning in the mainstem, Chinook spawn primarily in the lower reaches of 10 large tributaries up to the Milk Creek confluence at around RM 28.6 (Table 2-4). Rearing occurs in the mainstem along gravel bars and in and around tributary confluences. Some Chinook will only rear in freshwater during their first summer, then rear in the Skagit estuary, while others will rear a full year.

All stocks of Chinook in the Skagit are considered depressed by local state and tribal biologists except the Suiattle stock. Escapement information in recent years and use of new recovery modeling methods have led to a 2003 redesignation of the Suiattle stock from depressed to healthy. However, available spawning habitat in the Suiattle has likely been fully utilized during the last few years.

## *Native Char*

Native char include Bull Trout (*Salvelinus confluentus*) (Federal Threatened species, Coastal-Puget Sound Distinct Population Segment) and Dolly Varden (*Salvelinus malma*)

While there are eight local subpopulations of bull trout in the Suiattle River, they are considered part of the Lower Skagit population. Local biologists consider the bull trout population in the Skagit system to be the most abundant in Puget Sound. The status of spawning and early rearing of the Suiattle subpopulations are: five subpopulations are excellent; two subpopulations are good; one subpopulation is fair. Bull trout and Dolly Varden exhibit similar life history characteristics and habitat requirements, and they are managed the same due to similarity of appearance. Native char require cold water temperatures for spawning and incubation, with spawning triggered by temperatures around 8°C (46°F). They are known to utilize the Suiattle River up to about RM 42 and have been observed in the upper river tributaries such as Milk, Vista, and Dusty Creeks within the Glacier Peak Wilderness. Early rearing occurs in close proximity to spawning habitat, but juveniles will disperse downstream throughout the system to rear.

Char are piscivorous and feed on smaller fish as well as macroinvertebrates and the eggs of salmonids.

## *Coho (Oncorhynchus kisutch)*

(Federal Candidate species, Puget Sound/Strait of Georgia ESU, July 1995; Forest Service Sensitive)

Coho in the Suiattle River are part of the Skagit coho stock. The Suiattle River is considered to produce 10 to 20 percent of the coho salmon of the Skagit River (Hayman and Beamer 1987 and Beechie et al. 1994). Floodplain habitats, side channels, wetlands and other off-channel habitats, are of particular importance to coho salmon. In the Suiattle, coho generally utilize low gradient reaches of smaller tributaries and off-channel habitats. They have been found in the Suiattle River to RM 27.2. Coho are known or presumed to utilize the lower 0.5 miles of Big and Lime Creeks, the lower 1.2 miles of Tenas Creek, the lower 1.1 miles of Straight Creek, the lower 1.5 to 2 miles of Downey Creek, and the lower mile of Sulphur Creek (Cutler 2001), though they have been documented to spawn in the low-gradient reaches of many tributaries in the Suiattle.

Coho spawning is triggered by the first significant fall freshet. Coho rear for about a year in freshwater, distributing downstream throughout the river system. The availability of side channel habitats in the mainstem Suiattle will vary from year to year. Overwintering habitats such as slow side channels and other off-channel areas of the river and tributaries are critical to the rearing phase of the coho life cycle.

### *Steelhead (Oncorhynchus gairdneri)*

Steelhead have a more complex life history pattern compared to Pacific salmon. Steelhead stocks in the Puget Sound ESU were determined by NMFS to be "Not Warranted" for federal listing under the ESA in August 1996. The Suiattle River steelhead are part of the Sauk winter steelhead stock. This stock comprises up to 95 percent of the steelhead in the Sauk basin and utilizes most of the Sauk basin.

Steelhead are known to spawn in tributaries to the Suiattle River up to RM 24.4 (Downey Creek) and are suspected to spawn in tributaries up to RM 32.3 (Canyon Creek).

### *Other Fish Use*

The Skagit River produces the most chum and pink salmon in the contiguous United States (Beamer et al. 2000). Chum (*Oncorhynchus keta*) limitedly use habitat in the Suiattle River, and have been documented up to RM 1.6. The Puget Sound/Strait of Georgia ESU for chum salmon was designated by NMFS as "Not Warranted" for federal listing (March 1998).

Pink salmon (*Oncorhynchus gorbuscha*) are known to spawn in major tributaries of the Suiattle River up to RM 28.6 (Milk Creek). West coast pink salmon were designated by NMFS as "Not Warranted" for federal listing in October 1995.

Sockeye salmon (*Oncorhynchus nerka*) in the Suiattle are a riverine form, Sockeye found in the Suiattle watershed are not recognized as a distinct stock, and they are not managed for harvest. They have been documented spawning in the lowest reaches of a few large tributaries. Use of the Suiattle River is limited, although information on sockeye is lacking.

Coastal (sea-run) cutthroat trout (*Oncorhynchus clarki clarki*) (Forest Service Sensitive species) are known to spawn in a few tributaries to the Suiattle. Resident cutthroat reside in several tributaries. The Puget Sound ESU for coastal cutthroat was designated by NMFS as "Not Warranted" for federal listing in April 1999.

Resident salmonids in the Suiattle watershed include cutthroat, rainbow, char, and mountain whitefish (*Prosopium williamsoni*). Sculpin (*Cottus spp*.), dace (*Rhinichthys spp.*), threespine stickleback (*Gasterosteus aculeatus*), and Salish sucker (*Catostomus spp.*) are other resident fish known to be present in the watershed. The Salish sucker (Forest Service Sensitive species) have been documented in Suiattle Slough and Marsh Pond; distribution data for this species is very limited.

Non-native fish species and strains have also been introduced into the watershed through stocking.

## Poaching

Forest Service law enforcement (Roger Nichols, pers. comm.) has seen evidence of fish poaching on numerous occasions in Buck, Downey, Lime and Sulphur Creeks. Fish biologists with WDFW consistently see bones or gut piles along Downey Creek (Brett Barkdull, pers. comm.). Campsites at Buck, Downey, and Sulphur Creeks, and the relative remoteness of the Suiattle River make migrating salmon highly vulnerable in these streams. There is some indication that Skagit River System Cooperative tribal members have also seen evidence of illegally caught fish in the Suiattle as well, although no definitive information was obtained during this analysis.

## Trends in Aquatic Habitat and Fish Species of Interest

The fact that a large portion of the Suiattle River is in wilderness means that much of the watershed is not impacted by significant human-induced effects. This will remain the case. Natural geomorphic and biologic processes will be unimpaired in much of the watershed. This does not mean disturbance levels are low in the Suiattle River. The presence of Glacier Peak and bare slopes recently exposed by the retreat of glaciers and snowfields will continue to disrupt aquatic habitats. Global warming may increase the frequency of damaging winter storms and, over time, alter the amount of ice melt to sustain summer flows. In contract, summer flows may carry less glacial flour and fine sediment.

Large wood is expected to increase in the mainstem Suiattle River. This will provide opportunities for development of diverse habitat features, but also may increase the amount of streambank erosion until sediment loads and discharge reach an equilibrium tempered by the stability and longevity of log jams.

In the lower river, where the land management imprint is, there will continue to be effects of roads on sediment and wood supply to the mainstem river. Conflicts between roads on floodplains and river migration processes will remain a management challenge for providing user access whole protecting aquatic resources.

At-risk fish stocks may continue a short-term decline as recovery plans are implemented and recovery actions begin to have an effect. Over the long term, fish stocks are expected to rebound and fully utilize habitats in the Suiattle River. Habitat conditions will improve as riparian areas on National Forest System lands are allowed to recover from past management, and sources of accelerated sediment are reduced. These improvements to flows, erosion, channels, and water quality may be delayed by lack of funding. Fish access will improve as barriers are identified and removed.

Demand for salmon produced from all ownerships in the Statewide Comprehensive Plan for Area 1 (most of the western half of Washington State, north of the Cowlitz River, and including all of the Olympic Peninsula) is estimated to increase by 15 percent (estimated from USDA Forest Service 1990b). This estimate is based on the demand increase from 1970 to 2000.

Resident fish numbers are expected to remain at current levels over the short-term. In the long-term, resident fish numbers may decline due to increased recreational fishing pressures, particularly as restrictions on anadromous salmon become tighter.

Emphasis on upslope watershed restoration, and riparian and instream habitat restoration, is expected to continue over the next few years. Upslope restoration will focus on decreasing both the numbers and magnitude of sediment and runoff inputs to the channel network. Instream habitat improvements passage barrier removal associated with restoration activities will help in the shorter term providing benefits in additional and better quality habitat while upslope conditions and improve and natural processes are restored. Cooperative restoration efforts with local Tribes, County/State/Federal agencies, non-profit groups, and private landowners are expected to increase over time. Effective monitoring efforts are also expected to increase to demonstrate successes and correct undesirable situations.

### *Opportunities*

The Skagit River System Cooperative has secured funding to replace fish passage barrier culverts, and for fish passage restoration to Swamp Creek/Marsh Pond.

### *Watershed Restoration*

Watershed and fish habitat restoration has been a component of Forest Service resource management for several decades. Earlier work in the 1980s focused around stabilizing landslides after floods, revegetating road cuts and fills to prevent erosion, and installing instream fish structures to improve pools and spawning gravel habitat. See Table 2-14 for a sampling of some restoration activities within the Suiattle watershed intended to have direct and indirect benefits to aquatic species.

The Northwest Forest Plan ROD (USDA FS 1994b) formalized the term, watershed restoration, by outlining four components of an Aquatic Conservation Strategy (Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration). Recovery of fish habitat, riparian habitat, and water quality are integral to meeting the goals and objectives of watershed restoration. Formal watershed restoration under the ROD on the Mt. Baker-Snoqualmie National Forest began in fiscal year 1995.

Restoration strategies are comprehensive, addressing both the protection of physical and biological processes and functions of the best habitats that remain (refugia) and restoration of those processes and functions of degraded habitat. Managing the road system to reduce sediment, eliminate migration barriers, and disconnect the roads from the stream network is emphasized. In-channel work has evolved from attaching (rebar) individual logs to the streambed to constructing large wood jam structures that flex and move under channel dynamics.

In the Suiattle Watershed Analysis Area, restoration activities stopped with the implementation of the 1994 ROD, pending the completion of a watershed analysis. Some road stabilization work has been completed, but major projects were deferred. Work prescribed to address deficiencies outlined in this analysis will benefit fish and aquatic species by reducing human-influenced sedimentation, particularly in the clear water habitats of the watershed. Attempts will be made to increase or enhance off-channel habitat quantity or quality. Activities might include treatment of upslope drainage problems associated with roads through either closure or obliteration, or through reconstruction of roads to improve local hydrology. Where roads are needed, opportunities to relocate them out of riparian areas and away from fish-bearing waters should be considered as well as improving the drainage structure. Retaining adequate forest canopy will help reduce impacts to the flow regime. Removing fish passage barriers provide an immediate and long-lasting benefit to all fish species. Because restoration of habitat does not often have immediate results, instream habitat improvements can also be done to provide temporary benefits. Impacts to riparian and aquatic habitats from recreational use can be assessed and treatments considered to address problem areas.

**Table 2-14 Partial Listing of Restoration Work Within the Suiattle Watershed. Question marks indicate where the details of the work were not found in the time to complete this assessment.**

| Location | Date | Description/Comments |
|---|---|---|
| Tenas Creek | 1983-2002? | Sediment trap, settling pond, bank planting, jam treatment for fish passage |
| Boundary | 1994 | Increase quantity of rearing habitat in pond |
| All | 1989-92 | Instream structures |
| Conrad | 1987 | Instream structures |
| Flat Alder | 1987-88 | Instream structures; 0.25ac rearing pond |
| Straight | 1987-92 | Instream structures, jam treatment for fish passage |
| Seed Orchard | 1996 | Culvert replacement for fish passage |
| Marsh | 1985-97 | Instream structures, settling basin, increase quantity of rearing habitat in existing beaver pond, fishway |
| Buck | 1985 | Instream structures |
| Circle | 1985-86 | Instream structures, bank planting |
| Pedestal | 1984-90 | Instream structures, off-channel creation |
| Clear Beaver | 1984 | Instream structures |
| Lime | 1985-92 | Instream structures, off-channel rearing enhancement |
| Danny Boy | 1987 | Instream structures |
| Cutoff | 1988 | Excavation of pools |
| John Roy | 1988 | Instream structures |
| Sulphur | 1986 | Instream structures |
| Road 25 South Suiattle | 2002 | 2.5 miles waterbars, culvert removals |
| Road 2550 Meadow Creek Rd. | 1993-94? | Road decommission, incl. slope recontour and revegetation |
| Road 2510-012—Conrad Para Rd. | 1997 | Removal of old stringer bridge over Conrad Creek |
| Road 26, MP ?? | ?? | Replace culvert at Captain Creek |
| Road 26, MP ?? (Cattle guard location) | ?? | Replace culvert with open structure for fish passage at unnamed Suiattle tributary |

## Trends in Watershed Restoration

Emphasis on upslope watershed restoration, and riparian and instream habitat restoration, is expected to continue over the next few years. Upslope restoration will focus on stabilizing roads and improving drainage. Instream habitat improvements associated with restoration activities will help in the shorter term by providing benefits while upslope conditions improve. Cooperative restoration efforts with local Tribes, County/State/Federal agencies, non-profit groups, and private landowners are expected to increase over time. Effective monitoring efforts are also expected to increase with time.

Watershed restoration funding under the ROD has all but dried up. Limited National Forest dollars will need to be leveraged with other funds through partnerships in order for restoration to continue.

There is interest in restoring and protecting aquatic resources in the Suiattle River. The Skagit River System Cooperative has expressed an interest in working with the forest to improve conditions for anadromous salmonids.

# Terrestrial Ecosystem

## *Vegetation Zones and Ecozones*

The following discussion is based largely on a classification of the vegetation that was completed on the Mt. Baker-Snoqualmie National Forest as a part of the Pacific Northwest Region Ecology Program (Henderson et al. 1992).

Ecozones are areas of land with similar environments, and are defined by the elevation of the lower limit of the Pacific Silver Fir Zone. An Ecozone map can be used to interpret broad moisture related environmental patterns. Correlated with Ecozones are many of the plant associations, fire history, wind disturbance history, and timber productivity. Ecozones on the Forest range from Ecozones 5 to 13, with 13 being the driest. In the analysis area, most of the lower watershed is in Ecozone 11, although some of the higher ridges near the Cascade Crest (such as Miners Ridge) are in Ecozone 12. The area around the mouth of the Suiattle River is in Ecozone 10. The significance is that the analysis area is the driest part, not only of the District, but also of the north end of the Forest. Geographically, it sits so far to the east, with so many high peaks between it and in-coming weather systems, that most of those systems lose the majority of their moisture load before they arrive at the east end of the watershed. The affect this has on vegetation will be discussed later.

Henderson et al. (1992) defines Vegetation Zones as “taxonomic units, which are aggregates of Plant Associations with the same climax indicator tree species”. Table 2-15 shows the distribution of Vegetation Zones within the Suiattle River analysis area, within the limits of available data.

**Table 2-15 Vegetation Zones in the Suiattle Watershed**

| Vegetation Zone | Acreage | Percent of total |
|---|---|---|
| Douglas Fir | 613 | <1 |
| Western Hemlock | 50,100 | 23 |
| Pacific Silver Fir | 46,132 | 21 |
| Mountain Hemlock | 62,142 | 28 |
| Subalpine Fir | 2,550 | 1 |
| Parkland | 43,748 | 20 |
| Alpine | 14,666 | 7 |
| Total analysis area acreage | 219,951 | |

The Suiattle River watershed is one of very few on the north end of the Forest that has seven Vegetation Zones. The Douglas Fir Zone and the Subalpine Fir Zone, for example, are not typically found on the north end of the Forest due to the generally higher precipitation levels here. These Vegetation Zones will be discussed in further detail below, but are mentioned here to illustrate their rarity and to further point out the dry nature of the analysis area.

### *Douglas Fir Zone*

Approximately 613 acres (less than 1%) of the analysis area are in the Douglas Fir Zone (Table 2-15). This Zone lies in the Suiattle River bottom from west of Canyon Creek to about Miners Creek. There are also a few acres of it in the Milk Creek drainage. This Zone tends to be on south and southwest facing, convex slopes, on thin soils. It occupies what would ordinarily be Western Hemlock Zone, but on microsites, which are too dry for western hemlock. Elsewhere on the Forest, this Zone can be found in the North Fork Nooksack drainage, and north and east of Mt. Rainier, all of which are in the driest Ecozones. It is most abundant on the east side of the Cascades.

### *Western Hemlock Zone*

Approximately 50,100 acres (23%) of the analysis area are in the Western Hemlock Zone. This Zone occupies the lowest elevations, mixing in places with the Douglas Fir Zone, and so is typically along river bottoms up to approximately 2,500 to 3,000 feet elevation. This Zone is continuous along the Suiattle River to approximately Miners Creek.

The climate in the Western Hemlock Zone portion of the watershed is characterized as warm temperate to maritime, receiving most of its precipitation in the form of rain. The Western Hemlock Zone occurs on some of the most productive growing sites in the analysis area.

### *Pacific Silver Fir Zone*

Approximately 46,131 acres (21%) of the analysis area are in the Pacific Silver Fir Zone. This Zone lies above the Western Hemlock Zone elevationally and so extends further into the major drainages. In some areas along the Suiattle, the Pacific Silver Fir Zone actually drops below the Western Hemlock Zone, probably as a response to the cooler, moister conditions adjacent to the River.

The climate in the Pacific Silver Fir Zone is characterized as cool temperate, receiving much of its annual precipitation in the form of snow. This Zone occurs on low to moderately productive sites in the watershed. Cold temperatures and soil types can limit stand growth potential in this series. Western hemlock is present in significant amounts in this zone and may in fact be the dominant species in many stands at the lower elevation limit of Pacific silver fir.

### *Mountain Hemlock Zone*

Approximately 62,142 acres (28%) of the analysis area are in the Mountain Hemlock Zone. This is the largest Vegetation Zone in the analysis area. It occupies the area between the upper Pacific Silver Fir boundary and the upper limits of closed forest.

The climate in this Zone is characterized as cold temperate, receiving much of its annual precipitation in the form of snow. Site productivity in this Zone is generally low, primarily due to soil types, long periods of cold temperatures, and a heavy, persistent snowpack.

### Subalpine Fir Zone

Within the analysis area are approximately 2,550 acres (1%) of Subalpine Fir type. This Zone occupies upper elevation slopes, mostly above 5,500 feet elevation on drier parts of the Forest, but may occur at lower elevations if on talus or recent lava flows. This vegetation type is typically found in the driest Ecozones and is not common on the north half of the Forest due to the greater precipitation levels here. In this part of the Forest, it is typically replaced by the Mountain Hemlock Zone. In the analysis area, the Subalpine Fir Zone is found at high elevations, close to the Cascade Crest, between approximately Sinister Peak and Buck Creek Pass.

### Parkland Zone

Above approximately 4,500 feet, the forest becomes increasingly discontinuous and the landscape appears as a mosaic of tree patches and meadows. There are approximately 43,748 acres (20% of the area) of Parkland Zone in the analysis area. Temperature, topography, and aspect affect the location of late-melting snow patches that are important in determining the vegetation patterns in this Zone. At the upper limit of the Parkland Zone, trees lose their erect growth habit and eventually disappear from the community altogether. In the analysis area, this Zone occurs on the flanks of Glacier Peak and on the high ridges, and is increasingly abundant the further east into the watershed, as the decreasing moisture limits tree establishment and growth.

### Alpine Zone

In this Zone trees are absent, and the upper limits of plant life are reached. This Zone occurs downslope from glaciers and snowfields, generally above 5,500 feet. There are approximately 14,666 acres of Alpine Zone in the analysis area, representing 7 percent of the total area. It is found on the flanks of Glacier Peak, on the ridges, and near the Crest, but at the highest elevations still support plant life.

## Plant Association Groups

Vegetation is the major component of the ecosystem, and one way to describe vegetation is through a classification based on potential vegetation, using the plant association as the basic unit (Henderson et al. 1992). Potential vegetation is the projected climax plant community that will occupy a site, given current climate and site conditions. Plant association groups (PAG) are useful for indicating the growing potential of an area's vegetation, for getting a sense of appropriate management activities in a given area, and for identifying potential rare plant habitat. It should be noted that the PAG model continues to undergo refinement, and the information used in this analysis is based on the model as it existed at the time of writing.

The PAG model groups together plant associations, which have similar floristic characteristics. Forest Ecologists developed the model using moisture, temperature, and topography variables. The results have been field-checked and show a high degree of accuracy; however, care should be used in interpreting any point on the ground because the model interprets broad vegetation patterns across the landscape and may be misleading on the microsite scale. Most of the plant associations grouped in each PAG are described in the Plant Association Guide for the Mt. Baker-Snoqualmie National Forest (Henderson et al. 1992).

