3.0 THE AFFECTED ENVIRONMENT

3.0.1 Introduction

Chapter 3 – The Affected Environment describes the physical and biological environment (e.g., water resources, wildlife, etc.) as well as the human environment (e.g., social and economic factors, recreation, etc.), which may be affected by the range of alternatives, as described in Chapter 2 - Alternatives.

Much of the information on the affected environment is compiled from detailed technical reports and other analyses prepared by the USFS and consultants. Some of these reports are attached to this FEIS as appendices. All reports are available for review as part of the Analysis File maintained for this project at the MBSNF Supervisor's Office. References cited in this FEIS are provided in Chapter 5 - References.

3.0.2 Analysis Area

The "analysis area" (referred to as the "Study Area" throughout this document) varies by resource area. The Study Area includes all public (USFS) lands as well as private land owned by Ski Lifts, Inc. and other land holders. When discussing individual projects within the Study Area, the following terms are used to distinguish the different locations within the SUP: Summit East, Summit Central, and Summit West, are collectively referred to as "The Summit." Alpental, when discussed individually, is referred to as "Alpental." All four ski areas are collectively referred to as "The Summit-at-Snoqualmie."

Figure 3.0-1, Study Area illustrates the boundaries of the Study Area, including The Summit and Alpental. Figure 3.0-2, 5th Field Watersheds illustrates the boundaries of the two 5th field watersheds used in this FEIS analysis: the South Fork Snoqualmie River Watershed (S.F. Snoqualmie Watershed) and the Upper Yakima River Watershed (U. Yakima Watershed).

3.1 CLIMATE AND SNOW

3.1.1 Regional Climate

The Summit-at-Snoqualmie is located within the Pacific Coastal Ecoregion, which has a climate that is characterized by moist, cool winters and warm, dry summers. The mild climate in this region is moderated by the close proximity to the Pacific Ocean. The variation in summer and winter precipitation patterns in this region is due to the seasonal changes in the location of semi-permanent high and low pressure systems and the path of prevailing westerly winds (i.e., the jet stream). In the summer, the Pacific High Pressure system moves northward to a location off the California and Oregon coast, which protects the Pacific Northwest from storms and keeps the summer dry and warm (Ahrens 1993). Occasional thunderstorms develop along the crest of the Cascade Mountain Range as a result of moist marine air from the Pacific Ocean converging with dry unstable air from east of the crest.

During the winter, weather patterns in this region are dominated by the combined influences of the Aleutian low pressure system that is located in the Gulf of Alaska and changes in the path of the jet stream that moves these storm systems from their genesis point to the Pacific Northwest (Ahrens 1993). Once these storm systems reach the mainland, they are uplifted by the Cascade Mountain Range, causing significant precipitation. Cold interior air masses from Canada commonly move into Western Washington during the winter. Moist air masses that are carried by the westerlies from the Gulf of Alaska converge with these cold air masses along the crest of the Cascade Mountain range, resulting in considerable snowfall. The Pacific Northwest has a greater average annual snowfall than any other region within the continental United States due in large part to the climate phenomenon described above (RRC Associates 2002). Year-to-year climate variations correlate with two large-scale climate oscillations: El Niño/Southern Oscillation and Pacific Decadal Oscillation, both of which are associated with warm years tending to be dry, and cool years tending to be wet (National Assessment Synthesis Team 2000).

3.1.1.1 Global Warming

The global warming hypothesis has been generally accepted by the scientific community and is a concern of ski area operators throughout the United States (NSAA 2000, 2002, and 2005). According to recently published research, projections for climate change scenarios for the Pacific Northwest indicate that average annual temperature would increase by 2.5 to 3.7°F by 2020 and by 3.1 to 5.3°F by 2040 (Mote et al. 2005). Precipitation would increase by 2 to 9 percent by the year 2040 (Mote et al. 2003). In a more recent report, the Climate Impacts Group (2006) examined climate change scenarios for the Pacific Northwest generated by ten different climate models. All models projected temperature increases throughout the year, and most predicted the largest temperature changes would occur during the summer (June-August). The majority of models projected small decreases in precipitation during the summer, and slight increases in winter (December-February), but little change is projected in the annual mean through mid-century. However, precipitation predictions were more variable and less certain than temperature

forecasts, and the precipitation change projections fell within the range of year-to-year variability observed during the 20th century (Climate Impacts Group 2006).

Research indicates that the projected increase in temperature would have a much greater effect on winter snowpack and streamflow than the increase in precipitation, especially at middle elevations in the transient snow zone (Mote et al. 2003; Miles et al. 2000; and Snover et al. 2003). The predicted effects of the temperature increase for the middle of the 21st century include: more precipitation falling as rain in the winter, an increase in the typical snow level by as much as 1,000 feet, a decrease in the winter and spring snowpack extent and water content, and earlier spring snow melt and subsequent peak streamflows (Mote et al. 2003; and Miles et al. 2000). According to the Pacific Northwest National Laboratory climate change model, snow cover in Washington State will be lost within the existing snowline, resulting in a projected rise of the average Cascade snowline from its current 3,000 feet to approximately 4,100 feet in the next 50-80 years (Pacific Northwest National Laboratory 2004).

Snowpack in the Cascades has been declining since 1945 due predominantly to increases in temperature over the last 80 years (Mote et al. 2005a; Hamlet et al. 2005, 2005a). Model simulations conducted by the Climate Impacts Group showed that temperature changes of 3.6°F, projected to occur around the 2020s, could reduce the season length by 28% at The Summit-at-Snoqualmie, and the percentage of rainy days during the ski season may increase to above 50 percent (Casola 2005). A temperature change of 4.5°F, projected to occur around the 2040s, could reduce the probability of opening by December 1 to less than 25 percent (Casola 2005). However, the study notes that warmer temperatures and less snow on the highways during the ski season could improve customer access to ski areas (Casola 2005).

The ability of global climate models to accurately predict localized effects of global warming are still being debated (Climate Impacts Group 2006; Fagre et al. 2003; Watson et al. 2001; Miles et al. 2000; and USEPA 1997). Climate predictions are frequently based on averages of many climate models, which are often based on single runs using the same emissions scenario, resulting in varied climate projections. The National Assessment Synthesis Team of the U.S. Global Change Research Program notes that:

> "a more reliable regional assessment would require controlled regional-level comparison of several state-of-the-art models, each with a statistical ensemble of multiple similar runs under each of several emissions scenarios" (National Assessment Synthesis Team 2000).

While this research represents the best available science regarding climate change impacts in the Pacific Northwest, the prediction models still have many limitations and unknown factors, including insufficient resolution to include regional topographic features (e.g., mountain ranges, large estuaries), high confidence with temperature predictions but low confidence with localized changes in precipitation and weather patterns, and reliance on multiple assumptions for increases in greenhouse gasses and carbon cycling. As a result of the uncertainty that remains with regional climate models and the long timeframes

for the climate change models relative to the timescale of the MDP (i.e., 10 to 15 years), global warming is not an integral part of the climate and snow analysis in this FEIS, but was considered as part of the planning process for the MDP.

3.1.2 Local Climate Conditions

The average annual precipitation in the Study Area is approximately 105 inches based on the 40-year period of record for the Snoqualmie Pass weather station (Western Regional Climate Center 2003). Precipitation in mountainous environments such as Snoqualmie Pass is highly variable over time and geographic area. Annual precipitation ranged from approximately 77 to 145 inches in the Study Area for the period of time from 1931 to 1972 (Western Regional Climate Center 2003). In general, December and January are the months with the most precipitation in the Study Area and July is the month with the least amount of precipitation. Temperatures in the Study Area range from an average minimum monthly temperature of 21°F during the month of January to an average maximum monthly temperature of 70°F during the months of July and August (Western Regional Climate Center 2003). Predominant winds in the Study Area typically come from the southwest, with occasional winds originating from the east. Easterly winds result from the sharp pressure gradient differences between coastal low-pressure systems and high-pressure systems in the interior of Eastern Washington. Easterly winds typically produce very low humidity and relatively high temperatures.

Average annual snowfall in the Study Area has averaged approximately 413 inches over the 76-year period of record for the period of time from 1930/31 to 2005/06 (White 2003; www.skimountaineer.com 2007). The large annual variations in precipitation in the Study Area are mirrored by the annual snowfall records. The minimum annual snowfall recorded for the period of record is 172 inches and the maximum annual snowfall recorded is 800 inches. Average snow depth in the Study Area during the winter operating season (i.e., December 1st through April 30th) is 74 inches for the 41-year period of record from 1931 to 1972 (Western Regional Climate Center 2003). Due to the relatively low elevation of The Summit-at-Snoqualmie, the area is susceptible to rain-on-snow events. Rain-on-snow events can occur at almost any time during the winter, but they are most common during the months of March and April, when average monthly temperatures range from 34°F to 40°F.

The quality of the snow from a skiing perspective also varies considerably during the winter operating season. Snow conditions are typically good during the winter months of December, January, and February when temperatures average 29°F. Snow conditions during the winter are most commonly packed powder, but conditions range from new powder to groomed hardpack. Snow conditions are extremely variable in the spring and can vary from deep new snow to spring corn snow during the remainder of the operating season due to the temperature fluctuations described above.

3.1.3 Avalanche Conditions

The Study Area is located in a Class A avalanche area, which is indicative of a high incidence and high risk of avalanche occurrences, according to The Avalanche Handbook (McClung and Schaerer 1993). The Summit-at-Snoqualmie has a maritime snow climate, which is distinguished by relatively heavy snowfall, comparatively mild temperatures (for mountainous terrain), deep snow accumulations, rainfall which may occur at any time throughout the winter, and cold arctic air that appears several times per year. Maritime snowpacks can be relatively unstable and can have rapidly fluctuating degrees of stability. According to The Avalanche Handbook (McClung and Schaerer 1993),

> "Avalanche formation in maritime snow climates usually takes place during or immediately following storms, with failures occurring in the new snow near the surface. The prevalence of warm air temperatures promotes rapid stabilization of the snow near the surface once it falls, thereby limiting the time over which instability persists. A significant cause of major avalanching can be rain if it immediately follows deep, new snowfall. Rainfall may also cause formation of ice layers, which can act as future sliding layers when buried by subsequent snow storms. Due to the deep snow covers and warm snowpack temperatures, the persistence of buried structural weaknesses deep in the snowpack is not usually as common in maritime snow climates as in continental snow climates. Weather observations are primary tools for predicting avalanches in a maritime snow climate."