Table 2-16 Plant Association Groups lists the PAGs in the analysis area. As a percent of the total, the largest PAG is the Parkland Zone, but only because there is a single plant association group within that Zone. Other than that PAG, the largest is the Mountain Hemlock/mesic big huckleberry. Other notable PAGs are Mountain Hemlock/Alaska huckleberry, and Pacific Silver Fir/wet Alaska huckleberry. The size of these PAGs is illustrative of the amount of high elevation vegetation in the watershed.

**Table 2-16 Plant Association Groups**

| Plant Association Group | Acreage | Percent of Total |
|---|---|---|
| **Douglas Fir Zone/oregongrape-salal-oceanspray** | 548 | <1 |
| **Western Hemlock Zone** | | |
| Big huckleberry-queen's cup | 735 | <1 |
| Dry salal | 15321 | 7 |
| Vine maple-vanilla leaf | 3 | <1 |
| Mesic salal-oregongrape | 12127 | 6 |
| Wild ginger-oak fern | 10086 | 5 |
| Alaska huckleberry-oxalis | 1386 | <1 |
| Undetermined | 814 | <1 |
| Dry non-forest | 72 | <1 |
| **Pacific Silver Fir Zone** | | |
| Salal-oregongrape | 285 | <1 |
| Dry Alaska huckleberry | 11499 | 5 |
| Big huckleberry-beargrass | 5217 | 2 |
| Big huckleberry-white rhododendron | 2548 | 1 |
| Vine maple-vanilla leaf | 126 | <1 |
| Wet alaska huckleberry | 20825 | 9 |
| Devil's club | 4900 | 2 |
| Dry non-forest | 52 | <1 |
| Wet non-forest | 112 | <1 |
| **Mountain Hemlock Zone** | | |

| Plant Association Group | Acreage | Percent of Total |
|---|---|---|
| Big huckleberry | 296 | <1 |
| Big huckleberry-fools huckleberry | 2799 | 1 |
| Mesic big huckleberry | 32963 | 15 |
| Alaska huckleberry | 21094 | 10 |
| Wet devil's club | 2878 | 1 |
| Dry non-forest | 16 | <1 |
| Wet non-forest | 23 | <1 |
| **Subalpine Fir Zone** | | |
| Boxwood | 27 | <1 |
| Big huckleberry | 417 | <1 |
| White rhododendron-beargrass | 1932 | 1 |
| Mountain arnica-smooth woodrush | 4 | <1 |
| Bunchberry dogwood-horsetail | 173 | <1 |
| **Parkland Zone/mountain hemlock-red heather-blueleaf huckleberry** | 42740 | 19 |
| **Alpine Zone** | 14969 | 7 |

*Note: the PAG names are uniform for the entire Pacific Northwest Region, and may not accurately reflect the particular species found in the analysis area. In addition, the total for all PAGs will not match the watershed total because private lands are not reported.*

## Plant Species of Concern or Interest

This section discusses the species on the Regional Forester's Sensitive Species List (USDA Forest Service 2004); Sensitive species listed by the Washington Natural Heritage Program (1997); species described in the Northwest Forest Plan, as amended by the ROD dated January 2001 (USDA, USDI 2001); and species regulated by law. Less than one percent of the analysis area has had systematic botanical surveys, and additional sightings beyond those already recorded are expected with further surveys.

### Sensitive and Survey/Manage Species

Partway into this analysis, a Record of Decision was signed which removed the Survey and Manage Standards and Guidelines. Approximately half of the species on the Survey/Manage list were moved to the Agency's Sensitive Species list. The following information was compiled before these events occurred, and so mention is still made of the Survey/Manage program.

As of the time of writing, there are 17 known occurrences of Sensitive or Survey/Manage plant species in the watershed, from 15 sites. The species found and their general locations are listed below:

- *Pseudocyphellaria rainierensis* (Survey/Manage lichen) – Downey Creek, Milk Creek
- *Platanthera orbiculata* (S/M vascular plant) – just north of Black Creek, near the Circle Creek Road, near the Suiattle Cemetery, north slope of Box Mountain, Downey Creek, Sulphur Creek (2 sites), and Milk Creek (2 sites)
- *Hypogymnia duplicata* (S/M lichen) – near the Suiattle Cemetery
- *Agoseris elata* (Sensitive vascular plant) – south slope of Green Mountain
- *Nephroma bellum* (S/M lichen) – Sulphur Creek
- *Galium kamtschaticum* (Sensitive vascular plant) – Milk Creek
- *Saxifraga rivularis* (State Sensitive vascular plant) – at the Cascade Crest, south of Liberty Cap
- *Carex proposita* (State Threatened vascular plant) – Cascade Crest, south of High Pass

This is not a large number compared with other areas on the District or Forest, but since the number of sightings is largely a function of survey effort, this number mainly reflects the amount of survey work that has taken place in the watershed. Given the abundance of suitable habitat in the analysis area, the number is almost certainly much larger.

### Noxious Weeds

Forest Service policy is to work with State and County weed control boards to prevent the introduction and spread of noxious weeds, and eradicate established populations. The Forest Service has adopted the State's weed list when targeting species for control.

As of the time of writing, the following noxious weed species have been documented in the analysis area:

- Herb Robert – All Creek gravel pit, Road 2510
- Scotsbroom – All Creek gravel pit, Grade Creek Road
- Sulphur cinquefoil – All Creek gravel pit, Green Mountain horse pasture
- Tansy ragwort – Grade Creek Road, Road 26 (off the National Forest)
- Orange hawkweed – Grade Creek Road, Suiattle Guard Station, Road 25
- Canada thistle – Green Mountain horse pasture

Canada thistle is a State listed Class C weed. Herb robert, scotsbroom and tansy ragwort are Class B non-designates, meaning that they are not designated for control in this area, but preventing new infestations is a high priority. Sulphur cinquefoil is a Class B designate in Snohomish County, and orange hawkweed is a Class B designate in Skagit County. Both are designated for control in their respective County.

With the exception of Road 25 and 2510, all infestations have been treated over the past several years. Most treatment has consisted of hand-pulling the plants, or flower head removal. The exception is the All Creek pit where herbicide was used in 2002 and 2003. By far, the most success has occurred with the use of herbicide. There was a near-total weed kill in the rock pit after the first year. In all other areas, the populations have persisted or declined very minimally, depending on the weed species.

## Plant Habitat Characteristics and Trends

### Unique habitats

For thousands of years, Glacier Peak has produced eruptions and mudflows. Roughly 12,000 years ago, a mudflow filled the Suiattle River valley with ash, rock, and pumice (Harris 1988). The soil types resulting from this are very porous and don't hold water well. As a result, there are extensive stands of lodgepole pine in the Suiattle valley bottom because this species can withstand droughty soil conditions. With a slight increase in elevation, less porous soils are encountered and the pines give way to the typical hemlock and fir species. There are other areas on the District where lodgepole pine stands can be found, such as near Darrington, and they also coincide with previous mudflows from Glacier Peak.

The dry nature of the Suiattle River watershed was mentioned earlier in terms of the presence of the Douglas Fir and Subalpine Fir Zones, but it also manifests itself at higher elevations in some fairly extensive stands of Engelmann spruce (*Picea engelmannii*) near the Cascade Crest. These can be observed walking the trail from Miners Ridge toward Suiattle Pass as well as other areas. This species can be found high on the west slopes of the Cascades but is more common on the east slopes from approximately 4,000 feet to timberline where it intermixes with subalpine fir (Lyons 1999). It is generally intolerant of ocean climates and seldom grows very far west of the Crest (Arno and Hammerly 1977).

In the 1990 Mt. Baker- Snoqualmie National Forest Land Management Plan, several areas on the Forest were recommended for addition to the Research Natural Area system. One of those areas is Green Mountain. Approximately 80 percent of this proposed RNA would be in the Glacier Peak Wilderness. The area is considered suitable for RNA designation because it is a good example of a subalpine parkland mosaic, with heather-huckleberry plant communities, and subalpine lush herbaceous plant communities. The south face of Green Mountain has a notably large open area near its top with avalanche tracks extending partway down the slope, apparently kept free of trees by a persistent snowpack and avalanches. This area is fairly moist in the summer, and supports a lush herbaceous plant assemblage, including one documented Sensitive plant species (*Agoseris elata*). The north side of the slope contains the parkland mosaic and heather-huckleberry community types.

Due largely to the amount of Wilderness and Late Successional Reserve in this watershed, old-growth forest is well represented in all Vegetation Zones except for Western hemlock. This is valuable habitat to a whole host of plant and animal species. The Sensitive or Survey/Manage plant species documented in this watershed were found primarily in old-growth settings. It is also in the old-growth along the Suiattle River near Miners Creek that the tallest Grand fir (*Abies grandis*) in the State is found (Van Pelt 1996). When last documented, this tree was 16 feet 3 inches in circumference and 267 feet tall.

## Seral Stages

Seral stages by vegetation zone for the Suiattle River watershed were determined using the definitions shown in Table 2-17 Seral Stage Definitions by Vegetation Zone. They are different for different Vegetation Zones because natural regeneration times and growing conditions vary from low to high elevations, and the time needed to reach a certain stage generally becomes longer with increasing elevation. Seral stages also differ by plant association group, but have been reduced to averages for this analysis.

**Table 2-17 Seral Stage Definitions by Vegetation Zone**

Numbers are stand ages in years.

| Vegetation Zone | Early seral | Mid seral | Late seral single- story | Late seral multi-story |
|---|---|---|---|---|
| Western Hemlock | 0-30 | 30-180 | 180-400 | >400 |
| Pacific Silver Fir | 0-40 | 40-300 | 300-500 | >500 |
| Mountain Hemlock | 0-100 | 100-350 | 350-500 | >500 |

Seral stages for the Douglas Fir Zone were not analyzed because there are no data to use for comparison, and the total acreage in the watershed is small. Seral stages are not reported for the Parkland and Subalpine Fir Zones because they are not significantly forested, and are not reported for the Alpine Zone because it does not support trees. In the Western Hemlock Zone, there were nearly 12,000 acres outside the Forest boundary whose successional status is unknown. They were assumed to be in an early successional status because they are on private or State land. The current seral stage situation is shown in Table 2-18 and Table 2-19.

**Table 2-18 Current Seral Stages in the Suiattle Watershed**

Numbers are percent of total acreage in each vegetation zone.

| Vegetation Zone | Early seral | Mid seral | Late seral single-story | Late seral multi-story |
|---|---|---|---|---|
| Western Hemlock | 24 | 36 | 14 | 26 |
| Pacific Silver Fir | 2 | 36 | 9 | 51 |
| Mountain Hemlock | < 1 | 25 | 13 | 57 |

## Range of Natural Variability

The concept of the range of natural variability (RNV) acknowledges that ecosystems are not static and that they vary over time and space. Native species have evolved within a context of natural disturbance regimes and habitats that result from those regimes. A key assumption of this concept is that when systems are outside their spatial and temporal range of natural variability, there is increased risk that species survival may be compromised and that biological diversity and ecological function may be adversely affected. Their dynamic nature of ecosystems presents the need for us to consider ranges of conditions under natural disturbance regimes, rather than conditions at a single point in time in order to provide the context for ecologically justifiable management decisions. Comparisons of the current condition to a single year in the past can be misleading because that particular year may be atypical, and because other conditions may be equally appropriate and better meet natural resource demands.

Rather than analyze RNV data within the Suiattle basin only, the team compared the situation in the analysis area with RNV data from two other watersheds (Table 2-19). The natural variation in a single watershed is subject to extremes that can be purely random, and there are long intervals in the natural disturbance regime. Observing the variation among multiple, similar watersheds effectively increases sample size and gives greater confidence in the results. The Nooksack and Puyallup watersheds were chosen for comparison because they are comparable to the Suiattle River basin in terms of climate, and they have available historical data. The Nooksack River occupies Ecozones 10 and 11, and the Puyallup River occupies Ecozone 11. See Appendix B2 for a more thorough description of the methods and assumptions used in this analysis.

Using multiple watersheds for comparisons has precedent in the work done in the Interior Columbia River Basin (Hessburg et al. 1999). Data for the present analysis came from the Subregional Ecological Assessment for the Mt. Baker-Snoqualmie National Forest (USDA Forest Service 1993).

**Table 2-19 Range of Natural Variability and Current Seral Stages**

Numbers are percent of total acreage by vegetation zone.

| Vegetation Zone: | Percentage Early Seral: RNV/Current | Percentage Mid-Seral: RNV /Current | Percentage Late Seral Single-Story: RNV /Current | Percentage Late Seral Multi-Story: RNV /Current |
|---|---|---|---|---|
| Western Hemlock | 0-90/24 | 0-95/36 | 0-95/14 | 2-50/26 |
| Pacific Silver Fir | 0-95/2 | 3-98/36 | 0-45/9 | 1-55/51 |
| Mountain Hemlock | 0-95/ <1 | 0-95/25 | 0-43/13 | 1-55/57 |

The analysis shows that, although all Vegetation Zones in the analysis area are technically within their historic range of natural variability (with one exception), there are some patterns that reflect the harvest history, land allocation patterns, and probably fire suppression efforts.

In the Western Hemlock Zone, 60 percent of the stands are in early to mid seral condition. This reflects the harvest in the lower watershed off-Forest, as well as harvest on National Forest land along the river bottom, and in the Grade Creek, Tenas Creek, and Green Mountain areas. The percent of late seral single-story is close to the bottom of its range.

In the Pacific Silver Fir Zone, 60 percent of the acres are in late seral condition. There was extensive harvesting in the Circle Creek, Conrad Creek, and Lime Creek drainages, but it represents a fraction of the total in this Vegetation Zone. Outside these harvested areas, nearly all of the Pacific Silver Fir Zone is in the Glacier Peak Wilderness.

In the Mountain Hemlock Zone, 70 percent of the land is in late successional condition and, in fact, the late seral multi-story stage is apparently above the RNV level. There has been relatively little harvest in the Mountain Hemlock Zone, and most of the Zone is in Wilderness. Fire suppression efforts have also likely helped to keep the amount of early seral forest to historicly low levels.

## *Habitat Trends*

Given the amount of acreage in Wilderness or Late Successional Reserve allocations, the outlook for old-growth dependent species is favorable. Most of the previously harvested areas are now in LSR. Over time, there should be abundant old-growth habitat. Species dependent on early successional habitats will likely be concentrated in the lower watershed, primarily on private or State land. One important aspect to long-term biodiversity and proper ecosystem function will be management of wildfire that allows it to return to its historic role in all Vegetation Zones within the watershed. A fire management plan for the Glacier Peak Wilderness that recognizes this and provides for it is needed.

In most areas of the watershed, plant habitat connectivity is good. The habitat is continuous and existing barriers are natural ones, such as glaciers and snowfields. The exceptions are in those areas where timber harvest occurred and the habitat is still highly fragmented. These areas are primarily on the south side of the Suiattle, west of Lime Creek. Most of this is now in Late Successional Reserve. The Big/Grade/Tenas Creek area is also fragmented, but transfer of genetic material between the Suiattle and the Illabot/Cascade drainages can still occur by means of the Buck Creek and Downey Creek drainages.

## *Fire and Other Disturbances*

Depending on the severity of a disturbance, there can be a major effect on forest structure and species composition through time. Disturbances can be very localized, isolated events which only influence a few acres or they can be major events resulting in wide spread stand-replacing episodes. Large-scale disturbances such as volcanic eruptions, major floods, avalanches, wind, and large fires are potential causes of wide spread change, but their occurrences are not frequent. However, more frequent are smaller disturbances caused by wind, insects, diseases, and fire.

## Fire History

A discussion of the fire history of the Suiattle valley will be general, by necessity (Figure 2-3). The fire history of this area is very complex and would require a great deal of field verification to determine its accuracy (Lesher, pers. comm.). Fires often erase the evidence of previous fires, and there have been several large fires in this watershed. Areas that burned often will reburn a few years later, further complicating the pattern.

In general, there have been two major burning periods on the Forest, in approximately 1508 and 1701 (USDA Forest Service 1993). These fires burned in the Suiattle River valley, as well, and evidence of them can still be found, primarily in the upper watershed but also in scattered patches in the lower watershed. In the Suiattle, there was also an extensive fire that occurred earlier, in approximately 1308, that probably burned most of the lower two-thirds of the area. In 1834, there was also a notable fire that burned much of the lowland near the confluence of the Sauk and Suiattle Rivers, as well as up the Suiattle to about Downey Creek. After the 1834 episode, evidence of large stand-replacing fires is absent due probably to fire suppression efforts and the natural cycle of large fire occurrences. There have been very few fires since then, and none of them have burned extensive areas.

The number of large fires in the Suiattle is noteworthy, and this pattern is more similar to the fire history of the southern, drier portion of the Forest than to the northern portion. An important aspect of long-term management in this watershed will involve the return of fire as an agent of disturbance. This is a dry area, prone to infrequent large fires, as well as frequent small ones. A fire plan, which allows for the management of fire, other than merely its suppression, is needed.

## Wind

Winds that have had the most influence on the watershed occur in the winter and are associated with storms. The prevailing winds in the fall and winter come from the Northwest and generally move up the valleys. Blow down from these winter storms has been minor in recent years. The most recent large storm occurred in October 2003. Loss of standing trees to winter storms is usually an annual event; however, the number and distribution of these wind blown trees is usually scattered throughout the watershed and has very little effect on the stand structure or species composition.

## Insects

There are many kinds of insects in the forest, but they often remain at low (endemic) levels causing very minor damage to living trees. When trees are weakened by stress such as a drought, the insect populations can build to epidemic proportions causing tree mortality over large areas. Insect populations are very cyclic over time. The epidemic outbreak of the western hemlock looper, *Lambdina fiscellaria lugubrosa* (Hulst) that occurred from 1991 to 1994 killed several hundred acres of conifer trees. Fortunately, the Suiattle watershed was not the main thrust of this epidemic, and only a few trees were defoliated and killed.

Trees that have been blown over and remain on the ground for a few months will also attract insects, which prey on down trees. These insects, the Douglas-fir beetle and the Ambrosia beetle, are common in this watershed and do attack downed trees within a few weeks, depending on the time of year.

## Diseases

Unlike insect populations, diseases are not considered cyclic over time. Disease pathogens are always present in the forest, similar to insects, but they do not have highs and lows, they are fairly constant, although slow, in their spread to healthy trees. There are three main root diseases within this watershed. *Fomes annosus* is the main disease on western hemlock trees. *Armillaria mellea* is common on all conifers, and *Phellinus (Poria) weirii* mainly affect Douglas fir, mountain hemlock and Pacific silver fir. Evidence of these root rot diseases can be seen throughout the watershed in the form of small (usually less than 5 acres) patches of dead and dying trees

Hemlock dwarf mistletoe is a branch and bole disease mainly affecting western hemlock. This disease, however, can also spread to Pacific silver fir. Dwarf mistletoe occurs in patches in certain areas of this watershed. Seldom does the dwarf mistletoe kill trees outright. The mistletoe will cause the trees to become stressed making them more susceptible to insect attacks and/or root rot pathogens.