According to Section 2343.12 of the USFS Manual, the USFS authorizes control of avalanche areas at ski areas by other than USFS personnel through a special use authorization (USFS 1997b). The Summit-at-Snoqualmie Pro Ski Patrol is the responsible party for performing avalanche control within the Study Area and has made this duty an operational priority. Avalanche conditions at The Summit-at-Snoqualmie are evaluated by the Pro Ski Patrol on a daily basis throughout the winter operating season. Avalanche hazard evaluation and control work is done on a daily basis at Alpental and on an as-needed basis at The Summit. Avalanche conditions are evaluated at many points throughout the day when avalanche hazard is elevated. Active avalanche control is accomplished through methods such as ski cutting and detonating explosives in starting zones, while passive control involves area closures to allow natural stabilization and snow compaction from skiers.

Active avalanche control is performed on an as needed basis within the Alpental Study Area in the Edelweiss bowl and ski pod, Snake Dance area, the Upper Internationale area, and the Shot 6 area. Avalanche conditions are evaluated and controlled with active and passive control methods as needed along the Nordic trails west of Summit Central and in the Triple 60 ski pod at Summit Central. The gated backcountry skiing areas within the Alpental Study Area are evaluated for avalanche danger daily, but this area is not routinely controlled for avalanches. As such, the Pro Ski Patrol encourages guests to check in for updated avalanche danger information and guests are informed that they enter the gated backcountry

at Alpental at there own risk. However, the Pro Ski Patrol monitors the hazard level in these areas and publishes its assessment for backcountry users. The backcountry skiing areas outside of the Alpental Study Area are evaluated for avalanche hazard periodically by the Pro Ski Patrol. Backcountry skiers that are not paying guests are encouraged to check in at the Ski Patrol office in the base area for information on weather and avalanche forecasts as well as the timing and location of avalanche control activities.

Since Alpental is located in avalanche terrain, the planning for the development of the existing lifts, trails, and facilities accounted for avalanche hazard as part of the design process (LaChapelle 1966). The USFS, in cooperation with the Ski Lifts, Inc. planners and Pro Patrol, identified avalanche slide paths within and adjacent to the Alpental Study Area using aerial photograph interpretation, vegetation and slope analysis, historical observations and professional judgment. The largest and most active slide paths identified are located on the southwest face of Snoqualmie Mountain (i.e., The Phantom) and the northeast face of Denny Mountain in the Alpental backcountry (i.e., in the area known as “Trash Can”). Three relatively small slide paths in the bowls located in the Edelweiss ski pod are also controlled regularly during high hazard conditions. The Upper Internationale area and the cliffs and talus slopes to the southeast of Internationale are also slide paths that receive active control during high hazard conditions. A number of relatively small slide paths are located along the ridge of Denny Mountain and in the middle elevation portions of the Alpental backcountry. Based on the identification of avalanche slide paths in the Alpental Study Area and vicinity, none of the existing facilities at Alpental are located in avalanche slide paths. However, some lift terminals as well as the maintenance shop are located adjacent to avalanche runout zones, the extent of which can be difficult to predict because the runout extent can vary dramatically with avalanche size and type.

3.2 GEOLOGY AND SOILS

This section describes the geology and soils of the Study Area and defines the basis for the evaluation of impacts on these resources that may occur with implementation of the Proposed Action or Alternatives (see Section 4.2 – Geology and Soils). Where needed throughout these sections, larger and smaller spatial scales than the Study Area will be defined to describe specific areas of interest and address regulatory concerns. These scales include, in order of increasing area:

- Drainages (7th field scale)
- Study Area
- Subwatersheds (6th field scale)
- Watersheds (5th field scale)

Drainages may be considered the smallest defined compartments within subwatersheds, and subwatersheds are in turn grouped to compose even larger watersheds. The Study Area contains parts of two watersheds defined for this assessment, the S.F. Snoqualmie River and the U. Yakima River. Several smaller drainages help provide detail and add spatial context to landscape descriptions that are provided. Some analyses in this FEIS expand beyond the Study Area to include the larger watershed, but the intensity of the analyses decrease and earth resources are described in successively less detail.

This description of geology and soil resources is based primarily upon field analyses that resulted in the publication of two watershed condition assessments (Jones & Stokes 2001; Jones & Stokes and SE GROUP 2003). Other sources of information include the South Fork Snoqualmie River Watershed Analysis (USFS 1995a); U. Yakima Watershed Analysis (USFS 1997); the Soil Survey of Snoqualmie Pass (Soil Conservation Service [SCS], 1992), and geographic information system (GIS) data obtained from the MBSNF and OWNF and/or developed for this FEIS analysis. Other literature sources are cited within the text.

3.2.1 Summary of Existing Conditions within the Study Area

Geology and soils information is summarized in this section for the entire Study Area, which is defined as the entire Study Area, but is also described by the 6th field subwatersheds in which the Study Area lies.

3.2.1.1 Introduction

Snoqualmie Pass is located at approximately 3,022 feet elevation and is the lowest elevation in the Washington Cascades that provides transportation access between eastern and western Washington. Located approximately 60 miles from Seattle, I-90 traverses Snoqualmie Pass and is the most heavily traveled east-west highway crossing the Washington Cascades.

The S.F. Snoqualmie Watershed lies west of Snoqualmie Pass and drains to the Snohomish River and Puget Sound at Possession Sound, near Everett. Elevations within the Study Area range from approximately 2,650 feet elevation on the S.F. Snoqualmie Watershed to approximately 6,278 feet elevation on Snoqualmie Mountain. Denny Mountain (approximately 5,520 feet elevation) and Guye Peak (approximately 5,168 feet elevation) are other prominent mountain peaks in the area. Topography is dominated by steep slopes, vertical cliffs, talus and avalanche chutes on either side of a narrow valley bottom. The Alpental ski area is located in this steeper setting and accesses more advanced ski terrain.

The U. Yakima Watershed lies east of Snoqualmie Pass and includes Coal Creek, Mill Creek, and other smaller streams that drain to Keechelus Lake, an irrigation reservoir operated by the U.S. Bureau of Reclamation. Elevations within the Study Area range from approximately 2,517 feet, where Coal Creek enters Keechelus Lake, to over 6,800 feet elevation on Kendall Peak. Mount Catherine (approximately 5,043 feet elevation) and Mount Hyak (approximately 3,745 feet elevation) are other prominent mountain peaks. Topography ranges from gentler, well-rounded knolls to broken slopes with steep pitches, benches, and incised channels. The main Summit-at-Snoqualmie ski areas, Summit West, Summit Central and Summit East, are located in this gentler setting and accesses terrain for all ability levels.

Private land in or near Snoqualmie Pass, including land owned by Ski Lifts, Inc., The Mountaineers, Plum Creek Timber Company, and other landowners, is all subject to state Forest Practices rules (WAC 222). East of the crest, private land is regulated by the Kittitas County Critical Areas Ordinance (94-22, Chapter 17A). West of the crest, private land is regulated by King County Sensitive Areas Ordinance (Chapter 21A-24). Public land is all managed as NFSL under the *MBSNF Forest Plan, as Amended* (USDA 1990a,) west of the crest, and the *OWNF Forest Plan, as Amended* (USDA 1990b,) east of the crest. The National Pollutant Discharge Elimination System requires any project activity with a stormwater discharge to a water of the state, including construction sites larger than 1 acre, to be consistent with its permit requirements, including control of construction site runoff, post construction runoff, and pollution prevention and good housekeeping practices.

Geology

The geology of Snoqualmie Pass within the Study Area is derived from the lava flows of ancient western Cascades volcanoes and the uplifting of more recent granitic rocks (Tabor et al. 2001; Alt and Hyndman 1984). Naches Formation bedrock dominates the geology of the Study Area. Three geological units within the Naches Formation include igneous rock, siltstone, and rare coal. The Guye sedimentary member underlies areas of low relief, including the mid slopes of The Summit and Alpental, and is the dominant geology within the Study Area (Tabor et al. 2001).

Granite, granodiorite, and tonalite of the younger Snoqualmie batholith intrude upward through the Naches Formation on the mountain slopes west of Alpental (Tabor et al. 2001). These are hard, mostly unweathered rocks on cliffs, outcrops, and talus areas (Alt and Hyndman 1984). The Snoqualmie

batholith is overlain by the Naches formation near lower slopes of Alpental and the mainstem of the upper S.F. Snoqualmie River. Quaternary alpine glacial deposits mantle the footslopes and some midslopes of The Summit, and much of the mainstem Coal Creek valley bottom (Tabor et al. 2001). Finally, it is likely that numerous unmapped inclusions of glacial drift occur across the Study Area.

Historic mining activities were common in the vicinity of Snoqualmie Pass (Prater 1981), particularly in the South Fork Snoqualmie River, but no ongoing or remaining impacts to soils from mining activities are known to occur within the Study Area.

3.2.1.2 Mass Wasting and Unstable Slopes

Mass wasting events, including slumps, avalanches, and flows of earth and debris, are natural disturbances that occur in mountainous landscapes where slopes are particularly steep or where soils are unstable. Although the effects of such natural processes may or may not be devastating on short-term time scales, mass wasting events that deliver their load to streams provide some of the sediment and wood necessary to create and sustain beneficial fish habitat over the long-term. Human management of the landscape, however, can increase the frequency of mass wasting events. Consequently, sediment and wood delivery to streams may occur at rates greater than the channel can convey, resulting in habitat losses. For example, stream substrate may become choked with fine sediment, or debris dams may form and then break, resulting in the loss of stable channel features to scouring flows.