**Figure 2-3 Fire History**

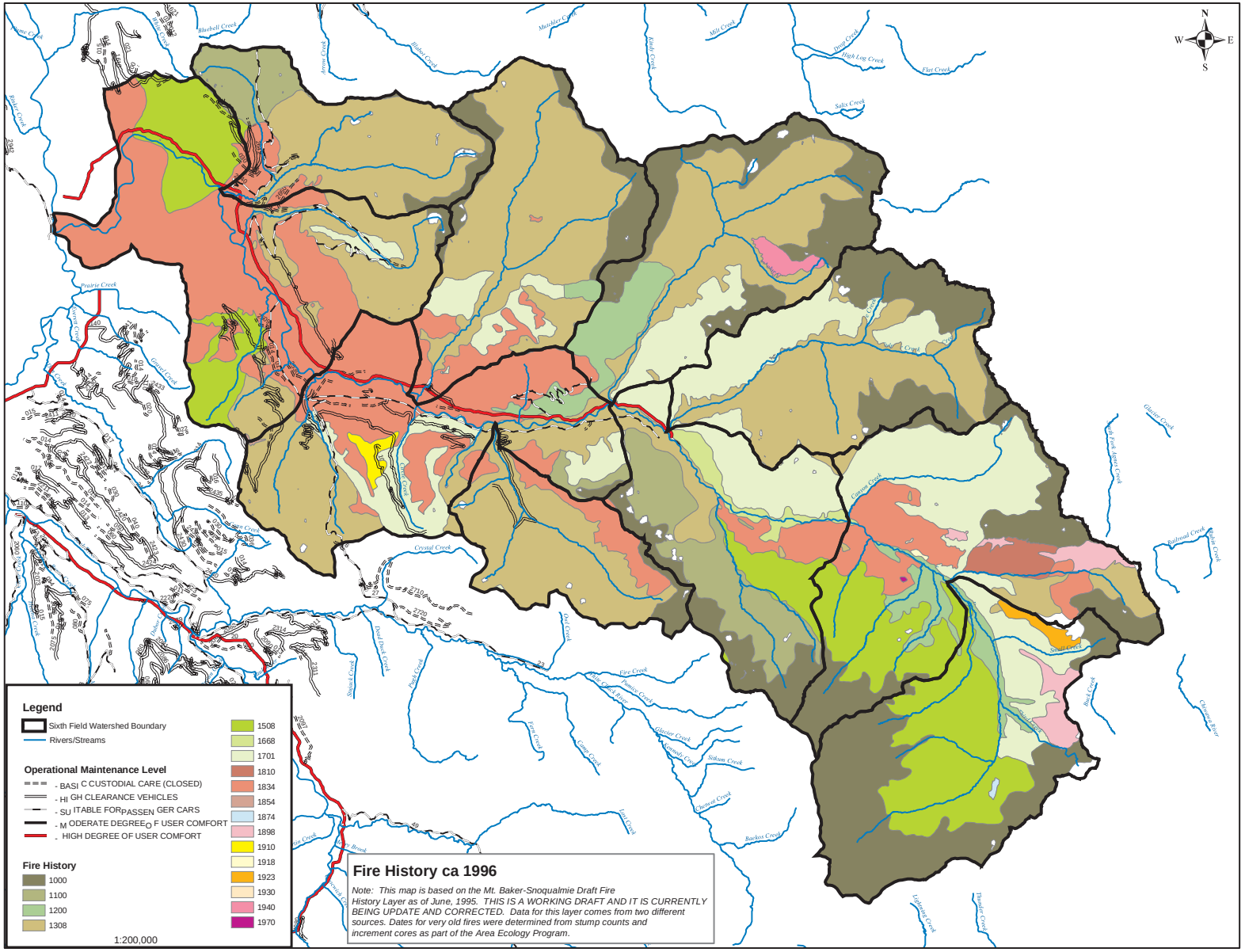


**Figure 2-4 Seral Stages**

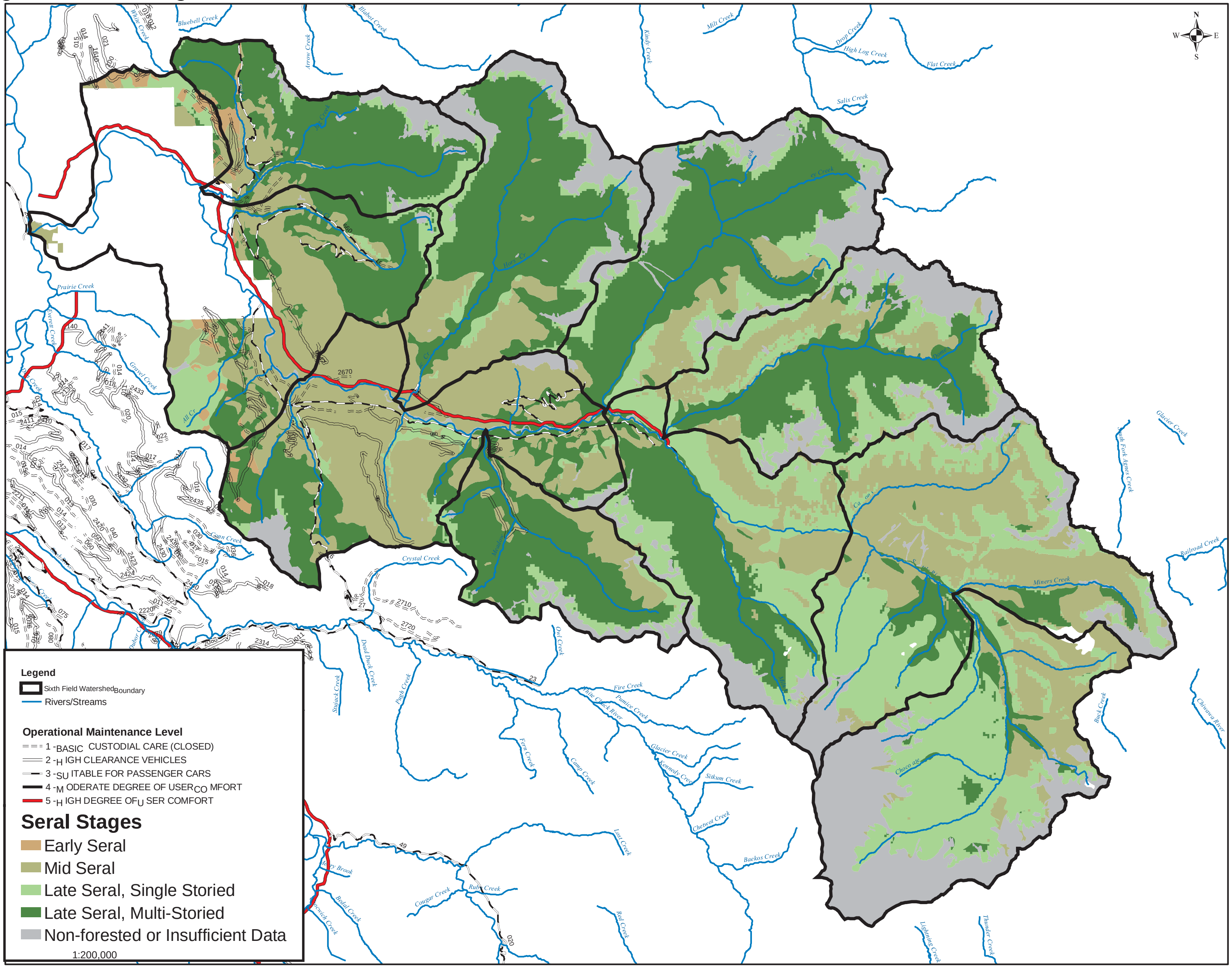
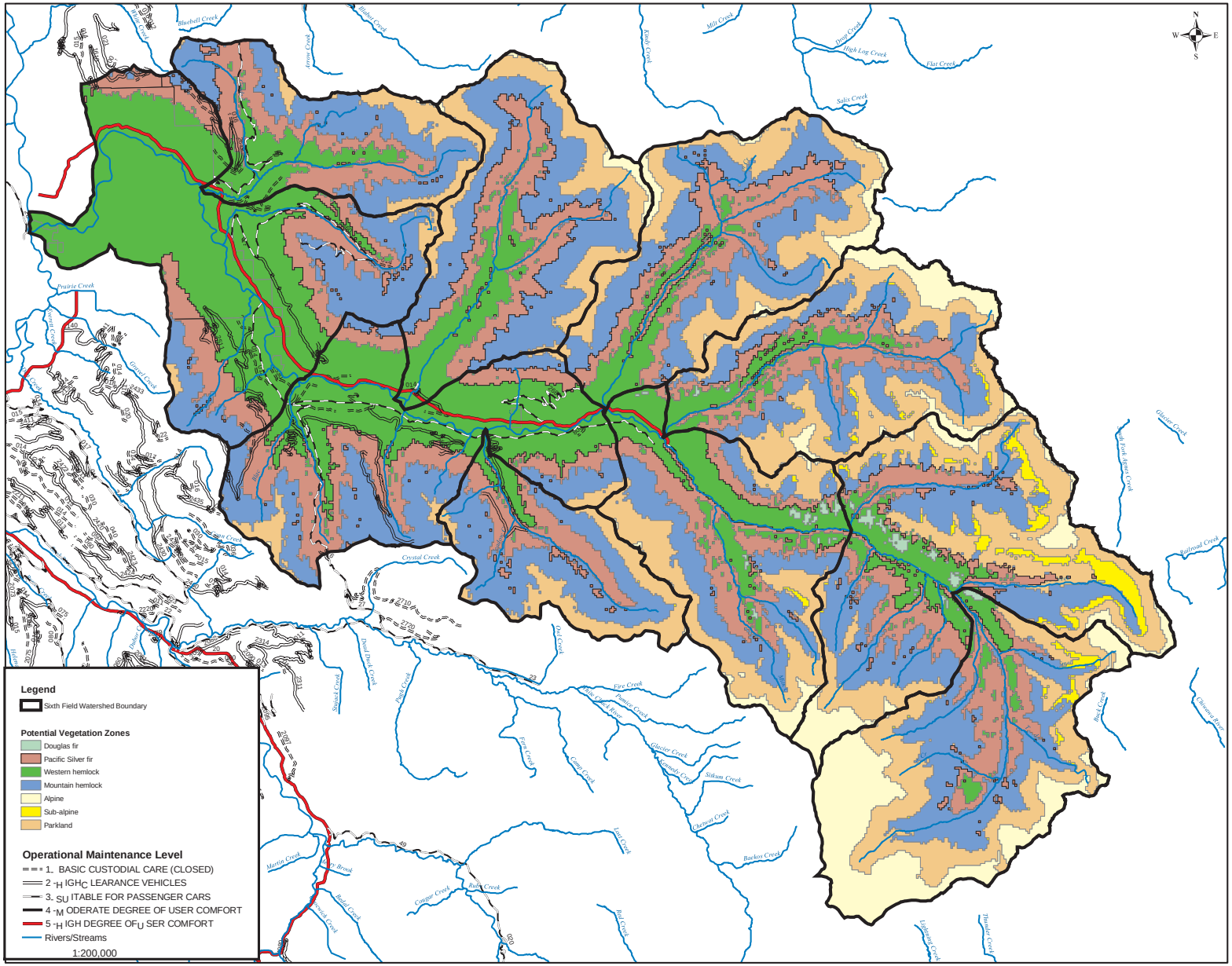


**Figure 2-5 Potential Vegetation Zones**



## *Air Quality*

A significant portion of the upper reaches of the Suiattle watershed is within the Glacier Peak Wilderness, which is considered a Class I area for air quality protection. The Clean Air Act Amendments of 1977 gives Federal Land Managers, including the Forest Service, "…an affirmative responsibility to protect the air quality related values (including visibility)…within a Class I area."

Visibility is a value that is protected primarily within the boundaries of a Class I area, although the Clean Air Act includes a provision for definition of vistas integral to a visitor's experience, even if these vistas extend beyond the boundaries of the Class I area. The Forest Service has never formally defined any "integral vistas" for Glacier Peak or any other Forest Service-managed Class I area in the country. Locally, the Washington State Department of Ecology asks that air-pollution permit applicants include analysis of their effects on views outside Class I area boundaries. Therefore, in working the Department of Ecology, the Mt. Baker-Snoqualmie has identified certain important vistas that originate within Glacier Peak Wilderness:

- Miners Ridge down Suiattle River toward Whitehorse Mountain and Three Fingers,
- Green Mountain down Suiattle River towards Whitehorse Mountain and Three Fingers,
- Pacific Crest Trail down White Chuck River towards Whitehorse Mountain and Three Fingers,
- Mt. Pugh summit towards Whitehorse Mountain and Three Fingers,
- Mt. Pugh summit down the Sauk River towards Mt. Baker, and
- Hurricane Peak towards Whitehorse Mountain and Three Fingers.

Smoke from fires can also cause significant visibility impairment. Since wildfires are not generally human-caused, their effects on visibility are considered natural. Smoke from prescribed fire though, is generally considered to cause unnatural visibility impairment, except in the case where prescribed fire is used for ecosystem management purposes within an ecosystem that is largely in a natural condition.

Glacier Peak Wilderness visibility is officially monitored at an IMPROVE (Interagency Monitoring of Protected Visual Environments) site shared with the National Park Service and located at Ross Lake. Another IMPROVE site is located at Snoqualmie Pass for Alpine Lakes Wilderness and has some applicability to conditions at Glacier Peak. Visibility at Glacier Peak Wilderness probably falls somewhere in between what is measured at the two sites.

Figure 2-6 Standard Visual Range At Two Sites shows average seasonal and annual standard visual range in miles as measured in 2001 (the most recent year with complete data). Standard visual range is simply how far someone can expect to see through the atmosphere. Theoretical maximum visual range with nothing in the air except natural components of the atmosphere is about 240-miles, but even without the influence of human-caused air pollution, visibility would not always reach this limit. Naturally occurring particles of dust, smoke, pollen, and gaseous hydrocarbons contribute to visibility impairment. Average natural visibility in the western United States is estimated to be about 110-115 miles. The annual average standard visual range measured at Ross Lake is very close to this, showing that visibility is generally excellent at this location. Visibility at Snoqualmie Pass is more impaired. The general sources of visibility impairment at both sites are shown in Figure 2-7 Sources Of Visibility Impairment.

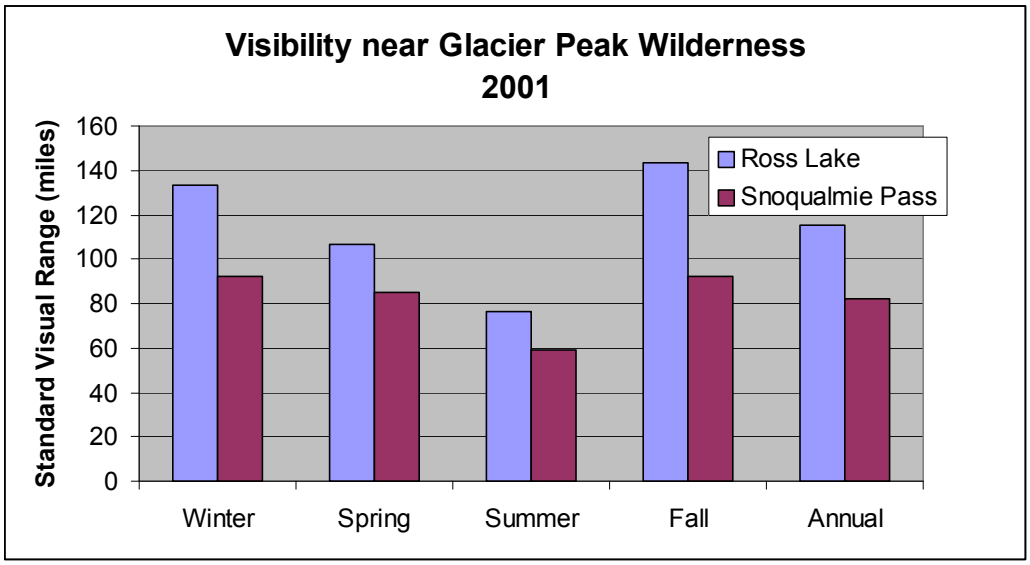



**Figure 2-6 Standard Visual Range At Two Sites**

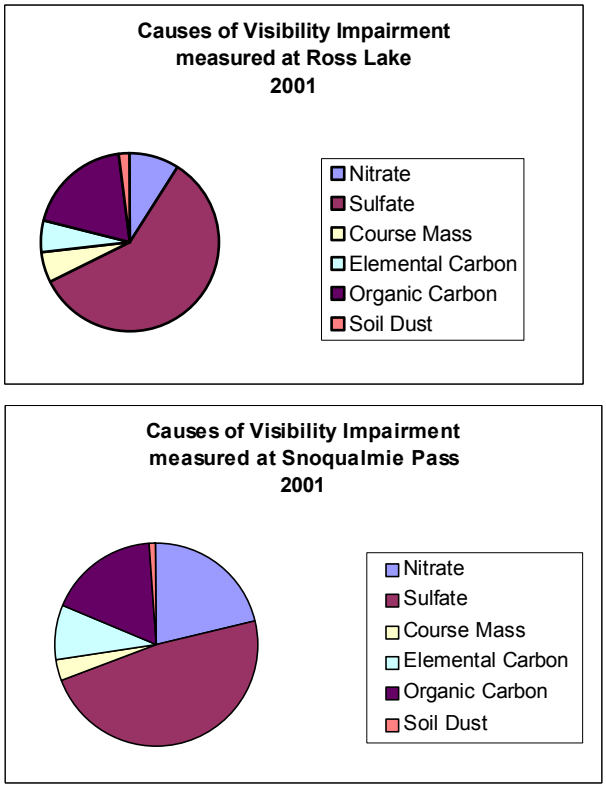



**Figure 2-7 Sources Of Visibility Impairment**

Identifying exactly what and who is causing visibility impairment can be challenging. Common sources of the pollutants measured by the IMPROVE monitors include:

- Nitrates: Automobiles, any combustion source.

- Sulfates: Coal/Oil fired power plants, refining and smelting.
- Course Mass: Smoke, pollen.
- Elemental Carbon: Diesel, oil, and coal combustion.
- Organic Carbon: Biogenics, industrial solvents, smoke.
- Soil Dust: Unpaved roads, agriculture.

In addition to visibility, other Air-Quality-Related-Values (AQRV's) of particular interest in the Suiattle watershed include surface waters and flora. Surface waters can become acidified through atmospheric deposition of pollutants, and sensitive flora (lichens especially) can be injured or killed from pollutant deposition or airborne concentrations of pollutants such as ozone.

Ozone monitoring was conducted near the Suiattle Watershed on the Sauk Prairie from 1994-1996 and revealed relatively low concentrations that should not be of concern. Higher elevations within the watershed could easily be experiencing higher concentrations of ozone, but due to monitoring equipment requiring electrical power, further monitoring is probably not possible.

The Forest has been sampling lakes for chemistry and looking signs of acid deposition, but no lakes within the Suiattle watershed have yet been sampled. Lakes in Alpine Lakes Wilderness have, in general, been found to be far more sensitive than lakes in Glacier Peak Wilderness due to geology and soils.

### Air Quality Trends

Visibility monitoring should continue at Ross Lake and Snoqualmie Pass to track this important and sensitive AQRV and to identify sources of visibility impairing pollutants near Glacier Peak Wilderness. The Forest should continue to work proactively with the Washington Department of Ecology to protect visibility in and near Glacier Peak Wilderness through their pollution permit program. Lakes within the watershed should be sampled for chemistry although this watershed is probably a lower priority than other areas of the Forest.

Fire planning should include analysis of potential visibility impacts, especially in the case of utilization of fire for something other than ecosystem management in natural stands. Smoke from fires can cause significant human health impacts, and any plans to use prescribed fire or allow for natural fires should include analysis of smoke impacts in local communities.

## Wildlife Habitat Diversity

The Suiattle River drainage provides diverse wildlife habitat, ranging from the snowfields of Glacier Peak (10,528 feet above sea-level) to the lowland forested floodplains of the Suiattle and Sauk Rivers. The Suiattle River bisects the analysis area, with much of the drainage covered with upland coniferous forests in large blocks (greater than 1,000 acres) of western hemlock, Pacific silver fir, and mountain hemlock old forest habitat. The north facing slopes host wetter, cooler habitat than the south facing slopes with cold air drainages supporting silver fir at a lower elevation in some areas.

Fire is the major stand replacement event occurring at historic intervals of 200 to 400 years. These intervals provide time for the development of late successional forests. Most of the watershed is in forests that regenerated following stand-replacing fires in approximately 1308, 1508, 1701, and 1834.

Unique wildlife habitat is present in steep cliff and rock outcrop areas of White Chuck Mountain, Glacier Peak, and other prominent mountain peaks and ridge systems. Parkland and alpine habitat of open heather and meadows is located on the high ridges, particularly in the eastern 2/3 of the watershed. Mountain lakes are found at the upper elevations along some of the ridge systems.

Patch openings in the forest are provided by avalanche chutes and rock and talus outcrops, associated with steep mountainous areas in the watershed. Shrub fields and wetland areas provide other openings, as well as early seral vegetation that occur following shifts in the river. A mix of hardwood and coniferous wetlands with beaver sign characterizes the valley floor and forest stands.

Historically, wildlife species that utilized the interior forest habitat were probably well represented. Species that utilized edge or early-seral habitat would have been more abundant following stand-replacing events or were abundant in localized areas, such as riparian areas or along the interface of the forest and alpine areas.

## *Structural Habitat Availability*

Table 2-20 summarizes the habitat types in the watershed by vegetation zone, and Table 2-21 summarizes structural habitat conditions for Forest Service lands in the watershed. Due to climatic conditions and better growing conditions, forest stands in the western hemlock zone mature earlier than in the higher elevation vegetation zones. Stands in the western hemlock zone are expected to reach old forest conditions with numerous large-diameter trees, snags, and logs at about 180 to 400 years. Some elements of late-seral habitat conditions may be reached at 80-100 years.

At higher elevations of the Pacific silver fir and mountain hemlock zones, older forest conditions are attained over a longer time span of about 300 to 500 years (see Table 2-17). Structural Habitat Class definitions used in this analysis can be found in the Terrestrial Vertebrate Habitat Condition (TVHC) Model description (Vandemoer 1994).