All public lands and a portion of the private land within the Study Area were surveyed for observable evidence of mass failures (Jones & Stokes 2001). A total of 17 mass failures were observed and recorded. Snow avalanches, debris avalanches, debris flows, rockfalls, streambank slumps, and soil creep are the common mass wasting processes observed. Ten failures originated from natural processes, including eight streambank slumps. The largest failure, a snow/debris avalanche track, terminates at the upper S.F. Snoqualmie River near the Alpental base area. Another landslide, upslope of the wastewater treatment ponds near Summit East, affected a small stream but terminated approximately 3,200 feet upslope of Coal Creek. Numerous rockfalls in the higher elevations at Alpental were not specifically inventoried.

A total of seven mass failures were observed related to ski area management (Jones & Stokes 2001). Five of these were small slumps associated with road cutslopes or fillslopes that terminated upslope of channels without yielding sediment to streams. The largest of these mass failures is a debris flow, caused by a rotational slump from a failed water bar that initiated on a regraded slope (a former road) in the Summit Central ski area. In another management-related mass failure, partial displacement of a culvert triggered a small debris flow in a tributary to International Creek, approximately 1,000 feet upstream of the S.F. Snoqualmie River. The event is expected to have provided a temporary sediment pulse to fish habitat in the mainstem river during and for a short time (hours to days) after the event.

3.2.1.3 Soils

Soil Types

Soils within the Study Area primarily belong to the Nimue-Haywire-Chinkmin soil association comprising approximately 51 percent of the soils in the Study Area. These soils are “moderately deep and very deep, well drained and moderately well drained, nearly level to very steep soils on ridgetops, mountainsides, and mountain back slopes, in cirque basins and valleys, and on lateral moraines and drift plains” (SCS 1992). The Reggad-Altapeak-Index soil association accounts for about 14 percent of the Study Area. These are "deep and very deep, well drained and excessively drained, gently sloping to very steep soils on mountain slopes and back slopes" (SCS 1992). Coarse fragments associated with avalanche chutes, rock, rock outcrops, and rubble land (talus) compose 18 percent of the Study Area, and the remaining area is composed of various other soil series. Surface soils are typically sandy loam or loamy sand, and they often contain a high percentage of cobbles or coarse rock fragments. Subsoil is generally cobbly loam or gravelly loam. These soils formed in poorly sorted glacial till deposits, weathered bedrock, and colluvial or landslide material.

Some of the most prevalent soil series within the Study Area are identified below.

- Chinkmin sandy loam: 15 to 65 percent slopes - This soil is found in the base areas of Alpental and The Summit, the valley bottoms of the upper S.F. Snoqualmie River and Coal Creek, and upper slopes from Summit-West to Summit-East. Permeability is moderate and exposed soil is subject to rilling and gullying. Trees are subject to windthrow where soils are wet and cemented in what is referred to as the ortstein layer.
- Reggad very cobbly muck: 30 to 90 percent slopes - This very deep, excessively drained soil, located on mountain back slopes, formed in a mixture of organic material, volcanic ash, and pumice over rock rubble. This soil is unstable when undercutting during construction may result in rock movement. It is found within the Study Area on midslope positions near Alpental.
- Altapeak gravelly sandy loam: 8 to 65 percent slopes - This deep, well-drained soil is on mountain slopes. Permeability is moderately rapid and effective rooting depth is 40 to 60 inches. Runoff varies with slope, and carries a moderate water erosion hazard on slopes exceeding 30 percent. Altapeak soils are found within the Study Area on mid- to upper slope positions near Alpental.
- Index loamy sand: 30 to 65 percent slopes - This deep, well-drained soil is on mountain slopes above the base at Alpental. Permeability is rapid and effective rooting depth is 40 to 70 inches. Cut and fill slopes tend to slump when wet, and exposed soil is subject to rilling and gullying.
- Rock outcrop - Rubble land - Serene Complex: 45 to 90 percent slopes - This soil is found at upper elevations at Alpental. The rock outcrop is granite and low-grade metamorphic rock.

Rubble land applies to talus slopes and Serene soil is moderately deep and well drained and hazard of water erosion is severe.

Soil Erosion

Railroad construction, completed in 1909 (Prater 1981), and railroad logging which followed, generated some of the earliest soils impacts within in the Study Area. Clearing of ski trails and construction of roads to maintain the ski areas began in the 1930s at Summit West and in the 1960s at Alpental (Prater 1981). Today, primary concerns for soil erosion in the Study Area include ski trail management activities on steep slopes (USDA 1995a) and the maintenance of the road network. The reduction of soil productivity and the short growing season associated with these soils is also a concern for revegetation and erosion control (SCS 1992), and will be addressed separately later in this section.

Erosion from Mountain Slopes

The South Fork Snoqualmie River Watershed Analysis rated the erosion potential of surface soils assuming that all vegetative cover, including the surface organic horizons, was removed (USFS 1995a). Ratings reflected the influences of climate, slope gradient and length, soil physical characteristics, and bedrock composition. The hillslope erosion potential for soils in the vicinity of Alpental and portions of Summit West located west of the Cascade crest range from moderate on valley bottom landforms to high or very high on mid- and upper-mountainslope positions (USFS 1995a). Similarly, the U. Yakima River Watershed Analysis reported a high erosion potential of surface soils in the U. Yakima Watershed in the vicinity of The Summit-at-Snoqualmie (USFS 1997).

An analysis of soil erosion potential using Washington Department of Natural Resources (WDNR) methods suggests a low to moderate erosion risk for area soils (WDNR 1995). This method uses broad categories to combine the slope and the NRCS soil K-factor, a measure of soil detachment, to produce erosion potential for a given soil type. However, to better describe the range of erosion potential and correlate the WDNR method to the ratings presented in the Watershed Condition Analysis, the assessment prepared for this FEIS modified the WDNR method to generate four soil erosion classes. A matrix using the K-factor and slope classes (0 to 30 percent, 30 to 65 percent, and greater than 65 percent) determined by GIS analysis (see Table 3.2.1-1). These values were then summed and divided in the four soil erosion potential classes. Class 1 soils had a combined value of 0 or 1, Class 2 had a value of 2, Class 3 had values of 3 or 4, and Class 4 a value of 6 or 9. These classes range from the Class 1 soils, with less erosive properties located on flatter slopes, and possess the lowest risk of surface erosion, to Class 4 soils, which are more erosive soils located on steeper slopes and pose the highest risk of surface erosion.

Table 3.2.1-1:
Classification of Soil Erosion Potential with the Summit at Snoqualmie Study Area

K-factor	Slope Class		
	1 (0 to 30%)	2 (30 to 65%)	3 (>65%)
0 (0-0.01)	0	0	0
1 (0.01-0.17)	1	2	3
2 (0.17-0.24)	2	4	6
3 (0.24-0.37)	3	6	9

Note: This table includes the Mill Creek portion of the Study Area.

This method describes which soils have a greater risk of surface erosion than others. It does not imply that Class 1 and 2 soils will not erode under management activities, nor does it imply that Class 3 and 4 soils will always severely erode under management. All management activities in forested mountainous landscapes generate some increased risk of erosion. Actual erosion, however, depends on the degree of impact of a management action and the effectiveness of best management practices and associated Management Requirements and Other Management Practices listed in Table 2.4-2.

The acreage of each erosion risk class within the Study Area is given by watershed in Table 3.2.1-2. The majority of soils within the Study Area are classified as Erosion Class 2 (55 percent) or Erosion Class 3 (34 percent) (see Table 3.2.1-2).

Table 3.2.1-2:
Existing Soil Erosion Potential within The Summit-at-Snoqualmie Study Area

Parameter (units)	U. Yakima	S.F. Snoqualmie	Study Area Totals
Study Area (acres)	1,885.34	1,014.16	**2,899.50**
Area of Soil Erosion Potential in Each Class (acres)			
1 (lowest)	3.88	113.97	**117.85**
2	1,181.18	411.62	**1,592.80**
3	623.11	369.83	**992.94**
4 (highest)	77.17	118.75	**195.92**

Note: This table includes the Mill Creek portion of the Study Area.

The Study Area straddles the Cascade crest, with approximately 1,885 acres lying east of the crest within the U. Yakima Watershed. The distribution of soil hazard classes within this watershed is similar to that of the entire Study Area with about 63 percent in Erosion Class 2 soils, and about 33 percent in Erosion Class 3 soils (see Table 3.2.1-2). The distribution of erosion risk classes at The Summit is shown in Figure 3.2.1-1, Soil Erosion Potential – The Summit.

West of the crest, approximately 1,014 acres of the Study Area lie within the S.F. Snoqualmie Watershed. The distribution of soil erosion hazard classes is broader here than in the U. Yakima Watershed, with less Erosion Class 2 soils (40 percent) and more soils classified as Erosion Class 1 and Erosion Class 4 (11 percent and 12 percent, respectively) (see Table 3.2.1-2). The distribution of erosion risk classes at Alpental is shown in Figure 3.2.1-2, Soil Erosion Potential – Alpental.

Areas of actual erosion were inventoried on both natural and managed areas using aerial photography and field inventories (Jones & Stokes 2001). Erosional features identified on 1990 orthophotography with 1-meter resolution included contiguous areas with a minimum area of 1 to 2 acres that contain sparsely vegetated soil (i.e., areas with less than 50 percent vegetative cover), in part because topsoil has eroded. Field observations permit the identification of much smaller areas of sheet erosion, rill erosion, gully erosion, bare soils, raw streambanks, and similar surface erosion indicators.

Surface erosion under natural conditions is common but not extensive. No large areas of surface erosion were observed in natural areas using aerial photography. Natural surface erosion areas observed in the field include: soils with minimal development of an organic horizon and sparse ground flora; secondary erosion of *scarps* and exposed banks in debris avalanche tracks and inner gorge slumps; and raindrop splash on subalpine soils under herbaceous cover disturbed by freeze-thaw action. The latter is indicative of the sensitivity of soils in subalpine areas to disturbance under management. Erosion from these natural sources is not considered significant and is probably indistinguishable from background sediment yields.