**Table 2-20 Habitat Type Acres by Vegetation Zone in the Analysis Area.**

Key: WH = Western Hemlock, PSF = Pacific Silver Fir, DF = Douglas-fir, MH = Mountain Hemlock

| Structure Class | Habitat Type | WH Zone | PSF Zone | DF Zone | MH Zone | Park land | Alpine Subalpine | Total |
|---|---|---|---|---|---|---|---|---|
| Open | sparse vegetation | 281 | 586 | 29 | 3818 | 6326 | 485 | 11525 |
| Open | grass/forb | 12 | 89 | 2 | 857 | 4355 | 530 | 5845 |
| Open | shrub | 417 | 2807 | 4 | 7184 | 2023 | 341 | 12776 |

| Structure Class | Habitat Type | WH Zone | PSF Zone | DF Zone | MH Zone | Park land | Alpine Subalpine | Total |
|---|---|---|---|---|---|---|---|---|
| Open | open sapling/ pole | 1840 | 1874 | 0 | 882 | 33 | 0 | 4629 |
| Open | wet meadow | 6 | 12 | 1 | 346 | 812 | 80 | 1257 |
| Hardwood | hardwood | 119 | 0 | 0 | 0 | 0 | 0 | 119 |
| Young forest | closed sapling/ pole | 3333 | 1524 | 30 | 440 | 119 | 162 | 5608 |
| Mature/old | open mature | 1577 | 6173 | 64 | 13114 | 6177 | 550 | 27655 |
| Mature forest | mature | 14974 | 4948 | 90 | 2241 | 38 | 4 | 22295 |
| Old forest | old-growth | 14060 | 26472 | 312 | 28811 | 6435 | 1272 | 77362 |
| Small | Conifer wetland | 618 | 377 | 4 | 41 | 9 | 0 | 1049 |
| Unique | river | 500 | 28 | 0 | 0 | 0 | 0 | 528 |
| Unique | Talus/cliff | 26 | 113 | 0 | 169 | 2590 | 965 | 3863 |
| Unique | Shrub wetland | 41 | 65 | 0 | 30 | 1 | 0 | 137 |
| Unique | lake/pond | 24 | 0 | 0 | 377 | 393 | 24 | 818 |
| Other | Unknown/ other/ admin | 270 | 209 | 77 | 2267 | 14393 | 12636 | 29852 |
| | **TOTAL** | **38098** | **45277** | **613** | **60541** | **43704** | **17049** | **205318** |

In the forested vegetation zones, the watershed is dominated by mature and old-growth habitat. This includes abundant old-growth habitat suitable for northern spotted owl, primarily found in the western hemlock and Pacific silver fir zones.

The stand year of origin map (Figure 2-8) displays a large portion of the watershed originating after fires in 1308, 1508, 1701, and 1834, with some older pockets of forest dating from the 1000s to 1200s. Consequently, open and small conifer habitats occur in small patch sizes within a “matrix” of older forest. This habitat pattern is the result of west side climatic conditions of the North Cascades, topography, and timber harvest in the 1900s, primarily during the 1960s through the 1980s.

**Table 2-21 Cover by Structural Habitat Classes**

| Habitat Class | Acres | Percent Cover |
|---|---|---|
| Open Habitat | 36,032 | 18 |
| Small Conifer | 6,657 | 3 |
| Large Conifer | 127,312 | 62 |
| Unique/Other/ Unknown | 35,317 | 17 |
| **Total** | **205,318** | 100 |

The old-growth forest provides habitat for old forest-associated species, such as the spotted owl, pine marten, and pileated woodpecker. Known owl activity centers are found in the lower elevation valley bottoms of the watershed within the western hemlock and Pacific silver fir zones. The open shrub –forb habitat class is also well represented for a west-side area of the North Cascades and is expected to provide habitat for species such as deer, grizzly and black bear, mountain goat, marmots, and a variety of other small mammals and birds. Table 21 displays the wildlife habitat types in the watershed.

## *Habitat Fragmentation*

Glaciers, avalanche chutes, and different vegetation zones naturally fragment the forested habitat in the upper watershed. In the lower drainage, fragmentation also includes timber harvesting and roads. The stand year of origin map (Figure 8) displays how timber harvest, primarily from the 1960s to the early 1990s, has influenced edge and patch size of forest stands in the lower portions of approximately the western third of the watershed and along the 26 road to the end near Sulphur Creek. While the drainage has some variation in forest stand age, the drainage is unique for the amount of older-aged forest.

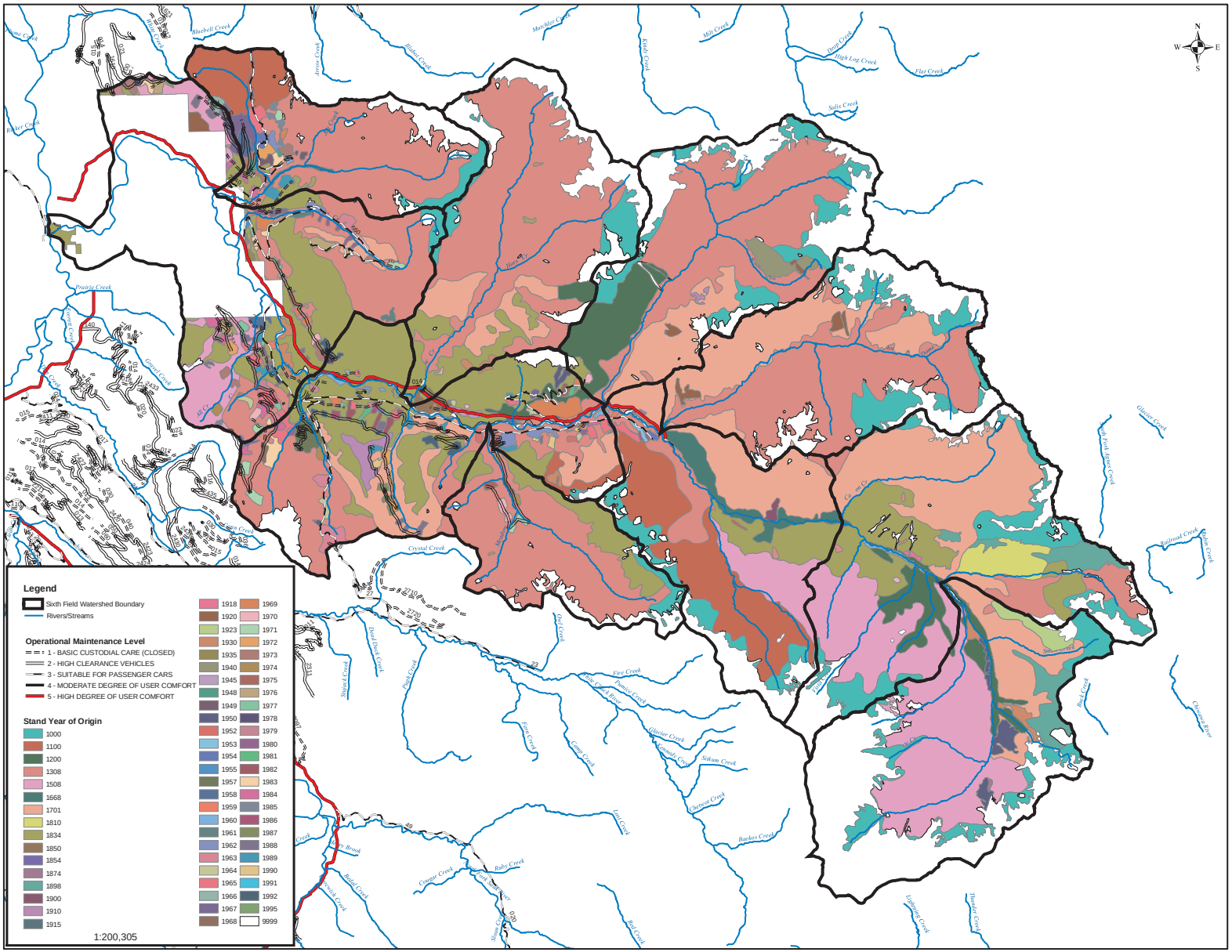
Timber harvest units were usually distributed in drainages with "leave" strips of un-harvested timber between the units. Following timber harvest, site preparation typically included burning the logging slash before planting the sites. Huckleberry regrowth has been vigorous in some of these units, with berry and shrub habitat for bears, birds and browsing wildlife species. This stage of early seral vegetation is available until approximately 20 years of age, when canopy closure results in limited sunlight to the forest floor and a decrease in forage plants. Canopy closure at elevations in the Pacific silver fir zone typically is later than in the western hemlock zone, and may retain a shrub component for 30-40 years following harvest. This timber harvest pattern provided additional edge habitat and forage for deer and early seral wildlife species, but also opened areas for predators of interior forest species.

Habitat fragmentation in the Glacier Peak Wilderness and portions of the Suiattle drainage is also reflected by natural progression in vegetation zones and changes in habitat due to elevation and parent material. Avalanche chutes, rock cliffs, talus slopes, and sparse vegetation in the silver fir and mountain hemlock zone provide a natural fragmentation of the landscape and create patch-edges. Several peaks with glaciers and high alpine habitat (Glacier Peak, Mt. Buckindy, Dome Peak and others) occur in the watershed and provide islands of unique habitat within the coniferous landscape.

Forest fragmentation influences wildlife habitat quality and the success of various species within the landscape. Spotted owls benefit by larger contiguous forest patches for successful foraging and dispersal. Fragmentation of coniferous forest used by spotted owls is thought to provide better habitat for great horned and barred owls, thereby increasing potential for predation or competition for the spotted owl.

Other species thrive within edge, or ecotonal habitat, with a variety of habitat components available. Many songbirds use edge habitat, as well as many predators that are habitat generalists.

**Figure 2-8 Forest Stand Year of Origin**



## Wildlife Habitat Connectivity

Habitat connectivity provides for full utilization of potential habitat and for successful dispersal and interactions among wildlife populations. Connectivity of habitat is a concern when the habitat occurs in patches or sizes that limit species movement, limit utilization of habitat, or creates conditions where resident populations become isolated. Isolated populations have little dispersal capability or exchange of individuals between populations and are often more susceptible to loss from stochastic events.

Prior to European settlement, large-scale fire disturbances and other events would have reduced suitable habitat in portions of the watershed, but adjacent drainages provided suitable habitat that allowed for maintenance of populations (although at lower levels) and ensured recolonization as suitable habitat redeveloped.

Connectivity of old-growth habitat within the Suiattle watershed and adjacent watersheds is high. The surrounding watersheds generally to the north, east, and south have contiguous extensions of the Glacier Peak Wilderness, and the Suiattle is primarily wilderness and LSR that still contains much old forest habitat. This connectivity of habitat is highest for dispersing avian species or mammals that might use forest cover and mammals with large home ranges that encompass the various forest associations within the drainage. For those species more closely associated with unique habitat or only one of the forest vegetation zones, the connectivity would be lessened because the valley floors and ridge systems are in different forest plant associations. Various forest zones may provide cover for dispersing animals, while not providing all the elements of breeding habitat.

Rat Trap Pass is the lowest elevation area on the ridge system between White Chuck Mountain and Glacier Peak, and is one of the natural travel corridors for species moving between the Suiattle River drainage and the White Chuck River drainage.

Connectivity of non-forest habitat is naturally fragmented. The mountain peaks are natural islands of alpine and parkland habitat with the ridges between peaks providing thin stringers of like habitat. Some of the connectivity of alpine habitats may be influenced by road systems constructed as part of timber harvests. Changes in adjacent habitat, and human presence on connecting ridges may influence wildlife use of the areas or movements between blocks of suitable habitat.

The Suiattle watershed is a relatively unfragmented forested landscape with breaks in the forest canopy in the parkland and high mountain peaks of rock and ice. The lower drainage has some younger aged forest from past timber harvest.

## Human Disturbance

Human use of forest resources in the Suiattle drainage includes both recreational uses and commodity production within the lower watershed. Harvesting and road construction resulted in changes to wildlife habitat in the western hemlock zone, and provided recreational access into the silver fir and mountain hemlock zones.

## *Human Influence on Wildlife*

Disturbance to individuals or populations can influence reproductive success, cause crowding into adjacent habitats, create barriers to movement, and in some cases result in direct mortality. Human disturbance has been shown to influence reproduction and population recruitment in many bird and mammal species (Bart 1977, Fraser 1984, Laws 1973). For example, grizzly bear have abandoned den sites following human disturbance (Jonkel 1980). Most species show some sensitivity to human disturbance during key periods of the year, including the denning or nesting seasons and the first few months after birth and during periods of nutritional stress (e.g., winter).

For many species, human presence reduces the quality and quantity of otherwise suitable habitat, due to avoidance of these areas, primarily near roads. Avoidance or reduced use of habitat near open roads has been demonstrated for a variety of wildlife, including elk (Lyon 1984), wolf (Mech et al. 1988, Thiel 1985), wolverine (Ruggiero et al. 1994), black-tailed deer (Perry and Overly 1976), and grizzly bear (McLellen and Shackelton 1989, Jonkel 1980). Forest carnivores have been shown to avoid some high use roads (Ruggiero et al. 1994).

Some species will use roads seasonally or during periods when the roads are not used by people. Perry and Overly (1976) reported depressed deer use of habitat within 1/2 mile of main roads. On secondary roads, deer use appeared depressed within 1/8 mile of roads. On primitive roads, deer showed an upward trend in use rates with increasing distance from roads. At 1/4 mile away, deer use was at or above control levels.

Information pertaining to trail avoidance has been less studied and is less understood (McLellan and Hovey 2001). Trails obviously are much narrower than roads, have shorter site distances, and generally do not entail use of motorized equipment. These factors tend to reduce effects on these species. However, avoidance of people on foot has been documented. In one study, people afoot were found to be more disturbing than snowmobiles to wintering deer (Freddy et al. 1986). Studies on bald eagles also have found that people afoot may elicit more response from eagles than vehicles do (Stalmaster and Newman 1978). Mountain goats apparently avoid some areas with heavy trail use by hunters (Johnson 1983).

Grizzly bears have been observed to avoid large groups of people on trails (Kasworm, W. and T. Manley. 1985), but may not always avoid these areas. In Montana, the mean distance from trails to radio-collared bears was roughly 0.5 miles (Kasworm and Manley 1985).

Traffic patterns also affect avoidance behavior. Wolves have been observed using roads during winter, but not during summer periods (Ream and Mattson 1982). Grizzly bear use of habitat adjacent to campsites was inversely related to human use of the site (Gunther and Renkin 1985). Schallenberger and Jonkel (1980) found bears to use habitats closer to low and moderate use trails than high use trails. The effects to wildlife from human use of roads and trails can be ameliorated by both topography and vegetation (Lyon 1993, Edge and Marcum 1984).

Roads and trails provide increased human accessibility into habitat, which can increase wildlife vulnerability to legal and illegal harvest. While some species may be generally tolerant of moderate levels of human activity during portions of the year, they can be susceptible to trapping effort or hunting. Areas with high road densities accessing habitat can increase the risk of over-harvest for species. All mortality of Selkirk and Cabinet-Yaak grizzly bears with telemetry collars was from poaching, preventing population growth and recovery. Poaching animals from the Church Mountain goat herd has been documented and may have limited population growth rates (Wright 1977). In Idaho, the combination of poaching and crippling loss associated with goat hunting may be nearly 30 percent over the number of goats legally harvested (Brandborg 1955 in Johnson 1983).

Direct relationships have been documented between recreation levels and the incidence of human/bear encounters. As recreational use increased, so have adverse human/bear encounters in the Yellowstone and Northern Continental Divide ecosystems (Servheen 1997, USDI FWS 1997b).

Some species sensitive to human disturbance require large areas where disturbance is minimal. Wolves tend to locate dens and rendezvous sites away from human activities (Jimenez and Ream 1995). Draft wolf guidelines include maintaining human disturbance 1.5 miles from den and rendezvous sites (Mech et al. 1988).

Jimenez and Ream (1995) reported telemetry and tracking studies of wolves in Montana where wolves frequently used roads, often at night, to follow deer. Road densities of one mi./sq. mi. or less were suggested for wolverine management (Ruggiero et al. 1994), and for fisher management in areas where trapping occurs for this or other species (Heinemeyer and Jones 1994).

## *Human Disturbance Within the Suiattle Watershed*

Recreational activities may cause potential impacts to certain wildlife species in the Suiattle drainage because the area is a popular hiking, climbing, and backpacking destination, particularly during the summer months. Although road and trail access within the watershed is limited, recreationists may access key habitat areas during nesting, denning, or breeding periods. Human use can reduce the amount of area effectively used by wildlife, and contribute to declines in some populations. Mountain goats and grizzly bears (if there are any bears present) are the primary species of concern regarding human disturbance.

The degree to which human activities influence wildlife populations varies with a multitude of factors. These factors include:

- The individual animals and their exposure to long-term disturbances;
- Population demographics;
- Landscape and vegetation condition;
- Topography;
- Type and frequency of road and trail use; and
- Hunting regulations.

Species suspected of being most influenced by human uses in the Suiattle are those that are or were hunted or trapped in the recent past, such as grizzly and black bear, deer, cougar, bobcat, beaver, marten, fisher, coyote, grouse, band-tailed pigeon, and mountain goat. Hunting of species may make the animals more wary of recreational users that are not hunters. An example is the potential displacement of mountain goats from summer use areas when mountain climbers are present.

Other species in the Suiattle that may have been influenced by humans are those species associated with certain seral stages of forest vegetation. Changes in habitat structure from timber harvest (such as the change from older forest to early-seral) would reduce the amount of late-seral and old-growth habitat available for species like the spotted owl, and increase early-seral habitat for species such as deer and certain neotropical birds. The barred owl, which is a species that is non-native to the northwest and competes with the spotted owl, can use numerous forest habitat types including hardwoods. This may give it a competitive advantage over the spotted owl.

### *Infrastructure Influence on Wildlife Habitat Within the Suiattle*

There are two commercial campgrounds within the watershed, and there are numerous dispersed campsites. The highest human activity occurs during spring through fall and is immediately adjacent to road and trail systems. Road 26 is a major portal to the wilderness, and during the months of May through October, Road 26 and the major trails are considered “high use”. Recreationists use the area in late fall for hunting, but the watershed receives little cross-country skiing or snowmobile use during winter.

Forest Service Road 27 over Rat Trap Pass connects the Suiattle River drainage with the White Chuck and provides a loop road for recreational driving. This road receives high dispersed recreation use, as well as Road 25 east to Circle Creek, and the Suiattle Road 26. Only approximately the western third of the watershed is roaded, primarily from past timber harvest activities. About 3 percent (5597 acres) of the watershed is in matrix allocation with a timber management emphasis. This area is located along the western boundary of the MBS north of the Suiattle River (Figure 1-5 in Chapter 1). The current road system provides access for recreation and for future land management options. During the intervals between forest stand treatments, many of the roads were put in storage (known as Maintenance Level 1 and closed to vehicles). Several road segments have been closed or decommissioned, notably the Forest Road 25 beyond Circle Creek and the Lime Creek Road 2550. Numerous other road segments have been identified for conversion to Maintenance Level 1 or decommissioned status.

Portions of Road 26 and other roads are within riparian reserve. The dispersed camping sites and road/trail systems along the major drainages result in a zone of moderate to high human influence in the valley bottoms and these riparian areas. This may limit the use of local riparian areas by some wildlife species sensitive to human use.

The MBS Forest Plan recommended a road density of not more than an average of two miles per square mile for areas with scenic foreground and middle ground. U.S. Fish and Wildlife Service (1993) has recommended a goal for open road densities of one mile per square mile or less in grizzly bear recovery zones. Including only open FS roads (Maintenance Levels 2 through 5) and FS lands, the Suiattle watershed has an average open road density of 0.36 miles/square mile, with a range of 0 to 1.57 miles/square mile by subwatershed. With the exception of the Lower Suiattle/Tenas and Suiattle/Circle Peak subwatersheds, the Suiattle watershed has limited road mileage and open road density, and the 6th field subwatersheds are well below the suggested open road densities for even the most sensitive species. Including the 60 miles of non-Forest Service roads and all land ownership, the average open road density in the Suiattle watershed is 0.52 miles/square mile (this assumes all non-Forest Service roads are open).

**Table 2-22 Current Open Road Densities**

| Subwatershed | Miles Of Open Road | Miles of Road/ Square Mile |
|---|---|---|
| **Suiattle River Headwaters** | **0** | **0** |
| **Suiattle/Miners Creek** | **0** | **0** |
| **Sulphur Creek** | **0.05** | **0.001** |
| **Downey Creek** | **0.35** | **0.01** |
| **Suiattle/Milk Creek** | **4.15** | **0.13** |
| ***Upper Suiattle River 5th Field Watershed subtotal*** | **4.55** | **0.025** |
| **Lime Creek** | **3.76** | **0.21** |
| **Buck Creek** | **1.62** | **0.05** |
| **Suiattle/Circle Peak** | **50.9** | **1.31** |
| **Big Creek** | **13.56** | **0.64** |
| **Lower Suiattle/Tenas** | **43.13** | **1.57** |
| ***Lower Suiattle River 5th Field Watershed subtotal*** | **113.0** | **0.81** |
| ***Suiattle Watershed Total*** | **117.6** | **0.36** |

## *Key Wildlife Species of Concern*

Key species for the Suiattle watershed include the northern spotted owl and marbled murrelet for focus on late-successional and old-growth forest habitat, and the grizzly bear and mountain goat for focus on unique habitats and interactions with the recreating public.

### *Northern Spotted Owl*

The Northern spotted owl is a federally listed threatened species (USDI FWS 1990). Habitat used by this species includes lower-elevation old-growth conifer stands for nesting, mature and old-growth conifer stands for foraging, and young to old-growth conifer stands for dispersal. This species occurs primarily within the western hemlock and silver fir vegetation zones. Currently, available nesting habitat is approximately 65,658 acres (Figure 2-10) distributed throughout the low to mid-elevation areas in the watershed. There is approximately 20,125 acres of additional foraging habitat. Fourteen spotted owl activity centers (nest sites or areas with multiple detections) have been located in the watershed (Figure 2-10), but much of the habitat has not been surveyed where there is no road or trail access. Because there have not been any management activities that required survey, little to no survey has occurred since the early 1990s.

Spotted owl home ranges average 4,300 acres, but can exceed 6,000 acres per pair in the Western Washington Province. Large home ranges are often associated with fragmented habitat areas, and are suspected to be a result of lesser prey base availability in the northern part of the owls' geographic range.

Old-growth stands within the analysis area primarily originated from fires dating from about 1308 to 1701. The resulting 300-year and older forest stands have high quality nesting habitat conditions for northern spotted owls. Old-growth western hemlock, Douglas fir, and western red cedar occur in these stands and provide important nesting habitat of larger diameter trees with cavities.

Overall, nesting habitat is lightly fragmented from timber harvest occurring over the past 75 years. Only approximately the western third of the watershed has had harvest activity (totaling about 7,800 acres), mostly along the valley bottoms. The largest blocks of nesting habitat occur in the Glacier Peak Wilderness, and there are large blocks occurring in all drainages.

There are several suspected factors that could be limiting northern spotted owls in the watershed. The watershed is located at the northern edge of the spotted owl range and likely has a limited prey base. Only 23 percent of the watershed is in the western hemlock zone and approximately 61 percent of that is in mature and old forests, which means approximately 15 percent of the watershed has low-elevation nesting habitat.

Another important factor that may impact spotted owl use of the area is increasing competition with barred owls, which are steadily increasing in number across the range of the spotted owl (Kelly 2001). Barred owls have been detected in the watershed, and they can use the same habitat types as northern spotted owls for nesting, as well as mixed hardwood and conifer stands along riparian areas for roosting and foraging (Kelly 2001).

The Suiattle watershed includes designated spotted owl critical habitat (USDI FWS 1992a) in the lower watershed from about Sulphur Creek west, and also about six sections in the upper Grade Creek area. Much of the watershed outside of the wilderness area is included in these critical habitat units. There are 40,964 acres of late-successional reserve (LSR) from the Northwest Forest Plan in the watershed, of which 20,445 acres overlap with MBS Forest Plan management areas that include research natural areas, mountain hemlock zone, and mountain goat habitat. (Table 1-2 and Figure 1-5). The LSR areas also are located in the lower watershed west of Sulphur Creek and in the upper Grade Creek area, largely overlapping with the critical habitat units. In addition to the surrounding wilderness area, these LSR areas provide additional habitat for spotted owl dispersal and connectivity with habitat in the White Chuck watershed. There are 13,492 acres in suitable forest associations and age classes for spotted owl nesting in these LSRs.

**Figure 2-9 Wildlife Habitat Types in the Suiattle Watershed**

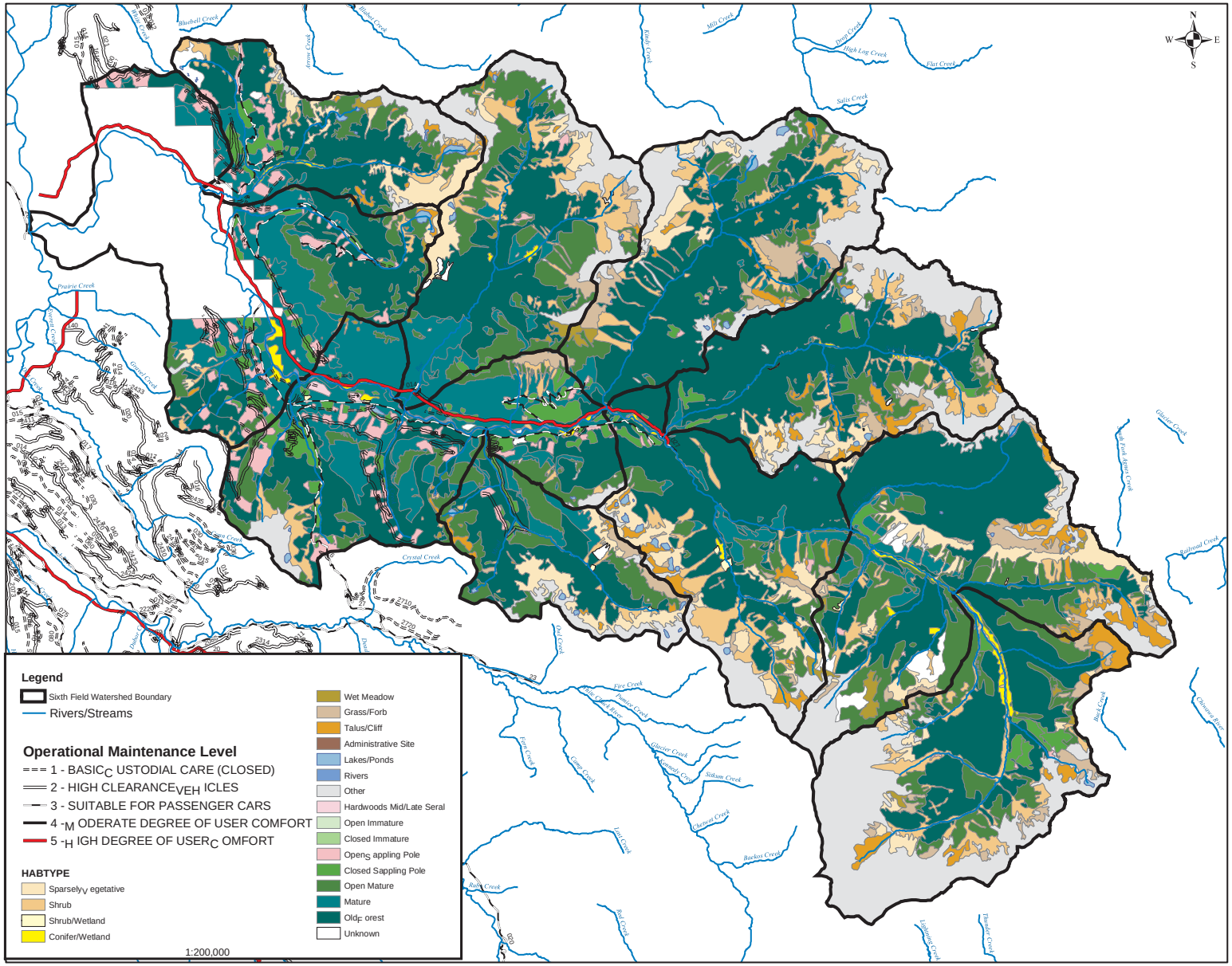
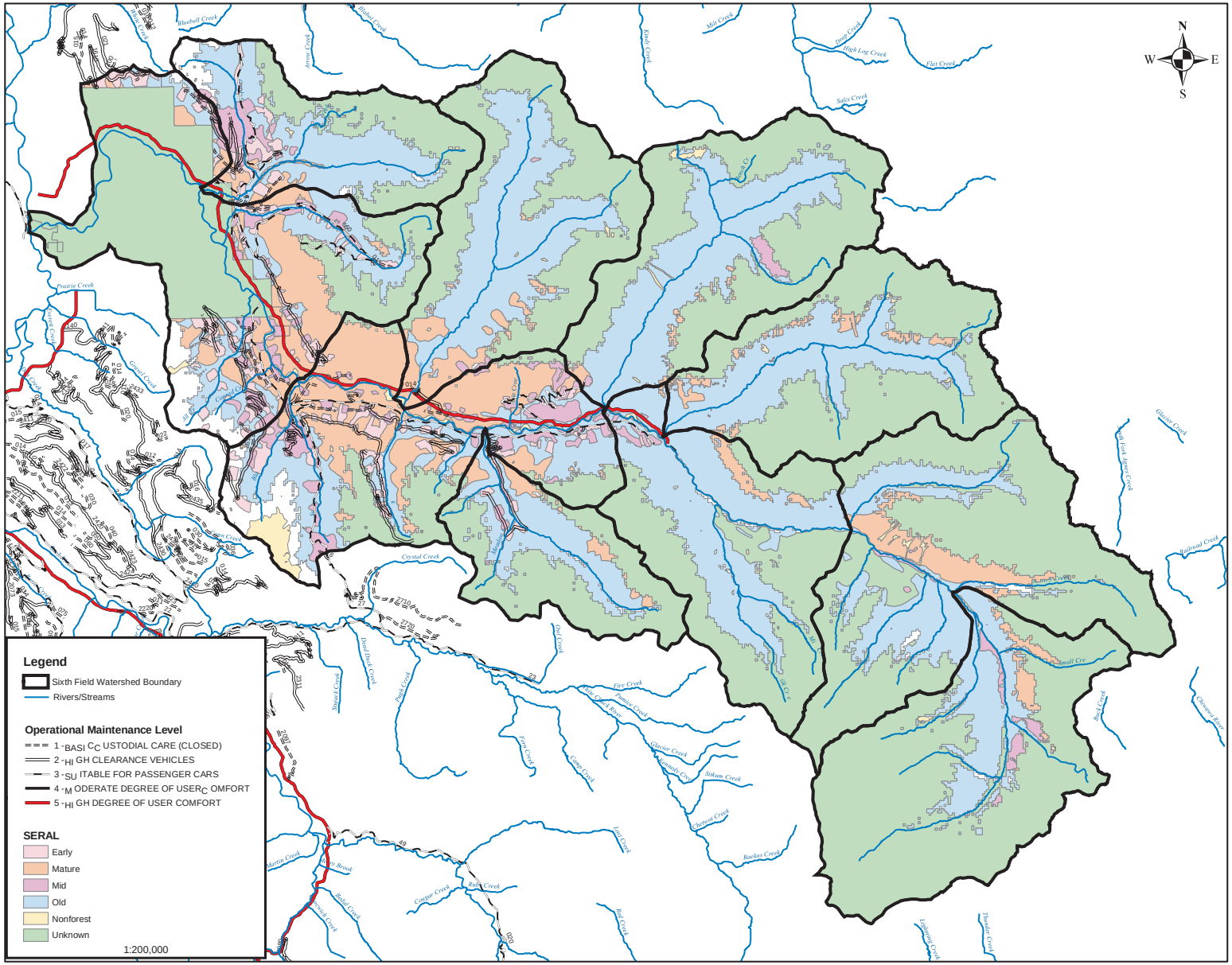


**Figure 2-10 Spotted owl nesting and foraging habitat and murrelet nesting habitat in the analysis area**



## *Marbled Murrelet*

The marbled murrelet is a seabird that uses inland forest sites for semi-colonial nesting from Alaska south to northern California (Marshall 1988). This bird, first reported on the Forest in 1909 in the Nooksack River basin, was federally listed as a threatened species in September 1992 (USDI FWS 1992c).

The first nest discovered in the State was located in the lower South Fork Stillaguamish River watershed (Hamer and Cummins 1991). Murrelets nesting on the National Forest are believed to originate from marine environments within Puget Sound. These waters were estimated to support one third of the State's population, or between 1,254 to 2,310 breeding-pairs (Marshall 1988). In 2002, it was estimated through saltwater surveys that there were 9,700 murrelets (Huff 2003) in the Puget Sound Zone of the Murrelet Recovery Plan (USDI FWS 1997a), which includes the Puget Sound, San Juan Islands, and Strait of Juan de Fuca areas in Washington.

Historical information pertaining to murrelet abundance is largely unavailable, although in the early 1900s they were described as common or abundant in areas currently supporting very low numbers (Pacific Seabird Group 1993). A monitoring effort in British Columbia yielded an estimated 40 percent decline in observed murrelets between 1982 and 1992 (Kelson and Manley 1993). Another estimate suggests an 80 percent decline in suitable nesting habitat availability over the past 200 years (Hamer and Cummins 1991).

In 1992, the Forest Service estimated a 13 percent decline in habitat on the north half of the MBS over the past 20 years (USDA FS 1992a). Reductions in nest habitat, susceptibility to perturbations in marine environments, and low recruitment rates were reasons reported for listing the species in 1992.

While this bird has been detected inland as far as 52.25 miles from Puget Sound, most (94 percent) have been reported within 40 miles of the Sound. The north half of the MBS contains over 85 percent of the murrelet detections on the Forest, and over 50 percent of the available nesting habitat. MBS lands in the watershed are within approximately 37 to over 55 miles from saltwater, and they are at the easterly extent of the potential murrelet nesting region. Two zones were identified (USDA Forest Service et al. 1993) for management of murrelet nesting habitat. In Washington, Zone 1 is the area within 40 miles of saltwater, and Zone 2 extends from 40 to 55 miles inland.

The watershed contains approximately 63,156 acres of potential nesting habitat in murrelet zones 1 and 2 (Figure 2-10) within the western hemlock and Pacific silver fir zones, but only about 6 percent (4,023 acres) is within 40 miles of saltwater. Suitable habitat closer to saltwater provides a short round trip for adult birds feeding juveniles at nests, and less distance for a fledgling to cover in the initial flight from nest to saltwater. Therefore, habitat closer to saltwater may provide some advantage to successful recruitment of young into the population. Approximately 59,133 acres of the potential nesting habitat is located 40-55 miles from saltwater, which may reduce the successful recruitment of murrelet chicks due to the distance from saltwater.

Murrelet activity on the Mt. Baker-Snoqualmie National Forest has been detected in forest stands containing large old-growth trees of the western hemlock and silver fir vegetation zones, generally below 3,200 feet. Low elevation old-growth forests provide the large lateral branches for nesting platforms, overhead protection, and ease of entry into the canopy for the adult birds. Suitable nest platforms also may occur in younger trees infected with dwarf mistletoe. Because murrelets do not construct nests, a moss or lichen substrate has been common to the nests found.

Within the old forest acreage, the western hemlock zone best fits the characteristics of forest stands located below 3,200 feet elevation, large lateral branches for platforms, moss or lichen covered branches, and protection from wind. The watershed provides relatively limited amounts of suitable habitat at less than 3,200 feet elevation. Only 23 percent of the watershed is in the western hemlock zone and 40 percent of that is in late-seral and old-growth forest.

Nesting occurs from April through September each year. Because murrelets have been observed flying inland to forested areas at other times than during the breeding season, it is thought that these forests may also be important for roosting (Pacific Seabird Group 1993).

There are only 5 murrelet detection sites in the Suiattle watershed. This is likely due to limited survey efforts because there have been few projects proposed that would remove suitable nesting habitat since the listing of the murrelet in 1992. There were detections of murrelets along Big Creek and near the Suiattle River just inside the Forest boundary (Forest Service files). These detection sites are about 39 to 42 miles inland. Limiting factors for murrelets may include amount of suitable nesting habitat and distance from saltwater.

Small patch size of suitable nesting habitat is often cited as a concern for potential nest predation, which is a primary source of nest failure for murrelets (USDI FWS 1997a). Suitable habitat in the watershed is most fragmented in the area assumed to be most suitable for murrelets - the area closest to saltwater in the lower Suiattle drainage. There is assumed to be little habitat in the non-FS timberlands before reaching the Forest boundary. On the MBS, this fragmentation is due to past timber harvest and an 1834 wildfire. There are large patches of suitable habitat (>1000 acres) in the upper watershed, but much of this is well beyond 40 miles inland from salt water. Increased recreational use with accompanying food sources may encourage populations of predatory birds that can take murrelet eggs or nestlings, such as crows and Steller's jays. These birds are opportunists and are attracted to food scraps left by recreationists.

Some biologists are concerned that loud noise may disrupt breeding success by flushing the incubating adults off the nest or interrupting the feeding of young. However, collective anecdotal observations indicate that the noise or disturbance source typically must be extremely close for this to occur (i.e. at or very near the nest itself) (Long and Ralph 1998).

The Suiattle watershed includes approximately 45,543 acres of designated murrelet critical habitat (USDI FWS 1992c, USDI FWS 1996) in the lower watershed from about Sulphur Creek west and a small area in the upper Grade Creek area. Much of the watershed outside of the wilderness area is included in these critical habitat units. There are 40,964 acres of late-successional and old-growth reserve allocation (LSR and LSOG) in the watershed from the Northwest Forest Plan, of which 20,445 acres are overlapping with MBS Forest Plan land allocations (Figure 1-5). The LSR areas also are located in the lower watershed west of Sulphur Creek and in the upper Grade Creek area, and they almost exactly overlap with the critical habitat units. There are 13,492 acres in suitable forest associations and age classes for murrelet nesting in these LSRs.

## *Grizzly Bear*

Historically, both the Upper Skagit and Thompson tribes are reported to hunt grizzly bears in the North Cascades and making ceremonial use of the head and meat (Collins 1974). In the book *Two Voices*, members of the Sauk-Suiattle tribe relate stories of hunting the grizzly bear along the Cascade Crest (Onat et al. 2000). Historical grizzly bear use has been recorded on the ridge system dividing the Suiattle watershed from the White Chuck to the south in the area of Meadow Mountain and east to Fire Creek Pass. Former Forest Service employees reported grizzly bear sightings along the Meadow Mountain trail in the 1940s (Holland 1980; Ryals, pers. comm. 2002/2003), and a grizzly bear sighting is reported to be the origin of the name Greybear camp near Fire Creek Pass (Ryals, pers. comm. 2002/2003).

By the early 1940s, grizzly bear numbers were at low levels within their historic range, and in 1975, the grizzly bear was listed as a threatened species in the lower 48 States. Almack et al. (1993) estimated that the number of grizzly bears in the North Cascades in 1991 was less than 50, and perhaps as low as 5 to 20, which seems more likely given the lack of confirmed sightings. The last confirmed grizzly observation on the MBS occurred in 1996.

The North Cascades area from Interstate 90 north to the border is designated as a recovery zone for this species by the U.S. Fish and Wildlife Service. The draft recovery plan covering the North Cascades emphasizes public education, a need to assess whether reintroduction of bears is needed, a zero grizzly bear mortality goal (Servheen 1997, USDI 1997b), and no net loss of core habitat (USDI FWS 1997b). Within this recovery zone, there have been only 3 confirmed grizzly sightings since 1980.

In 1997, the Forest Supervisors of the Okanogan, Wenatchee, and Mt. Baker-Snoqualmie National Forests agreed to support an interim recovery standard of “no net loss” in quantity and quality of grizzly bear core habitat. This no net loss policy was for federal lands within any bear management unit (BMU.) The policy is in affect until analyses have been completed and Forest Plans are revised or amended with specific information. Grizzly bear core habitat was defined as the area greater than 0.3 miles from open roads or from high-use trails (visitor use of 15 parties or more per week) (USDA FS 1998). In November 2003, the definition for a high-use trail was revised to 20 parties or more per week, the criteria used in other recovery areas.