Aerial photo analyses detected surface soil erosion in actively managed areas but not in relatively natural areas. Aerial photos indicate there are five areas, totaling approximately 14 acres, in which surface erosion is evident within the Study Area. These areas exhibit less than 50 percent vegetative cover, which allows for the ground and herbaceous layers to be detected in the photograph. All of these areas are in the U. Yakima Watershed, where sheet and rill erosion removed topsoil on steep slopes cleared for ski trails at The Summit. These eroded areas account for less than 2 percent of the total area of existing modified vegetation. Total area is limited due to the rapid growth of herbaceous vegetation sown on the ski slopes. No extensive bare soil areas were mapped at Alpental.

Field observations in the Study Area from recorded 3.15 acres of surface erosion in managed areas across 12 7th-field drainages (Jones & Stokes 2001). Much of the erosion is associated with water bars that failed to intercept storm runoff or adequately convey it to secure, stable areas. Sediment is delivered to streams in ten of the drainages and ultimately reaches the mainstems of Coal Creek or the upper S.F. Snoqualmie River. All sites were evaluated during the preparation of this FEIS to determine how they would be best addressed. Several areas would be corrected concurrent with the planting of tree islands as described in Chapter 2 for the MDP proposal. The remaining sites were reviewed, and those that would be the most effective in reducing sediment yield to streams were incorporated into a restoration plan developed as part of the MDP proposal (see Appendix F-MDP Implementation Plan). Soil stabilization is

one of the primary purposes of the restoration plan, and this objective would be achieved through a combination of revegetation, slope stabilization and road obliteration projects.

Channel erosion that occurs in linear fashion along reaches of some streams is not included in the area estimates given above. However, bed and bank erosion along stream channels is probably the largest erosion source related to the developed ski areas. Both deeply and shallowly incised mountain slope stream segments (referred to as MS1 and MS2 channel types described in Section 3.3.2 - Streams, respectively) located within ski trails are subject to a loss of rooting strength when overstory trees are harvested and riparian shrubs are mowed for ski trail maintenance. An increase in watershed runoff may also occur where a significant portion of the upslope vegetation has been removed. Recontouring of slopes adjacent to the channel may change the gradient, width, depth, roughness, or other hydraulic parameters of the channel. When one or all of these situations occur, the channel adjusts in an attempt to find or return to some equilibrium condition. At The Summit-at-Snoqualmie, this generally results in channel downcutting and the result is a narrow and deep channel that limits off channel flooding in a setting where it naturally might occur. It is estimated that 28 percent of MS2 stream segments near Alpental are degraded as a result of downcutting related to slope clearing, slope grading, parking lot construction, and increased runoff (Jones & Stokes 2001).

Most of the documented sheet/rill erosion and channel erosion areas deliver sediment to MS1 and MS2 channels. These channels transport fine sediment downstream to be deposited, at least temporarily, in pools and gravel bars and behind obstructions in valley bottom stream segments. This sediment, along with the fine sediment generated from roads and mass-wasting processes, may negatively affect fish habitat.

Erosion from Roads

Along with channel bed and bank erosion, roads are considered a dominant, management-related sediment source within the Study Area. Many characteristics of roads determine the volume of sediment generated and delivered to streams. Some of these include: total length of road, road density, geology of the area, form and steepness of slopes, location, road type, surfacing, number of stream crossings, type of drainage structures, and maintenance. Many of these characteristics for roads within the Study Area are summarized in Table 3.2.1-3 and are discussed in greater detail below.

A total of 22.0 miles of roads exists within the Study Area (see Figures 2.3.2-3, Alternative 1 Existing Utilities/Night Skiing/Roads – The Summit, and 2.3.2-4, Alternative 1 Existing Utilities/Night Skiing/Roads – Alpental).[32] These include all service roads that are part of The Summit-at-Snoqualmie's maintenance and operations and portions of SR 906 and Alpental Road. More than 55 percent of the road

[32]The 22 miles of roads include 3.5 miles of roads in the 290-acre parcel that is proposed for donation to the U.S. government under Alternative 3 and Modified Alternative 5 (i.e., the Mill Creek portion of the Study Area). Thus, the roads associated directly with The Summit-at-Snoqualmie total 18.5 miles.

network is on private land, and less than 45 percent of the roads are on NFSL. Since it relates road length and the size of the area being evaluated, road density is one useful index of road sediment potential. The density of roads within the Study Area is approximately 4.86 miles per square mile (see Table 3.2.1-3). This is a dense road network that indicates potential for sediment delivery to streams and impacts to channel conditions and aquatic habitat. The U.S. Fish and Wildlife Service (USFWS 1998) suggests watersheds are at risk of incurring degradation of aquatic habitat for bull trout when road densities exceed 2 miles per square mile, and that watersheds generally cannot maintain properly functioning aquatic habitat at densities exceeding 3 miles per square mile.

Most (86 percent) of the road network within the Study Area is situated within the U. Yakima Watershed, resulting in a road density of 6.43 miles per square mile (see Table 3.2.1-3; Figure 2.3.2-3, Alternative 1 Existing Utilities/Night Skiing/Roads – The Summit). This density is more than double the indicator of degradation established by the USFWS (1998). Since the S.F. Snoqualmie watershed contains a relatively small proportion of the road network in the Study Area (14 percent), the road density of 1.96 miles per square mile is significantly lower than the Study Area average (see Table 3.2.1-3; Figure 2.3.2-4, Alternative 1 Existing Utilities/Night Skiing/Roads – Alpental). This density is within the acceptable limits established by the USFWS (1998).

Table 3.2.1-3:
Existing Road Characteristics within The Summit-at-Snoqualmie Study Area

Parameter (units)	U. Yakima	S.F. Snoqualmie	Study Area Totals
Study Area Totals			
Study Area			
Acres	1,885.34	1,014.16	**2,899.50**
Square miles	2.95	1.58	**4.53**
Roads			
Roads (miles)			
Native	17.81	2.70	**20.50**
Paved	1.12	0.41	**1.53**
Total (miles)	18.93	3.10	**22.03**
Road density (miles/mile^2)	6.43	1.96	**4.86**
Road length by soil erosion potential (miles)			
1 (lowest)	0.00	0.30	**0.30**
2	14.43	2.54	**16.96**
3	4.46	0.27	**4.73**
4 (lowest)	0.04	0.00	**0.04**

Note: This table includes the Mill Creek portion of the Study Area.

Within the Study Area, approximately 17.3 miles (78 percent) of roads are constructed on soils less prone to erosion (erosion potential class 1 and 2). An additional 4.7 miles (21 percent) are built on erosion class 3 soils (see Table 3.2.1-3). Only very short lengths of roads are built on the most erodible soils in Erosion

Class 4. Roads built on Erosion Class 3 soils constitute 24 percent and 9 percent of the road networks in the U. Yakima Watershed and S.F. Snoqualmie Watershed, respectively (see Table 3.2.1-3).

Roads within the Study Area are predominately up-mountain service roads that are constructed from native materials with no surfacing. They consequently influence sediment production both within the Study Area and in the mainstem rivers downstream of the Study Area. About 17.8 of the 20.5 miles of native roads in the Study Area are within the U. Yakima Watershed, and only about 2.7 miles are within the S.F. Snoqualmie Watershed (see Table 3.2.1-3). Another 1.5 miles of paved roads are located near the base areas of the Summit (1.1 miles, primarily in SR 906) and Alpental (0.4 mile) (see Table 3.2.1-3). These roads are currently paved, thus reducing the erodible tread surface and countering the increased erosion risk that would accompany the high frequency of use. Roads are identified and displayed as a developed condition in Figures 3.2.1-1, Soil Erosion Potential – The Summit, and 3.2.1-2, Soil Erosion Potential – Alpental.

These roads are predominately ski area service roads and related forest roads maintained by the ski area, USFS, and private timber companies. Approximately 38 percent of the ski area service roads surveyed in 1997 were built with cut and fill construction, creating erodible surfaces on cut and fill slopes and in extensive ditches as well as on the road tread (Jones & Stokes 2001). The majority (62 percent) of the surveyed roads were built with overlay construction where erodible surfaces are limited to the road tread and occasional ditches (Jones & Stokes 2001). Although slumps of road cutslopes were observed, they did not generate significant volumes of sediment. Along the surveyed roads, it was observed that 8,000 square feet of cutslope erosion, 74,200 square feet (1.7 acres) of sheet and rill erosion on road running surfaces, and 4,380 linear feet (0.83 mile) of eroding or blocked ditches (Jones & Stokes 2001) were evident. Fillslopes generally appeared stable and well vegetated.

Ski Lifts, Inc. applies sand to all parking lots, maintenance areas, and arterial roads across The Summit-at-Snoqualmie for winter traction control. Applications occur on private land, NFSL, and state rights-of-way, including the Alpental Road and SR 906. In addition, WSDOT applies sand and deicing compounds to I-90, SR 906, and other public facilities outside of the Study Area. Sanding application rates for The Summit-at-Snoqualmie are listed below in Table 3.2.-4. From 2000 to 2004, WSDOT used a 5 to 1 ratio of sand and salt. More recent communications with WSDOT staff indicate that they have aggressively approached a chemical priority program increasing the ratio of liquid de-icers/ice-inhibitors and sand when conditions warrant. Data compiled for the entire highway section from Mile Post 34 (North Bend) to Mile Post 70 (Easton) indicate that the amount of de-icers/ice-inhibitors could reach as much as 4000-6000 tons of solid, 5000-7000 cubic yards of sand and approximately 100,000-130,000 gallons of liquid de-icers/ice-inhibitors over the winter months. Most applications during the winter are performed without sand, following WSDOT's standard operating procedures for winter deicing, however, Hyak uses the least amount of chemical de-icers/ice-inhibitors of the section sheds for their roads, due to the heavy snows and less icing conditions (Kukes 2007 pers.comm.).

Table 3.2.1-4:
Sanding Applications within The Summit-at-Snoqualmie Study Area from 2000 through 2004

Winter Season	Amount Applied (cubic yards)	Weight (tons)
2000-2001	665	931
2001-2002	1,141	1,597.4
2002-2003	422	590.8
2003-2004	994	1,391.6

The sand is an additional source of road-related sediment that may be discharged to adjacent soil and streams, with effects on channel conditions, fish habitat, and ditch maintenance requirements. Movement of the well drained, porous traction sand to soils in adjacent rights-of-way would not likely impact the drainage of the coarse, well-drained to moderately well-drained soils in the Study Area, except possibly in localized depressions where the finer fraction could settle and reduce permeability. This would, however be an exception and would not generally occur. Traction sand deposition would continue to cover adjacent vegetation and organic soil material, reducing soil productivity adjacent to sanded roads and parking lots.

Mountain biking and hiking on roads, hiking on the Pacific Crest Trail, and other summer recreation activities in the Study Area have been observed to yield sediment to streams, but only in very small amounts relative to the road-related sources described above.

Modeled Estimates of Erosion and Sediment Production

Sediment production and yields from the mountain slopes and developed base areas within an analysis area have been evaluated for this analysis using the 2003 version of the Water Erosion Prediction Project (WEPP) for Windows model, specifically the Watershed WEPP module (Elliott 1998). The WEPP model is a process-based, continuous computation, distributed parameter erosion prediction model implemented as a computer numerical simulation. The model is based on numerical representations of the physical processes influencing runoff and sediment yield. Thus, it permits a simulation of various actual watershed processes, including: rainfall/snowfall, infiltration, runoff, soil moisture accounting, snow accumulation/melt, evapotranspiration, plant growth and litter decomposition, and sediment detachment and deposition. The model parameters include rainfall amounts and intensity; soil textural properties; plant growth parameters; residue decomposition factors; slope shape, steepness, and orientation; and soil erodibility parameters. Soils may be represented in multiple layers with multiple parameters describing texture, rock content, moisture, permeability, organic content, and cation exchange capacity.

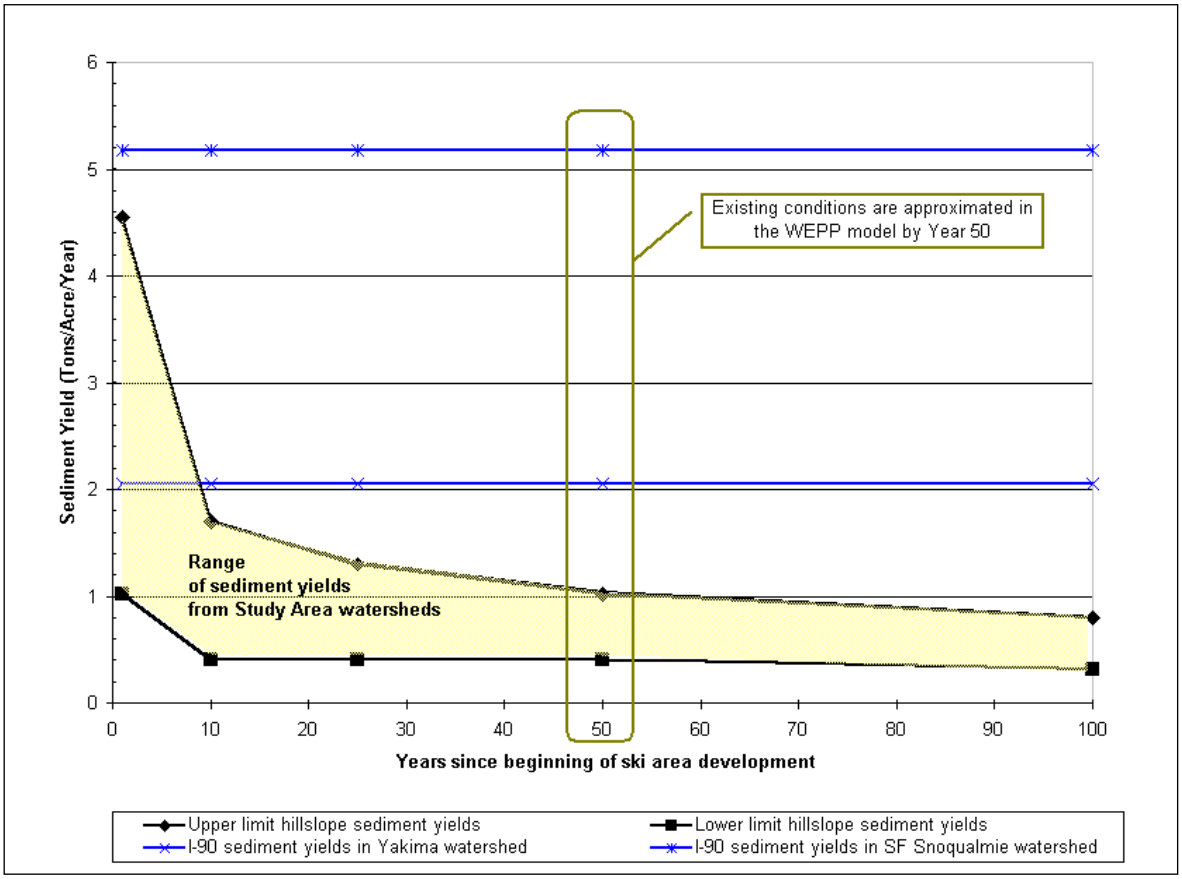
The model uses a statistically generated synthetic climate dataset to drive its simulations. The synthetic dataset is derived by applying a probabilistic model using statistical parameters computed from observed climate trends. Very high resolution climate data (including temperature, windspeed and direction, relative humidity, and solar radiation) is derived via the Parameter-elevation Regressions on Independent Slopes Model (PRISM) (Daly et al. 1994). PRISM is a system that uses point data and a digital elevation

model to generate gridded estimates of climate parameters. PRISM is well-suited to mountainous regions, because the effects of terrain on climate play a central role in the model's conceptual framework.

In interpreting the WEPP model's predictions, it is important to note that the WEPP documentation cautions that "At best, any predicted runoff or erosion value, by any model, will be within only plus or minus 50 percent of the [actual] value. Erosion rates are highly variable, and most models can predict only a single value. Replicated research has shown that observed values vary widely for identical plots, or the same plot from year-to-year. Also, spatial variability… of soil properties add[s] to the complexity of erosion prediction" (USFS 2000).

The WEPP analysis area includes the Study Area, portions of I-90 that yield sediment to the Study Area, and areas near the Mill Creek and Upper Alpental drainages required to complete contiguous modeling of streamflow and sediment. Inputs to the model include contributing areas (called hillslopes in the model), hillslope and soil characteristics, management practices, and precipitation history. The model simulated erosion processes under the given inputs and calculated rates of sediment detachment and delivery to water bodies located down gradient over a 100-year simulation period. Results are evaluated in this section to compare the influence of three general land cover classes (forest and natural shrub areas; non-forested, non-developed areas, including ski trails; and developed base areas, including base area roads and parking lots) on annual sediment volumes delivered to any stream the analysis area. In addition, I-90 and its adjacent rights-of-way were modeled to provide a comparison with sediment contributions from winter sanding of I-90 to Coal Creek and the S.F. Snoqualmie River. Results in Section 4.2 – Geology and Soils incorporate the effects of sediment routing and/or recruitment in the tributary streams to evaluate for each Alternative the annual sediment yields to three mainstem valley bottom streams (Coal Creek, Mill Creek, and the S.F. Snoqualmie River).

Illustration 3.2.1-1:
Trends in Sediment Yields From All Slopes Within the Study Area and From I-90 Adjacent to the Study Area



Development of the WEPP model provides documentation for the erosional history of the Study Area under ski area management. Model results include sediment yields through time, beginning with pristine soils subjected to a simulation of climate and management activities. Results indicate high yields of sediment on a unit area basis in the first year, rapidly declining in the first one to ten years before gradually declining for the duration of the simulation period (see Illustration 3.2.1-1). Sediment yields during early (the first ten years of) ski area development were in the range of existing yields to S.F. Snoqualmie River and Coal Creek from road traction sand applied to I-90. Yields range from about 1 to 4.5 tons/acre/year from slopes under the range of conditions from natural land cover to ski trail clearing. Ten years after disturbance, yields from these slopes have declined to 0.4 to 1.7 tons/acre/year. By comparison, yields from I-90 range from 2.0 to 5.2 tons/acre/year (see Illustration 3.2.1-1).

Assuming year 0 of the simulation period was comparable to the commencement of the development of ski area facilities between the 1930s and 1960s, year 50 of the simulation period is representative of current conditions in the Study Area (see Illustration 3.2.1-1). Current yields from all slopes within the

analysis area range from 0.4 to 1.0 tons/acre/year, about 2 to 12 times less than rates from road traction sand on I-90 (see Illustration 3.2.1-1).

Annual sediment yields to any stream are summarized for the analysis area and by subwatershed in Table 3.2.1-3 and Illustration 3.2.1-2. Road sand coming from I-90 is the largest single source of sediment in the analysis area, contributing about 675 tons every year, or 34 percent of the total sediment yield (see Table 3.2.1-5 and Illustration 3.2.1-2) from about 14 percent of the contributing area modeled (see Illustration 3.2.1-2). Forested areas and slopes in other natural conditions yield a somewhat smaller volume (574 tons or 29 percent; Illustration 3.2.1-2), and do so at a lower rate from a much larger contributing area (59 percent of the contributing area) (see Table 3.2.1-5; Illustration 3.2.1-2). Non-forested, non-developed areas comprise 26 percent of the contributing area and are the source of 17 percent of the total sediment yield. Developed ski areas compose 6 percent of all contributing areas modeled, but are responsible for 20 percent of sediment delivered to valley bottoms each year.