**Figure 2-11 Grizzly Bear Core Habitat – Area 0.3 Miles Outside Of Open Roads and High-use Trails**

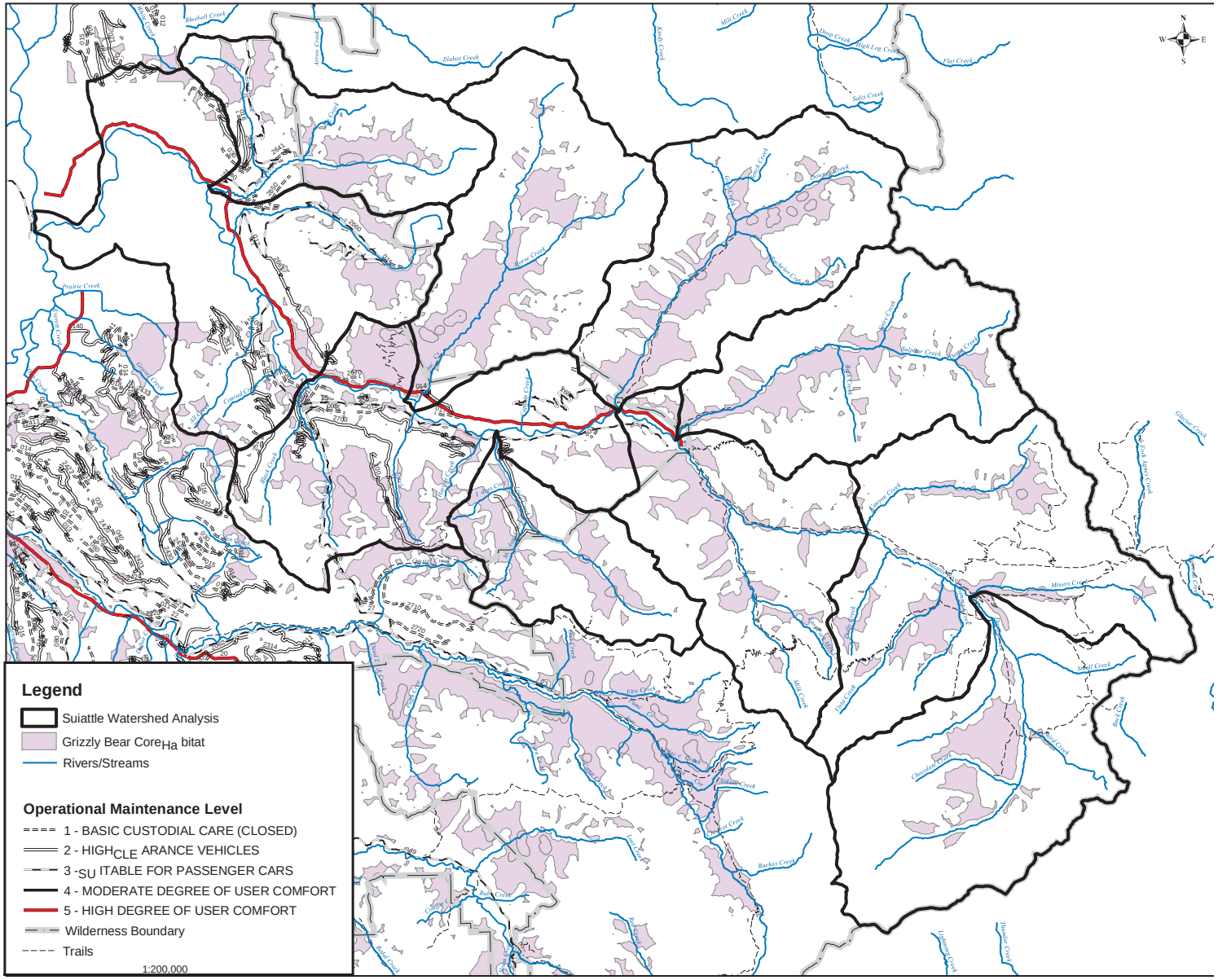
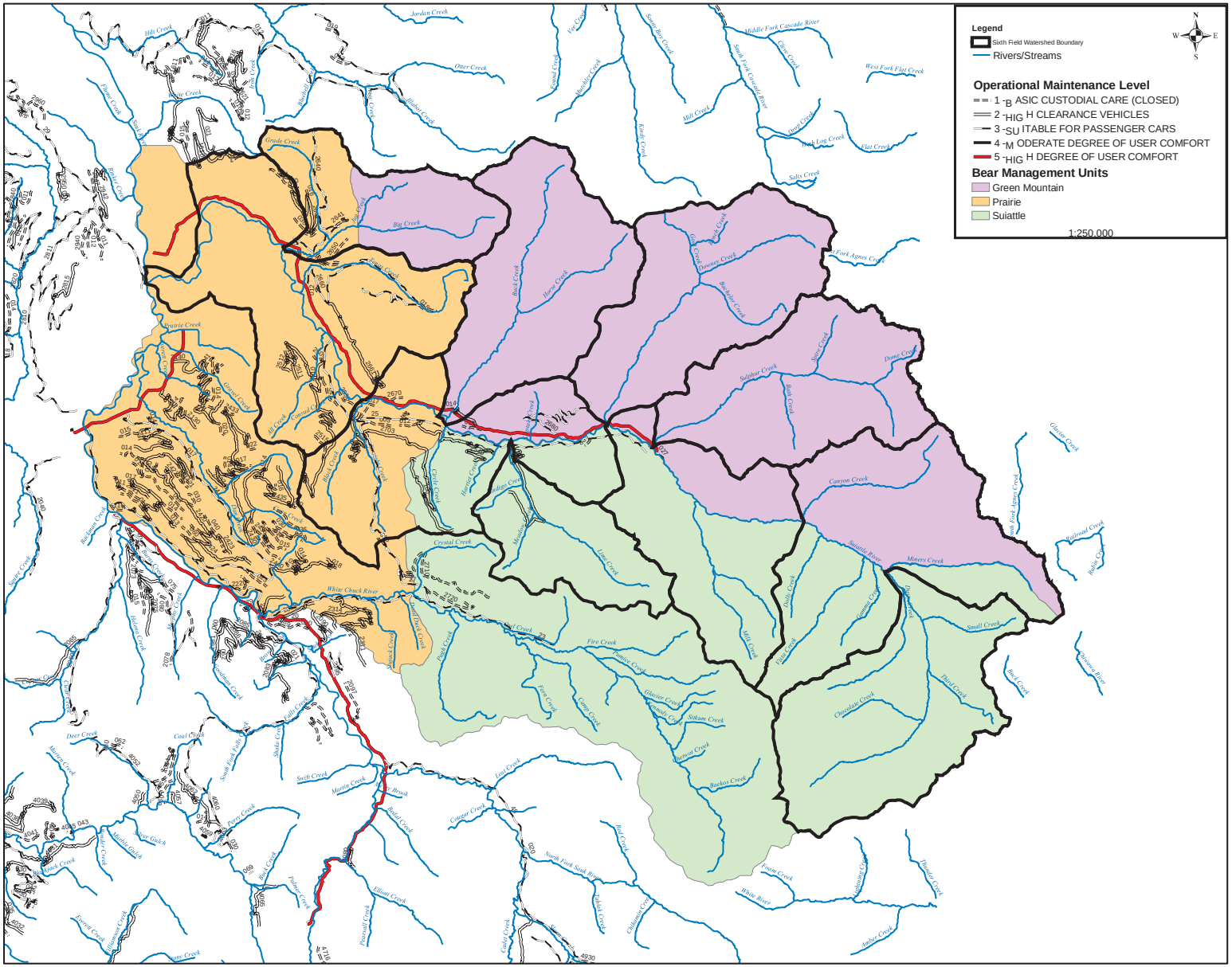


**Figure 2-12 Grizzly Bear Management Units (BMU) over the Suiattle Watershed**



Grizzly bears range over very large areas. Females have established home ranges in excess of 250 square miles. To provide an appropriate and consistent analysis area in which the effects of proposed project activities on grizzly core habitat could be made, areas referred to as bear management units (BMU) have been delineated. The Suiattle watershed is covered by the Green Mountain BMU and portions of the Suiattle and Prairie BMUs (Figure 2-12). The Green Mountain BMU is 99,357 acres in size, with 92 percent in core area during the grizzly early season, and 83 percent in core area in the late season. The Suiattle BMU has 118,038 acres total, which includes a large portion in the adjacent White Chuck drainage. Core areas for this BMU are high with 92 percent core habitat in early season and 75 percent in late season (USDA FS 1998). Both of these BMUs have high amounts of core area because of the large amount of wilderness area within each. The Prairie BMU is adjacent to the Darrington area and has 35 percent core habitat in early season and 32 percent in late season. This BMU is 89,976 acres in size, of which 64,800 acres are federal lands. The core area in this BMU is low because of the fairly high road density from timber harvest activities that have occurred on both FS and non-FS lands.

Core area connectivity to all adjacent BMUs is better in the spring when there is limited use of trails or roads that are still snow bound. During the late season, habitat connectivity is influenced by high recreational use of roads and trails. Due to the Glacier Peak wilderness area, connectivity to core habitat in BMUs to the north, east, and south is good.

Food habits of grizzly bears in the Cascades are not well known. Historically, grizzly bears in the North Cascades likely made use of anadromous fish where available, and plants, insects, and small burrowing mammals. Carrion from elk, deer, and goats also would have been used opportunistically. The high diversity of vegetation zones in the watershed is thought to include high quality grizzly foraging habitat. The Suiattle has a healthy black bear population, and it is thought that black bears would have a similar diet to what grizzlies would use in the area.

Within the basin, spring foraging habitat is found in the lower elevation areas along the main streams and rivers and in avalanche chutes. Spring forage is considered important for rebuilding the physical condition of bears after den emergence. Much of the early season habitat is in the riparian areas that also have many of the roads and trails.

Summer habitat includes a combination of vegetative communities and opportunistic feeding on protein sources. The watershed includes approximately 25,556 acres of potential forage types in coniferous wetlands, grass/forb communities, open sapling/pole stands, shrub lands, shrub wetlands, and wet meadows. There also may be some potential forage areas in the talus slopes, and sparse vegetated areas around the mountain peaks.

Fall foraging habitat includes berry fields, talus slopes, open forests, and areas with seasonal fish runs. The mountain hemlock zone also may provide forage in the huckleberry understory that is associated with much of this zone. Over 26 percent (57,152 acres) of the analysis area is in the mountain hemlock zone in a plant association group that includes huckleberry species. Both Alaska and big huckleberry are described as forming dense brush fields in the understory of these plant association groups (Henderson et al. 1992). Another 20 percent (43,748 acres) of the watershed is in the parkland zone, which would include much of the high mountain huckleberry fields and herbaceous meadows.

A potential limiting factor for grizzly bears in the area is the high recreation use this watershed receives. Minimizing potential for adverse human/bear conflicts is an important aspect of grizzly bear recovery and is a key management consideration in this high recreation use watershed.

Emphasizing proper food management in campgrounds and the backcountry can eliminate artificial factors that could attract grizzly bears to these sites. Attractants can include garbage, human food and waste, and livestock feed. High recreational use of unroaded areas or establishment of new trail in trail-less areas is a concern for potential impact to grizzly bear core habitat quality and increased human/bear interactions.

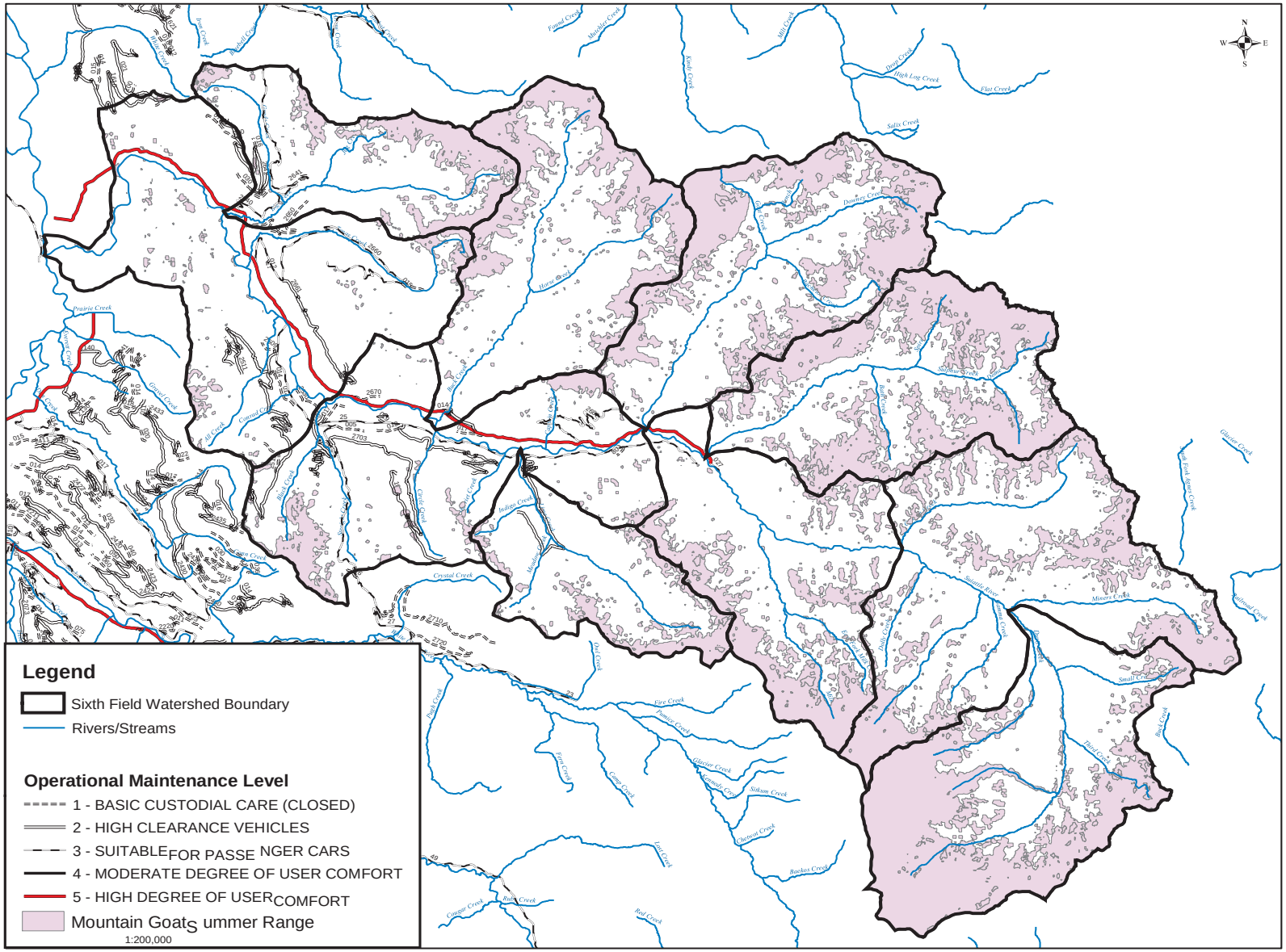
Other limiting factors may be the amount of spring forage areas available, as well as a reduction in the current size of anadromous fish runs from historical levels. While timber harvesting has increased early seral, open structural habitats in the lower part of the drainage, much of this habitat is within 0.3 miles of open roads or high-use trails. Many of the roads for timber management have been closed or are in storage so there are limited open roads for additional closure.

### *Mountain Goat*

Mountain goats are a management indicator species for goat winter range habitat on the Forest. The Forest Plan describes management for mountain goats to include "[e]mphasis… on inventory of actual goat use areas, determining goat populations, and investigating causes for the apparent decline in goat numbers." (USDA FS 1990a). Since the 1950s, many local goat populations have declined, resulting in the closure of the Skagit and Stillaguamish River basins to mountain goat hunting in 1995 (WDFW 1995).

In 1990, the Forest-wide goat population was estimated at 1,300 (USDA FS 1990b). Currently, there appears to be unoccupied suitable goat habitat on the Forest, indicating goat populations are below the potential carrying capacity. Over-hunting, parasites and disease, human disturbance, and wildfire suppression are suspected factors in the population decline. The Forest Plan has allocated areas to goat habitat prescriptions, with old-growth forest adjacent to cliffs identified as important wintering habitat. Tree canopy provides cover and forage, and additional forage areas are provided when snow slides from steep areas, exposing moss and underlying vegetation. Lichen on tree boles and windblown material are considered important winter forage in areas where deep snow typically covers ground vegetation. Areas with cliffs provide security and escape cover from predators. Figure 2-13 shows estimated mountain goat habitat in the watershed modeled from slope and vegetation data in the MBS GIS database.

**Figure 2-13 Approximate Mountain Goat Habitat**



## Population History

Between 1925 and 1948, there were reported to be several localized fluctuations in goat populations attributed to predators and extreme snow conditions (USDA FS 1948). In the 1960s, mountain goats were considered common residents of the alpine areas (USDA FS 1965).

In 1961, the Washington State Game Department (WSGD) initiated surveys to estimate goat population sizes in the North Cascades, including excursions into the Suiattle watershed and adjacent goat habitat areas. In 1961, the Glacier Peak area that would have included part of the Suiattle watershed had an estimated population of 300 goats. Goat management in the state has included transplants to augment or reestablish populations. In 1981, WSGD transplanted 10 goats from Olympic National Park to the Lime Mountain area in the watershed (Johnson 1983).

Goat observation information in the Darrington District files indicates mountain goat use in several areas throughout the watershed. The largest concentration is the Gamma Ridge area near Glacier Peak. This area historically has had up to 160 animals counted, and still had 50+ goats observed in 2003. Other notable areas with known goat use are Prairie Mountain and White Chuck Mountain. However, several other areas with goat sightings are spread throughout the higher elevation peaks and ridge systems in the watershed, or near other precipitous terrain like around Crater Lake and Goat Creek (Darrington District wildlife files).

In a 1983 published bulletin (Johnson 1983), the overall goat population trend in Washington was reported as declining since the 1961 and 1962 department surveys. The 1983 bulletin reported that mountain goat populations in eastern Washington had likely declined 50 percent from the 1961 surveys, and declined 20 percent in western Washington. It was noted that due to ease of hunting accessibility, declines in local areas of western Washington could be greater than the estimated 20 percent.

Local areas of decline included the Falls Creek and Penders Canyon area of the Darrington District. Additional localized declines on the Darrington District and within the Suiattle watershed are noted in Art Ryals' diary (notes compiled by Shari Brewer 2003). Art Ryals was a local resident who spent a lifetime counting goats in the Darrington area while he hunted, trapped, worked for the Forest Service, and later when retired. Art's diary provided historic accounts of mountain goat numbers on the Darrington Ranger District from the 1940s through the 1980s. The diary includes counts for portions of the watershed on White Chuck Mountain, Prairie Mountain, and Glacier Peak. In 1949, Art and Nels Bruseth made an eight-day trip around Glacier Peak reporting a total count of 208 mountain goats, with 126 animals sighted in the Suiattle drainage.

Lower in the watershed, Art recorded goat numbers on White Chuck Mountain in his diary. Although goat numbers around White Chuck are more numerous on the south side in the White Chuck watershed, there also is goat use of the north side in the Suiattle watershed. Art recorded over 60 animals on White Chuck Mountain from counts made in 1956 to 1976. By the mid 1980s, his goat counts were down to 40 animals, and by the early 1990s were only 10-20 animals. The most recent goat counts from surveys conducted in 2000-2003 have detected 5 to 7 goats in the White Chuck Mountain area. The number of young recruited into the population does not seem to be greater than mortality factors, and this decreasing population appears to be at risk of extirpation.

Due to concern with the decreasing goat numbers, in 1992-1993 much of the North Cascades was closed by the State to goat hunting. In 1995, all goat units in Snohomish and Skagit counties were closed to hunting.

## Potential Limiting Factors

There are a number of potential limiting factors for mountain goat population growth in the watershed. One potential factor is the past management of goat hunting concurrent with timber harvest, and the likelihood of concentrated hunting pressures related to timber harvest roads providing easy access into higher elevation areas. Increased ease of access by hunters and other recreationists into previously remote areas used by mountain goats may have resulted in localized hunting mortality and goat movements away from areas of increased recreational use. Even with the hunting closure, the association of people with danger may cause goats to flee areas used by climbers, hikers or backpackers. Many hiking, climbing, and camping sites go into alpine areas, such as White Chuck Mountain and Glacier Peak.

Past goat hunting allowed up to 50 percent of goats taken to be nannies in the States' goat harvest. Either sex is taken in the hunt due to the difficulty in distinguishing between the billies and nannies. This may have reduced recruitment of young into the population, with harvest of goats more additive to goat mortality rates than previously thought. The take of dominant nannies may also affect the use of areas by disrupting goat social orders. This may have resulted in loss of successful goat migration between summer and winter ranges, and decreased ability to defend against predators (WDFW biologists, pers. comm. 1994).

Past management of goat habitat also may be a factor. Previously, there was the expectation that timber harvest within the winter range could provide additional forage, or early seral vegetation for ruminants. This may have led to road building and timber harvesting to above 4,000 feet elevation in some sensitive areas, such as the flanks of White Chuck Mountain and the ridgeline between White Chuck and Prairie Mountain. While the timber harvest created early seral vegetation, roads may have cut across former goat migration routes in the Rat Trap Pass area, and the White Chuck to Prairie Mountain area. These roads could have provided additional hunter pressure on the White Chuck and Prairie goat population.

Concern has been expressed by WDFW that fire suppression has caused a reduction in habitat quantity and quality. Lack of wildfire allows forest vegetation to encroach on herbaceous and shrub communities, reducing available forage. Fires help keep forage areas open from tall shrubs and tree encroachment, and also can provide a boost in nutrition value of forage plants for a period of time. Rapid goat population increases have been observed after wildfires (Johnson 1983). Local concerns with goat populations include the growing cougar population that may prey on goats, and the potential for parasite infestations to limit population rebound in closed game management units (Ryals, pers. comm. 1994).

## Mountain Goat Research in the Washington Cascade Mountains

Since 1995, aerial census has found limited numbers of mountain goats in the Darrington District, even with the hunting closure. Concern from local citizens, the Sauk-Suiattle tribe, other tribes, and agencies led to additional ground surveys and the hiring of a biologist by the WDFW in 2001 to work specifically with mountain goat issues.

In 2002, the WDFW initiated a study in partnership with the Sauk-Suiattle Tribe, Seattle City Light, Western Washington University, the U.S. Forest Service (USDA FS), the Stillaguamish tribe, the Tulalip Tribe, and the National Park Service (NPS). The short-term objectives are to evaluate habitat relations for the mountain goat populations in the Cascade Mountain Range, and to refine survey protocols for mountain goats within the state of Washington. Habitat studies included suitability mapping in the North Cascades based on reported sightings and locations from mountain goats fitted with GPS tracking collars. Studies of collared goats also will provide information on habitat selection, home range, and movements. The study information is expected to assist in the development of a sightability bias model for use in aerial surveys of mountain goats. Long-term objectives are to collect information to assess the magnitude, extent, and causes for the declines in the local goat populations.