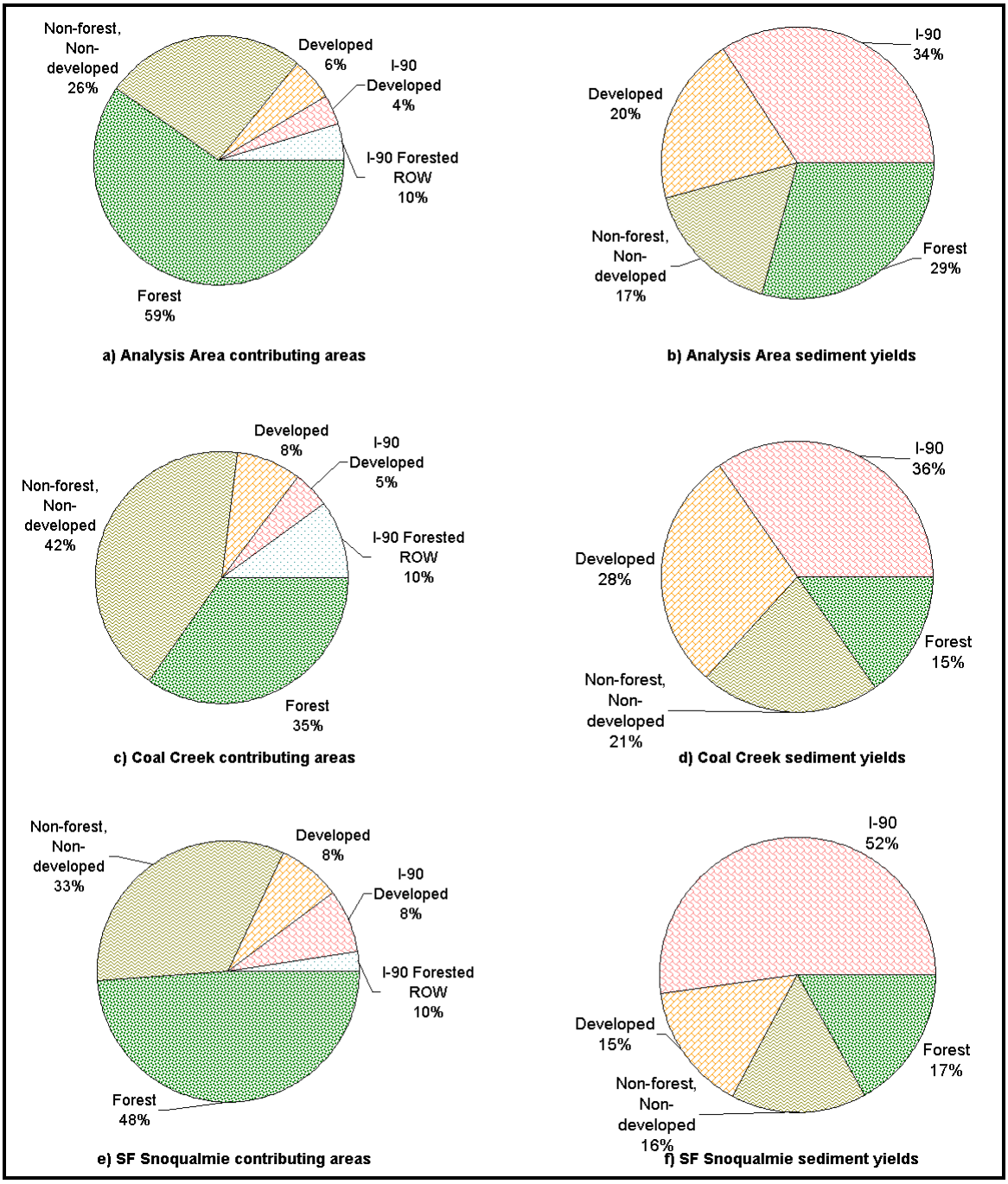
WEPP results in Table 3.2.-5 and Illustration 3.2.1-2 also distinguish between sediment yields across subwatersheds. Rates and total volumes of sediment in the Coal Creek and S.F. Snoqualmie Watersheds follow the typical patterns of the Study Area, but demonstrate an even greater dominance of sediment derived from I-90 road sanding. This is because Mill Creek is situated on the opposite shore of Keechelus Lake and is not subject to runoff from I-90.

Table 3.2.1-5:
Hill Slope Sediment Yields to All Mapped Streams[a] Under Existing Conditions for The Summit-at-Snoqualmie Sediment Source Analysis Area

Disturbance Source	U. Yakima Watershed		S.F. Snoqualmie Watershed	Analysis Area[b] Totals
Mainstem stream evaluated[a]	**Coal Creek**	**Mill Creek**	**SF Snoqualmie River**	
Approximate drainage area contributing to mainstem stream (acres)	2,509	1,122	2,924	6,555
Drainage area modeled for this EIS, including the Study Area (acres, percent)	1,617 (64%)	905 (81%)	1,152 (39%)	3,674 (56%)
Sediment Yield by Sediment Source Area				
Forested areas and slopes in other "natural" conditions (tons/year)	167	311	96	574
Forested Percent of Total Yield (tons/year)	15%	99%	17%	29%
Non-forested, non-developed areas, including ski trails (tons/year)	234	4	89	328
Base area roads, parking lots, and adjacent developed areas (tons/year)	311	0	84	395
I-90 and adjacent rights-of-way (tons/year)	381	0	295	675
Non-forested Percent of Total Yield (tons/year)	85%	1%	83%	71%
Total Hill Slope Sediment Yield (tons/year)	**1,093**	**315**	**563**	**1,972**
Total Sediment Yield after Stream Routing (tons/year)[c]	**671**	**365**	**427**	**1,463**

[a] This table documents sediment yield to all streams in the Analysis Area, including tributaries to mainstem streams and directly from hillslopes to mainstem streams. The routing of sediment through the stream network is not represented in this table in order to identify the sediment yields from various land management activities.
[b] Analysis area includes the Study Area, portions of I-90 that yield sediment to the Study Area, and areas near the Mill Creek and Upper Alpental drainages required to complete contiguous modeling of streamflow and sediment.
[c] Total sediment yield after stream routing reflects the modeled sediment load that actually reaches the outlets of the 7th field drainages in the Study Area. Sediment yield values below the hillslope yield values indicate that sediment is deposited in flatter (slower moving) stream segments before leaving the drainage. Sediment yield values above the hill slope values indicates that additional sediment is recruited from stream channel before leaving the drainage.

Illustration 3.2.1-2:
Proportion of Total Annual Sediment Yield (tons/year) Delivered to Any Stream in the Sediment Source Analysis Area by Sediment Source/Land Cover Type and Subwatershed



Left hand column (figures a, c, e) illustrates distribution of land cover types within the modeled contributing areas of each stream. Right hand column (figures b, d, f) illustrates the proportion of total annual sediment yield from areas under those land cover types. Note that contributing area data represent about 64 percent of the watershed contributing to Coal Creek (that is, about 36 percent of the contributing area and an unknown sediment volume are not included in figures c and d, respectively). Similarly, contributing area data represent about 39 percent of the S.F. Snoqualmie River subwatershed. Data for the Mill Creek subwatershed are not shown in this illustration.

Soil Productivity

Another management concern for soils in the Study Area is the potential for a reduction in long-term soil productivity. USFS policy identified in FSM 2520 for management on NFSL requires the implementation of specific Soil Quality Standards (SQS) to ensure the maintenance of ecosystem processes and to avoid the permanent impairment of land productivity (USFS 1998). Soil quality standards establish a threshold for the extent of disturbance that will be permitted within an activity area. No more than 20 percent of an activity area will be disturbed, including soil compaction, displacement, puddling, burning, and severe erosion (USFS 1998). Roaded area is included as a component of the disturbance thresholds established under this policy. This threshold is intended as a guide. Actual area of disturbance permitted may be much more restrictive if field investigations and analysis indicate the need. Although these Standards and Guidelines are not intended to be applied to developed recreation sites, they are considered here because of the dispersed nature of ski area management and the concerns for water resource management in this watershed.

Table 3.2.1-6 uses the SQS criteria to document detrimental soil conditions (soils not able to support vegetation), or their potential, within the Study Area. The existing ski area developments (e.g., the base area, up-mountain developments, and up-mountain roads), sparsely vegetated soil mentioned above, and management-related mass wasting areas have resulted in detrimental soil conditions on 108.1 acres (about 4 percent of the Study Area). The area of detrimental soil conditions within the Study Area is well below (within) the disturbance threshold of 580 acres (20 percent of the Study Area), indicating that SQS are satisfied at this scale (see Table 3.2.1-6).

Of the 108.1 acres of detrimental soil conditions in the Study Area, just over three-fourths (84.1 acres) occur in the U. Yakima Watershed (see Table 3.2.1-6), including the area in 18.9 miles of roads. Approximately two-thirds of this area is on private land in developed facilities. Nearly all of the 13.3 acres of severely eroded soils are located within this watershed (see Table 3.2.-6).

In the Study Area within the S.F. Snoqualmie Watershed, there are 24 acres of detrimental soil conditions (just under one-quarter of the area; see Table 3.2.1-6), including the area in 3.1 miles of roads. More than four-fifths of this area is on public land in developed facilities. Just under one-third acre of eroded soils is mapped within this watershed.

Table 3.2.1-6:
Existing Detrimental Soil Quality Conditions within The Summit-at-Snoqualmie Study Area

	U. Yakima	S.F. Snoqualmie	Study Area Totals
Study Area (acres)	1,885.21	1,014.15	**2,899.36**
Total detrimental soil conditions (acres)	86.9	27.02	**113.92**
Percent of Study Area in a Detrimental Soil Condition (percent)	4.6%	2.7%	**3.9%**
Detrimental Soil Conditions Below USFS 20 percent Threshold? (yes or no)	Yes	Yes	**Yes**
Percent of Study Area with Potential Detrimental Soil Conditions	2.5%	0.1%	**1.7%**

Note: This table includes the Mill Creek portion of the Study Area.

The potential for indirect erosion impacts resulting in additional detrimental soil conditions is greatest where converted forestland is maintained under herbaceous and shrub vegetation in ski trails on soils with high erosion hazard. There are 242.4 acres of higher hazard soils (erosion class 3 and 4) in the Study Area maintained in a modified vegetative cover (see Table 3.2.1-7). Most of these high hazard soils (231.5 acres or 95 percent) are located in the U. Yakima Watershed. This area does not necessarily exhibit detrimental soil conditions, but is at a higher potential for erosion that could cause detrimental soil conditions.

Table 3.2.1-7:
Potential Areas for Decreased Soil Productivity Resulting from Erosion on Moderate and High Erosion Potential Areas

Disturbance Potential	U. Yakima	S.F. Snoqualmie	Study Area Totals
Modified herbaceous and shrub cover by soil erosion potential (acres)			
1 (lowest)	0	24.8	24.8
2	440.5	68.2	508.7
3	221.0	10.9	231.8
4 (highest)	10.5	0.1	10.6
Total (acres)	**672**	**104**	**776**

Note: This table includes the Mill Creek portion of the Study Area.

Developed areas and existing bare soil areas on erosion prone soils increase the risk for future development of detrimental soil conditions because they generally result in a reduced or absent duff layer common in adjacent forests, sheet and rill erosion, and may lead to gullying. Subalpine and other high elevation soils, with their cool climate, short growing season, and naturally low organic matter, are particularly sensitive to disturbance, and require additional attention and monitoring to assure revegetation efforts are successful in maintaining soil quality.

As shown in Table 3.2.1-6, the U. Yakima River has the largest area that is at increased risk of development of additional detrimental soil conditions. Not only do most of the developed and bare soils areas occur within this watershed, but also more soils with higher erosion hazard are present. Even though there are areas with increased risk for future development of detrimental soil conditions, the Study Area would still be well under the 20 percent threshold if all of these areas deteriorated.

3.2.2 Drainages of Particular Concern

Study Area results presented in Section 3.2.1 – Summary of Existing Conditions Within the Study Area are based on a 6th-field subwatershed scale analysis. At this scale, the size of the ski area suggests that a 6th-field scale is too large of an area to adequately describe existing conditions relative to the four different ski areas (Summit West, Central, East, and Alpental). In addition, in order to adequately evaluate potential impacts from proposed activities described in Chapter 2, it is necessary to display conditions in smaller geographic areas. Therefore, the FEIS presents information that describes existing conditions in smaller area, the 7th-field drainage, to provide a better understanding of the differences in physical and biological features associated with soils, water, and fisheries resources. Describing site conditions at this scale provides a basis to understand how impacts may affect resources, especially where sensitive resources are concentrated in a smaller area.

The Study Area includes portions of 15 smaller, 7th-field drainages that make up the two larger 6th-field subwatersheds. This section describes conditions in the 7th-field drainages for soil resources. It is important to understand some of the drainages are in relatively undisturbed conditions, whereas other drainages have more disturbed conditions from historic development. A description of the existing condition in each drainage is required to understand how an activity proposed in the Action Alternatives may affect soil conditions in specific drainages, including beneficial impacts to soil conditions through restoration.

3.2.2.1 Process for Evaluation of Drainages of Particular Concern

A quantitative and qualitative process was used to describe existing conditions in the 7th field drainages and to identify where the drainages occur along a continuum of relatively undisturbed to degraded conditions. Tables 3.2.2-1 and 3.2.2-2 show the 15 drainages that occur within the U. Yakima Watershed and the S.F. Snoqualmie Watershed, along with a set of parameters used to measure conditions in the drainages. Key parameters were selected to evaluate conditions that influence sediment production, stream temperatures, stream flow, and the amount and quality of fish habitat. These parameters were selected because of their relevance to the ongoing processes within the 7th field drainages in the Study Area, types of land use that occur in the Study Area, and their importance in describing soil, water, and fish resources. Drainages of particular concern are those 7th field drainages that have a majority of the key parameters over established thresholds due to degraded watershed conditions.

To understand of the condition of the drainage relative to naturally functioning conditions for each parameter, a threshold value was identified for each parameter. Thresholds were determined from a variety of published sources applicable to the setting found in the Study Area, and from site-specific data gathered in the Study Area. If a threshold is exceeded in a drainage, it indicates that the resource conditions are of low quality due to degraded biological and physical factors for that specific parameter. See the DPC Parameter and Threshold Rationale Matrix in *Appendix I - Physical and Biological Resource Data Tables*, for a detailed description of how the thresholds where established.

For this specific analysis of soil resources, the most important parameters to consider are road density, road crossing density, impervious cover, bare soils modified channel length, and activities on high erosion soils. These parameters were selected because they are the ones that most directly affect soil resources (see rationale in Appendix I - Physical and Biological Resource Data Tables).

3.2.2.2 Upper Yakima River Watershed

Lower Mill Creek

Lower Mill Creek exhibits 4 parameters that exceed thresholds (see Table 3.2.2-1).

- Road Density (7.42 miles/square mile)
- Road Crossing Density (27.5/square mile)
- Bare Soils (1.46 acres)
- Activities on High Erosion Soils (1.99 percent)

A total of 396 acres of the Study Area are situated within the Lower Mill Creek drainage. Only about 2 percent of the drainage is under impervious cover (see Table 3.2.2-1). In addition to these parameters, 10.5 acres of the drainage is considered to be in detrimental soil quality condition (9.2 percent of all detrimental soils in the Study Area). WEPP-modeled sediment yields indicate that, together, lower and upper Mill Creek have the lowest unit-area rate of sediment delivery of in the Study Area, but that because of the large drainage area they yield a greater total volume of sediment than any other 7th field drainage (see related discussion in Section 3.2.1.3 - Soils). Specific problem areas identified in managed ski areas in the drainage include the failure of water bars and minor gullying downslope of roads accessing the upper terminal of the Backside chairlift.

Table 3.2.2-1:
DPC Analysis of Soil Conditions for Existing Conditions in the Upper Yakima Watershed Portion of The Summit-at-Snoqualmie Study Area[a]

Parameter	Threshold	U. Yakima Watershed								
		L. Mill Creek	U. Mill Creek	Creek Run	Summit South	Hyak	Tunnel	Ski Acres	Beaver	Other
Road Density (miles/mile^2)	3.0	7.42	2.90	2.52	5.66	2.78	12.34	9.28	8.65	1.66
Road Crossing Density (number/mile^2)	6	27.50	0.00	20.34	14.29	9.96	85.71	50.04	33.61	4.11
Impervious Cover (% of total)	8.0	2.25	0.88	0.76	4.33	1.28	7.03	8.16	4.29	1.16
Bare Soils (acres)	0.0	1.46	0.00	0.00	2.14	0.00	0.00	9.39	0.00	0.31
Activities on High Erosion Soils (% of total)	1.5	1.99	0.00	0.00	1.42	1.45	1.58	7.93	2.41	0.54
Parameters over Threshold:		**4**	**0**	**1**	**3**	**1**	**3**	**5**	**3**	**1**

[a] The value stated for each drainage is in terms of the metric used to compare to the threshold. A complete breakdown of the DPC analysis can be found in Appendix I and includes the area of impact and analysis area for each DPC parameter.

Upper Mill Creek

No parameters exceed threshold within the Upper Mill Creek (see Table 3.2.2-1). Approximately 33 acres of the Study Area are situated within the upper Mill Creek drainage. Most of the drainage outside of the Study Area is largely forested and is considered in pristine condition. However, the lower portion of the drainage in the Study Area contains a portion of the regenerating sapling forest described for the Lower Mill Creek drainage and some forest. Approximately 0.3 acre is in a detrimental soil quality condition. No specific soil problems or geologic hazards have been identified in the upper Mill Creek drainage.

Creek Run

One parameter exceeds threshold within the Creek Run drainage (see Table 3.2.2-1).

- Road Crossing Density (20.3/square mile)

A total of 220 acres of the Study Area are situated within the Creek Run drainage. Approximately 1.7 acres of the drainage is considered to be in detrimental soil quality condition (less than 1.5 percent of all detrimental soils in the Study Area). No specific existing soil problems or geologic hazards have been identified in the Creek Run drainage.

Summit South

Summit South exhibits parameters that exceed three thresholds (see Table 3.2.2-1).

- Road Density (5.7 miles/square mile)
- Road Crossing Density (14.3/square mile)
- Bare Soils (2.1 acres)

A total of 224 acres of the Study Area are situated within the Summit South drainage. The relatively short length of stream in the drainage translates into a reduced risk of sediment yield from these source areas. Only about 4 percent of the drainage is under impervious cover, primarily in base area parking lots (see Table 3.2.2-1). In addition to these parameters, 12.0 acres of the drainage is considered to be in detrimental soil quality condition (10.5 percent of all detrimental soils in the Study Area) including just over 2 acres of eroded soils near the summit of Mount Hyak, downslope of the *Dinosaur* chairlift. The WEPP model indicates that Summit South has the highest unit-area rate of sediment delivery in the Study Area, and the third highest total sediment yield of the 7th field drainages modeled (see related discussion in Section 3.2.1.3 - Soils).

Hyak Creek

Hyak Creek exhibits 1 parameter that exceeds threshold (see Table 3.2.2-1).

- Road Crossing Density (9.96/square mile)

A total of 193 acres of the Study Area are situated within the Hyak drainage. Additionally, 1.45 percent of the higher erosion hazard soils have activities occurring on them which is close to the threshold of 1.50 percent (see Table 3.2.2-1). In addition, about 2.5 acres of the drainage is considered to be in detrimental soil quality condition (about 2.2 percent of all detrimental soils in the Study Area, see Table 3.2.1-5). Specific areas of concern identified in managed ski areas in the drainage include sediment production associated with the *Silver Fir* parking lot and with gullies under the *Silver Fir* chairlift and in a ski trail near a small tributary to Hyak Creek.[33]

Tunnel Creek

Tunnel Creek exhibits 3 parameters that exceed thresholds (see Table 3.2.2-1).