Ground-based captures of goats were attempted with no success in the North Cascades in 2002. In 2003, helicopters were used in capturing mountain goats in both non-wilderness and wilderness areas to fit goats with GPS telemetry collars. In the Suiattle watershed, plans were to collar goats in the Gamma Ridge area. Within the adjacent White Chuck watershed, there was 1 goat captured and collared in the White Chuck Mountain area (1 out of 7 animals sighted) and 1 goat in the Round Lake area (1 animal out of 8 sighted). GPS telemetry downloads from these collared animals are beginning to provide information on movements and seasonal habitat selection by these animals.

Additional ground and aerial census work is planned to further monitor the population and to begin collecting data on numbers of marked goats observed. The surveys planned for 2004 and 2005 are to collect data to build a more accurate population estimate. The research project is expected to continue for 2-3 years to provide information on mountain goats in the North Cascades, particularly to improve our ability to estimate population changes.

## Other Wildlife Species and Habitat

Other wildlife species and habitat use within the Suiattle watershed not considered as important as the above species to the discussion of watershed issues and questions in key areas of interest are discussed in Appendix B1.

Species listed under the Endangered Species Act (ESA) that may occur in the watershed, but were not identified as major issues in the analysis, are bald eagle, gray wolf, and lynx.

Peregrine falcon, wolverine, and Townsend's big-eared bat are species whose habitat is limited or declining within the watershed. These species are included on the Pacific Northwest Regional Forester's list of Sensitive Species for the MBS.

Management Indicator Species (MIS) are identified in the MBS Forest Plan for three habitat types with special management concerns: (1) old-growth and mature forests; (2) snags and downed logs; and (3) big game winter range. MIS populations or habitat quality are expected to reflect conditions for other wildlife species that also use these habitats of concern. MIS for the old-growth and mature forest habitat type not discussed previously are pine marten and pileated woodpecker. MIS for the snags and downed logs type are primary cavity excavators (i.e., woodpeckers). The big game winter range habitat type has black-tailed deer and elk for MIS. Other MBS MIS species are mountain goat, spotted owl, bald eagle, peregrine falcon, grizzly bear, and gray wolf. These species were either discussed previously or have are discussed under sections pertinent to their classification (e.g., Federal listing for bald eagle and wolf).

Neotropical migratory bird (or landbird) conservation has become a bigger issue since the January 2001 Presidential Executive Order and implementing interagency Memorandum of Understanding that directed federal agencies to incorporate landbird conservation into their management activities. Under the Partners in Flight conservation strategy (Pashley et al. 2000), the MBS is located at the northern end of the Southern Pacific Rainforests physiographic area. Species discussed in Appendix B1 include the fisher, goshawk, and harlequin duck.

In addition to the Townsend's big-eared bat, five other species of bats also are of concern from the Northwest Forest Plan due to their use of caves, and abandoned mines, wooden bridges, and buildings for important roost and hibernation sites.

# Human Use

## Timber Harvesting

Timber harvesting in the watershed started slowly in the 1920s and nearly doubled or tripled in acreage over the following two decades. Starting in the 1960s the harvest levels increased significantly, averaging about 2,200 acres per decade, and held at this level for three decades. Harvesting dropped off considerably in the 1990s. Harvesting was concentrated along the valley bottom as far east as Sulphur Creek, especially on the south side of the Suiattle, and in the following drainages: Tenas Creek, Grade Creek, Conrad Creek, Black Creek, Harriet Creek, Circle Creek, Straight Creek, Lime Creek, and All Creek. Some harvest occurred on Green Mountain as well. In the earlier decades tree falling was done with axes and cross-cut saws (use of chainsaws started in the early 1950s), and yarding of the cut trees and logs was done by high-lead cable systems powered by portable donkey engines on the steeper slopes, and tractors on the lesser slopes. Logging systems improved during the later decades. Cable yarding systems also improved with technology during this time. There were no railroads built in this drainage, and consequently, the cut logs were hauled to the mills on trucks over logging roads.

During this 70-year period of timber harvesting, clearcutting was the main method of tree removal. However, not all the harvesting were clearcuts. In the 1960s the flatter areas between the Boundary Bridge and the Green Mountain Road, on both sides of the Suiattle River, were harvested with tractors. The trees removed from this area were diseased, insect-infected, and generally of poorer quality. This harvesting operation could be considered a salvage or improvement cut, which left a stand of healthy larger trees. In the early decades, the harvest clearcut areas were large contiguous blocks. Since the 1960s, the harvest unit size has been decreasing and was more dispersed throughout portions of the watershed. There have been several small timber sales which removed trees from root rot pockets of two acres and less in size. The following table shows the approximate acres harvested by decade within this watershed.

**Table 2-23 Acres Harvested by Decade**

| Decade | 1930 | 1940 | 1950 | 1960 | 1970 | 1980 | 1990 | Total Acres |
|---|---|---|---|---|---|---|---|---|
| Acres Cut | 140 | 260 | 450 | 2270 | 2240 | 2070 | 380 | **7810** |

The last timber sale that utilized clearcutting occurred about 1995. Since 1995, there have been no new timber sales in this watershed. In recent years, the major change in timber management has been to concentrate on the younger stands of timber, prior to the Culmination of Mean Annual Increment (CMAI). Commercial thinning is the current predominant method of timber harvest management.

Many of the previously harvested stands are currently overstocked and could benefit from commercial or pre-commercial thinning. Potential future harvest would occur either in the Matrix or in Late Successional Reserve in stands less than 80 years of age. There are approximately 5,580 acres of forest less than 80 years of age in Late Successional Reserves and approximately 1,700 acres in Matrix that are potentially available for future harvest. The stands potentially available for harvest are broken out as follows:

**Table 2-24 Acres Potentially Available for Harvest**

| Approximate Stand Age Midrange | Matrix Acres | LSR Acres |
|---|---|---|
| 14 | 50 | 130 |
| 24 | 340 | 1120 |
| 34 | 480 | 1570 |
| 44 | 490 | 2230 |
| 54 | 230 | 480 |
| 64 | 100 | 40 |
| 74 | 10 | 10 |

There are two seed orchards within this watershed. The Captain Moses Orchard was established in the 1960s to produce superior Douglas fir seeds for general reforestation purposes. This orchard never produced a significant crop of seed cones and was abandoned in the mid-1980s. The underlying land was returned to the Matrix land allocation for general timber management purpose. The Darrington seed orchard was established in the early 1980s to produce primarily superior Douglas fir and Pacific Silver fir seeds. The seed trees in the orchard are still too young to produce a sizeable crop of usable seed cones. The orchard's current status is a low level of maintenance in order to protect that investment. When a collectable seed cone crop develops, it is unclear at this time whether or not it will be harvested.

## Special Forest Products

Special forest products are sometimes called “other forest products”, however both terms refer to the same products. Special forest products are divided into two categories: those that are converted from logs to a smaller useable specialized form such as fence posts, poles, cedar shakes, and firewood, to name a few; and those products that are not converted from logs, such as mushrooms, berries, seedling transplants, floral greens, Christmas trees and tree boughs. In the past and currently, most of the Special Forest Products are collected by the public for personal use only. There are three exceptions to this personal use only policy. Seed cone collections may be sold to local buyers and conifer tree boughs have been sold for commercial use as well as for personal use. Conifer and hardwood seedling transplants have also been sold commercially.

The Suiattle watershed has been a source for a variety of special forest product collections. Road access into different parts of the watershed continues to make these areas desirable for collecting Special Forest Products. However, several of the roads have been closed due to storm damage, which limits the use of the watershed for collecting products for the next couple of years. Roadless areas are excluded from all harvesting of special forest products. The Special Forest Products program has seen little changes in the past few years even though the demand for such products has been increasing. The program is funded at a very low level that does not afford an opportunity to expand or improve it. There has not been an inventory of Special Forest Products for determining the sustainable level of potential harvesting.

The demand for Special Forest Products has been increasing in the past decade, as the public becomes more aware of the potentially available forest products. This trend is expected to remain constant or increase in the future. Illegal harvesting of Special Forest Products has been a concern throughout the accessible portions of the watershed. This illegal harvesting is expected to continue or increase as the value of certain Special Forest Products increases, such as cedar for shakes and shingles.

## Road Infrastructure

All of the roads on the National Forest lands were constructed initially for timber harvest activities, with roads along the valley floor being constructed first in the 1940s and 1950s. By the mid 1960s, the roads for timber harvest were being built in the steeper terrain of the watershed. Although built originally for timber access, in most cases a large portion of the road system has evolved to serve multiple forest management access objectives. Included in these objectives are public access for dispersed camping, hunting, fishing, mountain climbing, wildlife and scenic viewing, berry picking, and trailhead access to both wilderness and non-wilderness areas, to name a few.

Due to early road construction practices before 1970, as well as the age of many of the existing drainage structures, a significant portion of the system needs treatment.

The main roads are used mostly for access to trailheads and recreational driving and are in fairly good condition, even with a lack of maintenance. The exception is Road 27 over Rat Trap Pass. Rat Trap Pass is a major corridor for wildlife movement and also the route for loop driving between the Suiattle and Suiattle Rivers. The flood of October 2003 washed out access to the Rat Trap Pass on both ends, at the Suiattle Boundary Bridge Road 25 on the north end and on the Suiattle Road 23. Repairs at the flood damage sites have been proposed and are being analyzed.

Suiattle Road 26 is in fairly good condition except for several sections of pavement in the first 9 miles where the pavement has been badly eroded, and ditchlines are in need of cleanout or re-establishment. There were also portions of Road 26 that were damaged during the October 2003 flood event. In the past the Suiattle River has flooded the road repeatedly and the risk of future damage is high, since the road is located on the lower floodplain and on the high mudflow terraces that are subject to impacts from channel erosion and migration. An earlier analysis (1992) for repair of Road 26 considered closing the road and building a trail to the existing trailhead. The decision was to maintain the road access to the current Suiattle Trailhead, due to the established campgrounds at Buck Cr. and Sulphur Creek, numerous trailheads and dispersed camping sites along the route.

Within the analysis area, there are approximately 137.86 miles of Forest Roads. Table 2-25 gives a breakdown of these road miles by ownership. There are 60 miles of State, County, or private roads exist within the watershed.

**Table 2-25 Road Miles by Ownership**

| | |
|---|---|
| **National Forest System Roads** | 137.86 miles |
| **State, County, and Private Roads** | 60.00 miles |
| **Total Miles** | 197.86 miles |

The Infrastructure (INFRA) Travel Routes database holds the Forest's road inventory information. The total miles of the listed Forest Roads in INFRA are currently distributed into the following maintenance levels:

**Table 2-26 Forest Road Miles by Maintenance Levels**

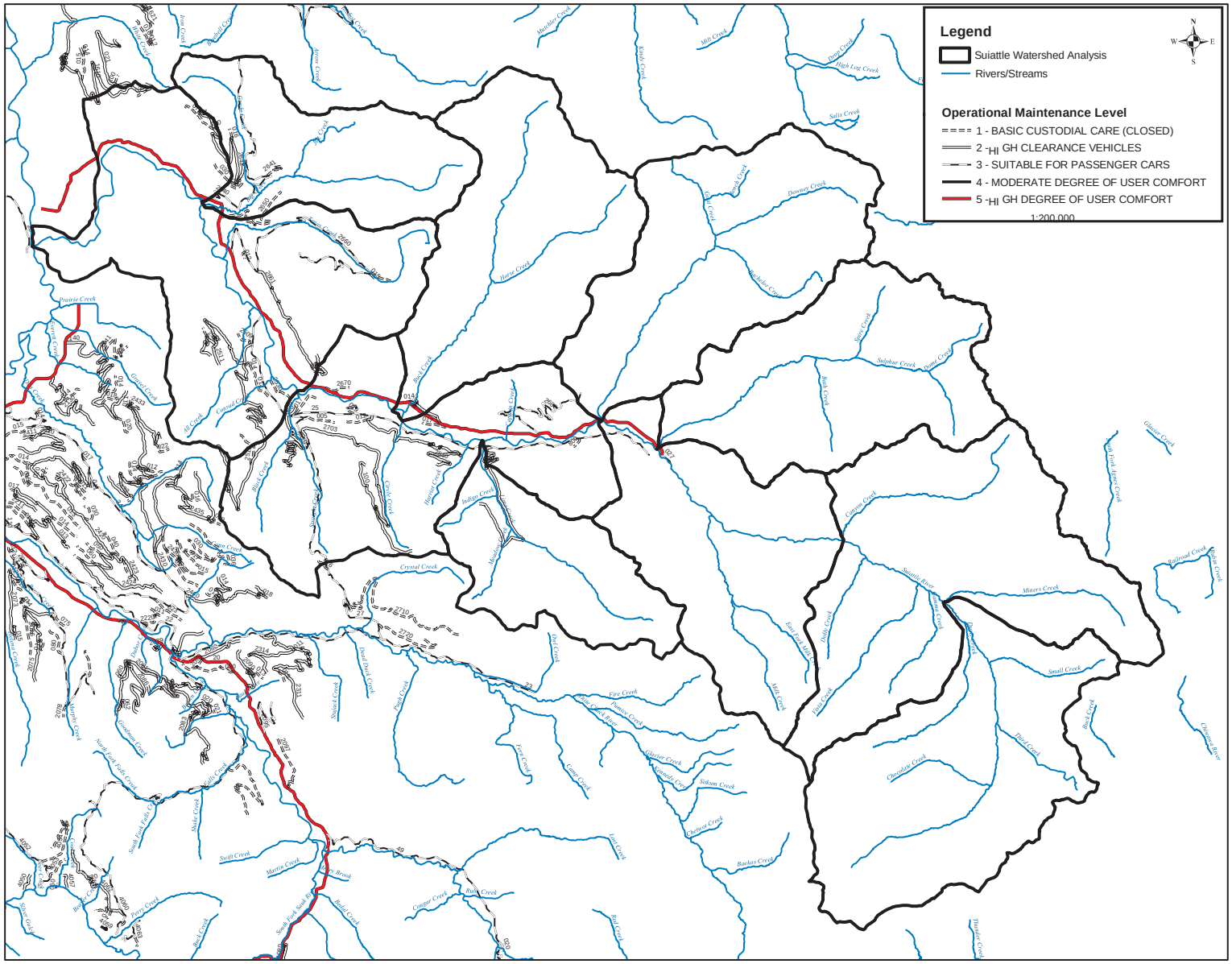
| Road Maintenance Level | Operational Level Miles | Objective Level Mile |
|---|---|---|
| Decommission | | 12.16 |
| Level 1 (Closed – In Storage) | 20.26 | 10.54 |
| Level 2 (Open – Maintained. For High Clearance Vehicles) | 48.36 | 40.56 |
| Level 3-5 (Open – Maintained. For Passenger Cars) | 69.24 | 74.59 |

The following table displays the miles of Forest Road within each subwatershed.

**Table 2-27 Forest Road Miles by Subwatershed**

| Subwatershed Number and Name | Miles |
|---|---|
| 171100060203 Sulfur Creek | 0.05 |
| 171100060204 Downey Creek | 0.35 |
| 171100060205 Suiattle River/ Milk Creek | 4.15 |
| 171100060301 Lime Creek | 3.76 |
| 171100060302 Buck Creek | 1.62 |
| 171100060303 Suiattle River/ Circle Creek | 57.86 |
| 171100060304 Big Creek | 18.06 |
| 171100060305 Lower Suiattle/ Tenas Creek | 51.95 |

**Figure 2-14 Roads Infrastructure**



## *Roads Analysis*

The Forest completed a forest-wide roads analysis in 2002 as per direction in Forest Service Manual (FSM) 7712.15 and Interim Directive 7710-2001-1 dated May 31, 2001. That analysis rated all roads for access need and resource concerns. The Appendix shows the results for roads, entirely or partially, within the Suiattle Watershed. The majority of the roads are considered as needed for access. Access needs are predominantly to maintain management options for matrix lands (Northwest Forest Plan land allocation) and secondarily for recreation (access to trailheads or campsites and driving for pleasure). Resource concerns generally rated high for potential or existing effects on aquatic and wildlife resources. This combination of high need and high concern places all but a few of the roads in the management category for high priority to maintain and/or stabilize. Emphasis would be placed on retaining access while minimizing effects on other resources. Retaining access could mean that a road is closed and in storage when not needed for project work.

Several roads have been decommissioned (non-system roads) in the subwatershed (Table 2-28 Decommissioned Roads) for a total of about 8.8 miles.

**Table 2-28 Decommissioned Roads**

| Decommissioned Roads | |
|---|---|
| **Route No.** | **Route No.** |
| N161004 | N250002-6 |
| N251001-7 | N251202-2 |
| N251501-2 | N252001-2 |
| N254001-1 | N260001-3 |
| N264051 | N264201-4 |
| N265001-3 | N266001 |
| N266101-2 | N270001 |
| N270301 | |

The Roads Analysis information is retained in Oracle (INFRA) and Access databases. This roads analysis relational database facilitates nesting different levels of the analysis and linking to other databases. The database allows easy queries and access to all pieces of information. A wide range of information was synthesized to result in broad management scenarios, however all the information is retained within the database.

The watershed analysis team reviewed the Roads Analysis results for roads in the Suiattle River. Several changes are recommended. In some cases the ratings should be reviewed and changed, as needed. In other cases, the team recommendation clarifies information obtained during the Roads Analysis. The team suggests the following changes or corrections:

- Road 25 segment 0.5 to 5.3 miles should be changed from low to moderate for recreation access and segment 5.3 to 13 should be changed to an operational level of 1 since it was closed as part of the Road 25 repair decision in 1993.
- Road 2500017 should be changed from office to admin under Admin Access data.
- Road 2511 segment 1.2 to 1.9 should be changed from low to high concern for wildlife.
- Road 2515000: No identified need for a Maintenance Objective Level of 2, road is currently closed and should be changed to Objective Level of 1.
- Road 2520 should be changed from low to moderate for aquatic concern.
- Road 2540: There is more to the road than 1.2 miles, need to check on rest of road.
- Road 25400012 needs to be reevaluated for aquatic concern.
- Road 2550 needs to be changed from Meadow to Lime Creek Road.
- Road 26 segment 10 to 23 miles needs to be changed to high need for recreation access.

- Road into the east side of Buck Creek where the old campground is not in the INFRA database and needs to be added.
- Road 2600017 should be changed from low to moderate for recreation access.
- Road 2640 segment 0 to 3.7 miles should be changed from high to moderate for recreation access.
- Road 2640 segment 4.8 to 10 miles should be reevaluated for aquatic concerns.
- Road 2642 should be changed from high to moderate for recreation access.
- Roads 2642016 and 2642025 should be reevaluated for wildlife concern.
- Road 2642080, 2650, and 2660 (0 to 7.2 segment) should be changed from low to moderate for recreation access.
- Road 2650 should be changed from low to moderate for aquatic concerns.
- Road 2660 segment 7.2 to 12 miles needs to have the mileage checked.
- Road 2660014 needs to be changed from low to moderate for recreation access.
- Road 2661 (both segments) needs to be changed from low to moderate for aquatic concern.
- Road 2670 should be changed to Doe Creek instead of Buck Creek.
- Road 2680 needs to be low for LSR and matrix access, high for recreation and heritage access, and high for aquatic and heritage concerns.
- Road 2703 needs to be changed from low to high for aquatic concern and reevaluated for wildlife concern.

## Communities and Settlements

National Forest land is an important supply of many natural resources for the surrounding area, including timber, water, recreation, mineral, fisheries, and wildlife. The Puget Sound region is one of the fastest growing areas in the United States. The population, though far from uniform, tends to be young and well educated, with incomes above the national average. The economy is highly diversified.

Recreation visitors spend money to acquire equipment related to their recreation activities and they spend money on food, transportation, lodging and other services for travel to and from their recreation sites. Much of this money is spent near their home area or area of origin before the start of the trip. Some of the money will be spent along the way and possibly near the destination site. These expenditures contribute to personal income, and to the creation and maintenance of jobs in the affected economic sectors (e.g., lodging, gas and oil, groceries, restaurants, auto repair, etc.).

Darrington is a small rural community that has been impacted by the changes in the timber industry during the past two decades. The local economy was dependent on the timber industry, but the community is trying to also include tourism, value added wood products, small businesses, and light industry.

Records from the 2000 Census data for the Darrington area (town plus rural areas to the east and north) had a population of 2,821 people, in 1,131 households. The Sauk-Suiattle Tribe Reservation is located seven miles northeast of Darrington and has a population of about seventy.

Within the city limits, the 2000 Census reports 1,136 people occupying 473 households, as compared to 1990 Census, where the population was reported as 1,042 in 421 households General Population and Housing Characteristics: 1990 (Source: U.S. Bureau of the Census, 1990 Census of Population and Housing Summary Tape File 1 (100% Data))

In 1990, 400 (60%) people worked in the area and 280 (40%) commuted from 15 minutes to 2 hours to work outside the area. According to the 2000 Census Report, 440 (34%) people (ages 16 and older) commute less than 15 minutes to work, and 795 (66%) people commute anywhere from 15 minutes to 90 minutes.

In 1990, Summit Timber Company was the main employer with about 370 employees during its peak production periods, and down to 240 more recently. In 2002, Summit sold the lumber mill to Hampton Lumber Mill. Currently there are 160 people employed by the Hampton Mill Company. The Darrington School District is the second largest employer at about 78 employees, followed by Oso Lumber Company Truss Division at 70 employees.

In 1990, the median household income was $21,574 and over sixty-two percent of the families were considered in the low-income level. The 2000 Census Report shows that the 1999 median household income was $32,813 and of the 607 students in the Darrington School District 51 percent qualify for free or reduced lunch programs for low-income families (Myra Lewis, Darrington School District, pers. comm. 2003).

# Recreation

## Wilderness

The Glacier Peak Wilderness is a Congressionally Designated Area and comprises 70 percent of the watershed. The goal of wilderness management as stated in the Forest Plan is to "feature naturalness, provide opportunities for solitude, challenge and inspiration and within these constraints to allow for recreational, scenic, scientific, educational, conservation and historical uses." It further states, "The criteria used for conflict will be to preserve and protect the wilderness resource." The Suiattle Trail and other trails are within the Transition/Trailed Zone of the Wilderness Recreation Opportunity Spectrum (WROS). Current use of the Suiattle Trail and adjacent areas is considered to be within the Limits of Acceptable Change (LAC) for WROS Transition Zone.

The Suiattle Trail provides access into the Glacier Peak Wilderness for a multitude of users including hikers and equestrians going through on the Pacific Crest Trail. Use season is generally from mid-May to October. The majority of visitors are from the Puget Sound area with a smaller number from other states or nearby communities. The following table displays the average number of users per year by trailhead. This information comes from the trailhead registration sheets and adjusted for an estimated 83 percent compliance rate. Registration information is not collected from other trailheads.

**Table 2-29 Trail Use Averages**

| Trailhead | Number of Users | Average Per Week |
|---|---|---|
| Downey Creek | 374 | 17 |
| Green Mountain | 1765 | 108 |
| Suiattle | 1650 | 63 |

Primary wilderness use was at the Pacific Crest Trail. Use begins in spring and steadily increases, as upper elevations become snow free. Flooding in October 2003 reduced access from the west side to the Pacific Crest Trail. It will be a number of years before trails are repaired and use returns to what it was.

Through travelers on the Pacific Crest Trail as well as backpackers on the Suiattle and Milk Creek Trails utilize a number of established campsites and Wallowa toilets. Group size within the Glacier Peak Wilderness is limited to *12 "heartbeats"*—which include stock animals. There is one toilet at each campsite listed below.

**Table 2-30 Wilderness Campsites**

| Campsite Name | Campsite Name |
|---|---|
| Canyon Creek | Miners Ridge Lookout |
| 9 Miles | Lady Camp |
| Skyline | Putt-Putt |
| Lower Miners Creek | Canyon Lake |
| Vista Creek | Box Mtn. Lake |
| Dolly Vista | Green Mtn. Tarn |
| Mica Meadows | Green Mtn. Summit |
| Image Lake Upper Backpack Camp | Image Lake Lower Backpack Camp |
| Sunnybrook | |

## *Trails*

Many of the trails in the Suiattle watershed were built in the 1920s and 1930s. Trail crews first built the trails primarily for access to the backcountry for the purpose of firefighting. Trail construction allowed for stock access and the ability to transport crews and supplies for fire suppression as well as materials and tools needed to construct lookouts.

Timber sales and road construction obliterated a large portion of the Suiattle drainage trail system. Forest Service Road 26 is built on what was once a portion the Suiattle River Trail and Forest Service Road 25 is built upon the Circle Creek Trail. Forest Service Road 2680 significantly shortened the Green Mountain Trail. This road and timber harvest activity also severed the trail connection between the Suiattle River drainage and the Whitechuck River drainage. The expansive road system, however, allowed for easier and sometimes shorter access to alpine lakes and meadows and increased hiker, climber, and recreational stock use.

The Suiattle River drainage contains 26.9 miles of the Pacific Crest Trail National Scenic Trail (PCT). The trail was designated in 1968 as a National Scenic Trail and was one of the initial elements of the enactment of the “National Trails System Act” of 1968. The PCT tied together the Skyline Trail in Oregon, the Cascade Crest Trail in Washington and a route that traveled the crest of the Sierra Nevada Mountains. Development and construction of the Cascade Crest was begun in 1935. The current PCT location through the Darrington District was completed by the early 1970s.

In October 2003, a devastating flood washed away portions of the Suiattle River Trail, Pacific Crest Trail, and numerous trail bridges. Current damage on this portion of the Darrington Ranger District trail system is estimated at $1.6 million. The watershed contains 123 miles of trail. Of the three difficulty levels, over 75 percent are more difficult, 23 percent are easiest and less than three percent are difficult. Over 90 percent of the trails are designated stock trails and 90 percent are within the Glacier Peak Wilderness Area. Some of the heaviest use of the trail system within the Glacier Peak Wilderness and on the Darrington Ranger District is along the Green Mtn. Trail, Suiattle River Trail, Miner's Ridge, Milk Creek Trail and the PCT. Use patterns may change due to extensive flood damage to the trails and roads in the Suiattle River drainage.

This portion of the trail system receives annual to bi-annual maintenance with larger reconstruction projects completed as funding is found. Funds for both maintenance and reconstruction come from a variety of sources including Federal and State Grants, the Forest Service Trails Capital Investment Program, Northwest Forest Pass Program, and private donations. Work is completed by contracts, youth work programs, Forest Service crews, and various volunteers groups.

The Downey Creek Trail was funded for reconstruction and a contract awarded in 2003. The Circle Peak Trail was also funded for reconstruction and a contract awarded in 2003. The PCT and other trails damaged by the 2003 flood are scheduled for repair in 2005- 2010.

Past reconstruction includes:

- Decking and handrails were replaced on the Suiattle River Crossing on Milk Creek Trail #790 in 2003.
- The Skyline Stock Bridge on the PCT was extended 110 feet in 1999. Miner's Creek Stock Bridge on the PCT was reconstructed in 1999. Miner's Creek Foot log on Suiattle River Trail #784 was reconstructed in 1999.
- Canyon Creek Suspension Bridge on the Suiattle River Trail was reconstructed in 1996.
- The Milk Creek Stock Bridge on the Pacific Crest Trail was reconstructed in 1993.
- Floods damaged the Milk Creek Trail #790, Suiattle River Trail #784 and portions of the Pacific Crest Trail in 1990 and 1995. Repairs were done from 1992 – 1996 on the damaged sections of trail.
- Hiker Foot log milepost 3 on the Milk Creek Trail #790, was reconstructed in 1993.
- Puncheon Stock Bridge Replacement – Milk Creek Trail #790, 1998 to 2003.

**Table 2-31 Trail Designations**

| Trail Number | Trail Name | Primary Objective | Difficulty Level | Use Level | Area | Mileage |
|---|---|---|---|---|---|---|
| 638.1 | Circle Peak | Hiker | More Difficult | Low | Non Wilderness | 2.5 |
| 740 | Boulder Lake | Hiker | Most Difficult | Low | Glacier Peak Wilderness | 1.7 |
| 768 | Downey Creek | Stock | More Difficult | Medium | Non wilderness | .4 |
| 768.01 | Downey Creek | Stock | More Difficult | Medium | Glacier Peak Wilderness | 6.2 |
| 780 | Huckleberry | Stock | More Difficult | Low | Non Wilderness | 5.5 |
| 780.01 | Huckleberry | Stock | More Difficult | Low | Glacier Peak Wilderness | 1.5 |
| 781 | Buck Creek | Hiker | Easiest | Low | Non Wilderness | 1.0 |
| 782 | Green Mountain LO (Lookout) | Stock | More Difficult | High | Non Wilderness | 1.0 |
| 782.01 | Green Mountain LO | Stock | More Difficult | High | Glacier Peak Wilderness | 3.0 |
| 784 | Suiattle River | Stock | Easiest | High | Glacier Peak Wilderness | 10.8 |
| 785 | Miner's Ridge | Stock | Easiest | High | Glacier Peak Wilderness | 9.9 |
| 785.1 | Image Lake | Hiker | Easiest | High | Glacier Peak Wilderness | .6 |
| 785.2 | Backpacker Camp | Hiker | Easiest | High | Glacier Peak Wilderness | .1 |
| 985.3 | Miner's Ridge LO | Stock | Easiest | Medium | Glacier Peak Wilderness | .1 |
| 986 | Dusty Ridge | Hiker | More Difficult | Low | Glacier Peak Wilderness | 3.5 |
| 987 | Sheep Camp | Stock | More Difficult | Low | Glacier Peak Wilderness | 1.0 |
| 788 | Grassy Point | Stock | More Difficult | Medium | Glacier Peak Wilderness | 3.5 |
| 789 | Buck Creek Pass | Stock | More Difficult | Medium | Glacier Peak Wilderness | 5.0 |
| 790 | Milk Creek Trail | Stock | More Difficult | High | Glacier Peak Wilderness | 6.5 |
| 791 | Gamma Way | Stock | More Difficult | Low | Glacier Peak | 6.0 |
| 792 | Triad Creek | Hiker | More Difficult | Low | Glacier Peak Wilderness | 4.7 |

| Trail Number | Trail Name | Primary Objective | Difficulty Level | Use Level | Area | Mileage |
|---|---|---|---|---|---|---|
| 793 | Sulphur Creek | Hiker | Easiest | Low | Non Wilderness | .2 |
| 793.01 | Sulphur Creek | Hiker | Easiest | Low | Glacier Peak Wilderness | 1.6 |
| 794 | Sulphur Mtn. | Stock | More Difficult | Low | Glacier Peak Wilderness | 5.0 |
| 795 | Miner's Cabin | Stock | Easiest | Medium | Glacier Peak Wilderness | 2.1 |
| 797 | Canyon Lake | Hiker | Difficult | Low | Glacier Peak Wilderness | 7.0 |
| 798 | Upper Suiattle | Stock | More Difficult | Low | Glacier Peak Wilderness | 4.0 |
| 798.1 | Upper Suiattle River | Hiker | More Difficult | Low | Glacier Peak Wilderness | 3.0 |
| 799 | Flower Dome | Stock | More Difficult | Low | Glacier Peak Wilderness | 1.0 |
| 2000.01 – 2000.05 | Pacific Crest National Scenic Trail (Suiattle Pass To Fire Creek Pass) | Stock | More Difficult | Heavy | Glacier Peak Wilderness | 26.9 |

Table E-1 Trail Inventory, p. E-17 – E-20.
Extra Heavy Use = 5000 plus users per year.
Heavy Use = 2501 – 5000 users per year.
Medium Use = 501 – 2500 users per year.
Low Use = 0 – 500 users per year

Prior to the flood event of October 2003 approximately 24 miles of trail were in need of reconstruction. These miles include portions of the Pacific Crest, Huckleberry Mtn, Buck Creek, Green Mtn., Miner's Ridge, Sulphur Mtn., Canyon Creek and Miner's Cabin Trails. Approximately 20 miles of the 123 miles of trail within the watershed have been reconstructed since 1990. These include six major bridge replacements and numerous smaller puncheon bridges and walkways as well as tread repairs. Much of the above repair work will be deferred until the damages from the October 2003 floods are repaired. Flood damage related repairs to date include repair of the Suiattle River Trail, reconstruction of the Suiattle River Crossing on the Milk Creek Trail, Vista Creek, Milk Creek Bridge and Skyline Bridge on the PCT. Reconstruction will also include relocation of approximately 2.0 miles of the PCT and repairs to approximately 2.0 miles of flood damaged tread along the PCT. Due to the extensive nature of the flood damage within the Suiattle and adjacent watersheds repairs may take up to 10 years to complete. The expected timeframe for other repairs would, therefore, be extended by 10 years.

Steep, unstable slopes, numerous stream and river crossings and annual precipitation make the Suiattle a particularly dynamic watershed within which to maintain a trail system. In spite of budget shortfalls, most of the trail system received annual to bi-annual maintenance. While FS budgets appear to be declining, other revenues sources such as NW Forest Pass and state, federal and private grant sources seem to be increasing. Given these funding sources it is reasonable to expect the current system will continue to receive the existing level of trail maintenance with possible increases as budgets allow and with hope that adequate funding for flood repairs is received within a timely manner.

## Dispersed Recreation

Recreational uses in the analysis area include lake fishing, hunting, berry picking, mushrooming, cross-country skiing, scenic driving, camping, hiking, climbing, backpacking, and horseback riding. Dispersed campers use spur roads and old skid trails for dispersed camping sites along the valley bottom and the old Downey Creek and East Buck Creek Campgrounds.

## Developed Recreation

Several sites in the Suiattle Watershed are listed or may be eligible for listing on the National Register of Historic Places. These sites include the Suiattle Guard Station, Miners Ridge Lookout, Green Mountain Lookout, and the Green Mountain Horse Pasture and Barn. None of these were damaged during the October 2003 floods.

Suiattle Guard Station was constructed in 1913 and is listed on the National Register of Historic Places. It is located approximately 26 miles northeast of Darrington on Suiattle River Road 26. This structure is a part of the cabin rental program. It was rented out 89 days during the summer season in 2003.

Miners Ridge Lookout was constructed in 1938 and is listed on the National Register of Historic Places. It is located within the Glacier Peak Wilderness on the highest point of Miners Ridge along the Miners Ridge Trail #785, approximately 5 miles west of the Pacific Crest Trail.

Green Mountain Lookout was constructed in 1933 and is also listed on the National Register of Historic Places. It is currently being restored at the Darrington Ranger District and is expected to be returned to the mountain in 2005. It is located at the end of Green Mountain. Trail #783 and within the Glacier Peak Wilderness.

The Green Mountain Horse Pasture is located along Road 26 just before the Green Mountain Road 2680. It has fenced pasture and a barn and shed that may be eligible for the National Register. This pasture is used mainly for administrative purposes as a helicopter landing for projects, fires and search and rescue operations and as a group camp area.

Developed campgrounds in the watershed include Buck Creek and Sulfur Creek Campgrounds, which are both under a concessionaire agreement with Recreation Resource Management. Buck Creek campground has 25 campsites. Sulfur Creek has 20 campsites, six of which were destroyed in the October 2003 floods.

### *Outfitter and Guides*

There are six land-based outfitters and guides who operate in the Suiattle drainage within the Glacier Peak Wilderness. The outfitters and guides along with their historical amount of user days in the analysis area are listed below.

**Table 2-32 Outfitter Guide Use Days**

| Company Name | Use Days | Activity |
|---|---|---|
| America's Adventure | 30 | Backpacking PCT |
| National Outdoor Leadership School | 900 | Mountaineering Course |
| Northwest Mt. School | 168 | Climbing Glacier Peak |
| Everett Parks and Rec | 32 | Day Hiking |
| Wilderness Ventures | 240 | Backpacking PCT |
| Icicle Creek Outfitters | 50 | Packing, Hunting, Horseback Trips |

Since 1999, the Mt. Baker-Snoqualmie National Forest has implemented a moratorium on permitting further commercial use until an outfitter guide and resource needs analysis is conducted. That is not to say that this moratorium has prevented other non-permitted companies and individuals from guiding. Decreased wilderness patrols have made it difficult to monitor illegal guiding activity.

## *Skagit Wild and Scenic River System*

The Suiattle River is a designated portion of the Skagit Wild and Scenic River System (Public Law 90-542 (10/02/1968) as amended PL 95-625 (11/10/1978)). The designated section of the Suiattle River is from the confluence with the Sauk River upstream to the Glacier Peak Wilderness boundary (approximately river mile 28.0).

The Outstandingly Remarkable Values for which the Skagit River system was designated under the Wild and Scenic River Act include fishery and wildlife resources and scenic quality. The Suiattle River is designated as a Scenic River. The free-flowing characteristics remain unaltered since the river was designated. Scenic values were diminished following extensive timber harvest on Suiattle Mountain during the late 1980s, but these harvest units have greened up considerably. Otherwise, the Suiattle River remains free from development other than roads and a campground.

Under the River Management Plan, the Suiattle is managed as two segments, the lower and upper, using Boundary Bridge as the segment break. Carrying capacity for recreation use on the river for the season April to September is set at 4,600 user days for the upper segment and 4,600 for the lower segment.

Eight outfitters hold special use authorizations from the Forest Service to conduct commercial whitewater trips on the lower Suiattle. Outfitters record about 500 user days in a typical year. There is an estimated 200 private boat user days per year on the Lower Suiattle. As described in guidebooks, the Lower Suiattle trips start at 'Boundary' Bridge and end at the Sauk Boat Launch adjacent to the SR530 Bridge across the Sauk River. Class II and Class III rapids and long calm floats characterize this trip. The gradient decrease below Derringer Park and the riverbank and gravel bars are loaded with wood debris and logjams. This river segment provides adequate flows for rafts during spring and summer until late August when flows become marginal. Winter trips are possible following flushing rain events though most skilled boaters prefer the Sauk River because of its superior rapids. Currently, the launch site at Boundary Bridge is inaccessible due to the washout of the bridge approach on the south side from the October 2003 flood event.

Following flood events in 1980 and 1990, the Suiattle River was full of wood with many logjams and wood piled high on gravel bars and banks. Few, if any, river trips were taken on the Suiattle. As wood obstructions moved out of the Upper Suiattle, the boating community rediscovered this section of river. Trips start at Downey Creek or Sulphur Creek and end at the 'Boundary' Bridge. Long Class II and Class III wave trains, rapids and drops characterize trips on the upper. The best time for these trips is spring and summer during times when glacier and snowmelt contribute to flow. As summer wanes, these contributions to flow decrease to the point that rafts are unable to navigate the reduced flows. Following the flood events of October 2003, considerable quantities of wood have moved back into the upper river and navigation by rafts and kayaks is not possible. This condition is likely to remain for several years.

## Heritage

Very little archaeological research regarding prehistoric use of the upriver and mountain regions of western Washington has been conducted. The first surveys of the Sauk River Valley and its tributaries were conducted for the Northern Pacific Railroad in 1870. Prior to the 1920s, relatively little timber harvest occurred in the Sauk River valley and its tributaries. In the 1930s, railroad logging proceeded in earnest and continued into the 1940s, when cable logging and truck hauling became the principle method of harvest. The historic buildings are described under Developed Recreations.

### Tribal Use and Treaty Reserved Rights

The Suiattle Watershed was the ancestral territory of the present day Sauk-Suiattle Tribe. Salmon fishing may have occurred as well as gathering and hunting. Traditional American Indian uses include fishing, hunting, and gathering. As rivers swelled with the return of anadromous fish, camps were temporarily set up. Steelhead was the most important fish resource because of its availability throughout the year (Lane and Lane 1977). A number of travel routes were accessed by trail and canoe. The stream banks were preferred for lowland foot travel because they were easier to negotiate than the forest. Canoes were used in the navigable rivers. Plants gathered in season included: blackberries, elderberry, cedar bark, and several of the other forest and river valley species used for food, material and medicines (Hollenbeck 1995). Hunting was an important substance for the tribe, which included a variety of animal species such as the mountain goats inhabiting White Chuck Mountain.

Current uses of the watershed by Indian tribal members include the exercise of treaty rights and practices of ceremonial and religious significance. The privacy and purity issues surrounding these practices are of concern to the Indian community. Treaty reserved rights include the rights to hunt and gather on open and unclaimed lands, and to fish at usual and accustomed grounds and stations. Data on the extent to which hunting and gathering rights are exercised are not available.

The Sauk-Suiattle Tribe has two cemetery sites, the Suiattle Cemetery and the Tenas Creek Cemetery, on National Forest lands within the Suiattle Watershed. The Suiattle Cemetery was established in the late 1870s when the land was occupied by John Enock under an Indian Allotment. The Tenas Creek Cemetery date of first use is unknown, but it was established on an Indian Allotment belonging to the Moses family. Both are currently authorized under a special use permit and have been under permit since 1931.

There have been intermittent discussions for the past 25 years about transfer of these cemetery lands to the Tribe. None of these discussions have resulted in transfer of ownership. Actions that could make a transfer happen have been discussed with the Tribe and Bureau of Indian Affairs. Those actions include a land exchange or acquisition under the Sisk Act. A third way of enabling this transfer would be a bill granting title to the Tribe. The transfer of these lands to the Tribe will continue to be discussed between the Tribe and the Forest Service.

### *Ethnobotany*

There is no specific information on ethnobotanical uses of the Suiattle River watershed. However, it's assumed that Native Americans used the area in the past and continue to do so. It's also likely that other groups and individuals use the area to gather medicinal plants or for crafting purposes.