- Road Density (12.3 mile/square mile)
- Road Crossing Density (85.7/square mile)
- Activities on High Erosion Soils (1.58 percent)

A total of 134 acres of the Study Area are situated within the Tunnel Creek drainage, a tributary to Hyak Creek. At 12.34 miles per square mile and 86 crossings per square mile, road density and road crossing

[33] Replacement of the existing *Silver Fir* chairlift was approved in a CE by the USFS in 2008. Replacement of the chairlift includes an upgrade to a detachable quad and moving the bottom terminal closer to the parking lot. For the purposes of this FEIS, the replacement of the *Silver Fir* chairlift is considered an existing condition.

density are both higher in the Tunnel Creek drainage than any other drainage in the Study Area. Roads also trigger another threshold of concern when they occupy 1.6 percent of the higher erosion hazard soils in the drainage (see Table 3.2.2-1). About 7 percent of the drainage is under impervious cover, including the Silver Fir parking lot, so it nearly reaches a fourth threshold of concern (i.e., percentage impervious cover - see Table 3.2.2-1). In addition to these parameters, 9.4 acres of the drainage is considered to be in detrimental soil quality condition (8.3 percent of all detrimental soils in the Study Area). Increased runoff from the cleared and developed areas in the drainage resulted in the gullying of the channel, subsequently followed by severe bank erosion. Placement of the stream in an extended culvert in 1995 resulted in a significant reduction of in-channel sediment recruitment. Sediment is still delivered from the Silver Fir parking lot, however.

Ski Acres

Ski Acres exhibits five parameters that exceed thresholds (see Table 3.2.-1).

- Road Density (9.3 miles/square mile)
- Road Crossing Density (50.0/square mile)
- Impervious Cover (8.2 percent)
- Bare Soils (9.4 acres)
- Activities on High Erosion Soils (7.9 percent)

A total of 358 acres of the Study Area are situated within the Ski Acres drainage. Ski Acres also has more stream length than any other drainage in the Study Area, indicating a very high risk for soil particles to detach from the soil profile and be delivered to streams (see Table 3.2.2-1). At 9.28 miles per square mile and 36 crossings per square mile, road density and road crossing density are second in the Study Area only to Tunnel Creek. Roads and bare soil areas occupy nearly 8 percent of the higher erosion hazard soils in the drainage (see Table 3.2.-1). Ski Acres is one of only two drainages in the Study Area to meet or exceed the impervious area threshold of concern (see Table 3.2.2-1). In addition to these parameters, 41 acres of the drainage are considered to be in a detrimental soil quality condition (or 36 percent of, and the largest concentration of, detrimental soils in the Study Area). These include approximately 5 acres of subsequent surface erosion on a site formerly scoured by a debris flow, as well as sediment yielded from the main Summit Central parking lot. WEPP-modeled sediment yields indicate that Ski Acres has the second highest unit-area rate of sediment delivery of in the Study Area, and the highest in the drainages currently managed for ski area management. More than one-third of the total sediment volume discharged to Coal Creek from drainages under ski area management comes from this drainage (see related discussion in Section 3.2.1.3 - Soils).

Beaver Lake Creek

Beaver Lake Creek exhibits 3 parameters that exceed thresholds (see Table 3.2.2-1).

- Road Density (8.7 miles/square mile)
- Road Crossing Density (33.6/square mile)
- Activities on High Erosion Soils (2.4 percent)

A total of 171 acres of the Study Area are situated within the Beaver Lake Creek drainage. At a road density of 8.65 miles per square mile, Beaver Lake Creek ranks third among all drainages. The road crossing density of 33 crossings per square mile is the third highest of all drainages in the Study Area. Roads also trigger another threshold of concern when they occupy 2.4 percent of the higher erosion hazard soils in the drainage (see Table 3.2.2-1). About 4 percent of the drainage is under impervious cover, below the 8 percent threshold of concern for this parameter (see Table 3.2.2-1). In addition to these parameters, 7.3 acres of the drainage are considered to be in detrimental soil quality condition (6.4 percent of all detrimental soils in the Study Area). Specific concerns identified in managed ski areas in the drainage include the effects of the existing maintenance facility on water quality; sediment from gullying near the Little Thunder chairlift; and bank erosion in and impaired riparian condition along Beaver Lake Creek.

Other Upper Yakima River

Other U. Yakima River exhibits 1 parameter that exceeds threshold (see Table 3.2.2-1).

- Bare Soils (0.3 acre)

Totaling 156 acres, this drainage is actually a grouping of smaller “sliver” drainages within the Study Area boundary, but primarily includes the valley bottom containing the mainstem of Coal Creek. Even though there are no projects proposed within these areas, analysis was performed and included in the DPC tables to provide a thorough analysis of the entire Study Area. In the vicinity of The Summit, this drainage receives streamflow from the Creek Run, Hyak, Tunnel, Ski Acres and Beaver Lake drainages. Only one of the five parameters evaluated for this drainage exceed a threshold of concern, although the bare soil area reflected in this measurement is near Hyak Mountain and is not a direct risk to Coal Creek (see Table 3.2.2-1). Interstate 90 is recognized as having a strong detrimental influence on Coal Creek, particularly in the yield of traction sand to the stream. In addition, this drainage contains 2.1 acres of detrimental soil conditions (nearly 2 percent of all detrimental soils in the Study Area).

3.2.2.3 South Fork Snoqualmie River Watershed

Northside

Northside exhibits 1 parameter that exceeds threshold (see Table 3.2.2-2).

- Road Density (4.9 miles/square mile)

Only about 49 acres of the Study Area are situated within the Northside drainage. The high value for road density reflects the approximately one-third-mile road segment located on a small area (see

Table 3.2.2-1). There are no mapped streams in the drainage, so the risk of sediment yield from roads or soils is negligible. Less than 1 acre of the Northside drainage is contains detrimental soil conditions. No site-specific soil problems or geologic hazards have been identified in the Northside drainage.

Table 3.2.2-2:
DPC Analysis of Soil Conditions for Existing Conditions in the South Fork Snoqualmie Watershed Portion of The Summit-at-Snoqualmie Study Area[a]

Parameter	Threshold	S.F. Snoqualmie Watershed					
		Northside	Summit North	Inter-national	Upper Alpental	Nacri-nomical	Other
Road Density (miles/mile^2)	3.0	4.88	7.02	0.50	0.68	1.70	2.34
Road Crossing Density (number/mile^2)	6	0.00	26.62	4.76	7.16	12.05	11.93
Impervious Cover (% of total)	8.0	1.65	14.26	0.21	0.23	1.93	2.68
Bare Soils (acres)	0.0	0.00	0.00	0.00	0.00	0.00	0.22
Activities on High Erosion Soils (% of total)	1.5	0.55	0.36	0.07	0.00	0.11	0.00
Parameters over threshold:		**1**	**3**	**0**	**1**	**1**	**2**

[a] The value stated for each drainage is in terms of the metric used to compare to the threshold. A complete breakdown of the DPC analysis can be found in Appendix I and includes the area of impact and analysis area for each DPC parameter.

Summit North

Summit North exhibits 3 parameters that exceed thresholds (see Table 3.2.2-2).

- Road Density (7.02 miles/square mile)
- Road Crossing Density (26.6/square mile)
- Impervious Cover (14.3 percent)

Only about 72 acres of the Study Area are situated within the Summit North drainage. Road density in the drainage is more than 7 miles per square mile, the most dense road network in the S.F. Snoqualmie Watershed. Summit North is one of only two drainages in the Study Area to meet or exceed the impervious area threshold of concern, and it exceeds the other (Ski Acres) by 75 percent (see Table 3.2.2-1). Somewhat similar to Northside, however, only one stream discharges from the drainage, and it is not intersected by any roads. The stream then passes under the Summit West base area in a series of ditches and culverts before it flows into an unnamed tributary to the upper S.F. Snoqualmie River. Consequently, sediment yield from the managed ski trails is probably not significant, but the potential for sediment in runoff from the parking lots is high. In addition, 10.3 acres of the Summit North drainage

contains detrimental soil conditions (about 9 percent of, and the second largest concentration of, detrimental soils in the Study Area). The WEPP model indicates that Summit North has the second highest unit-area rate of sediment delivery in the Study Area, and the highest in the S.F. Snoqualmie Watershed. Total volume of sediment yielded to the S.F. Snoqualmie River is, however, moderated by the small size of the stream network (see related discussion in Section 3.2.1.3 - Soils). Although the Summit North drainage has obvious drainage scale concerns, no site-specific soil problems or geologic hazards have been identified for particular evaluation in this FEIS.

Upper Alpental

Upper Alpental exhibits 1 parameter that exceeds threshold (see Table 3.2.2-2).

- Road Crossing Density (7.2/square mile)

A total of 89 acres of the Study Area are situated within the Upper Alpental drainage. In addition, less than a quarter acre of the drainage is considered to be in detrimental soil quality condition. No specific soil problems or geologic hazards have been identified in the Upper Alpental drainage.

International Creek

International Creek exhibits no parameters that exceed threshold (see Table 3.2.2-2). A total of 270 acres of the Study Area are situated within the International Creek drainage. Although it is about three times the size of Upper Alpental, it is similar in that none of the thresholds for the soils parameters in the drainage are exceeded (see Table 3-1). Only about 0.6 acre of the drainage is considered to be in detrimental soil quality condition. WEPP modeled sediment yields indicate that, with Mill Creek, International Creek has the lowest unit-area rate of sediment delivery of in the Study Area. This is due in part to the presence of talus slopes and rock outcrops in the drainage (see also WEPP-related discussion in Section 3.2.1.3 - Soils). One site-specific problem area identified in managed ski areas in the drainage is a small debris flow and subsequent chronic erosion that yields sediment to a tributary of International Creek, and eventually the S.F. Snoqualmie River.

Nacrinomical

Nacrinomical exhibits 1 parameter that exceeds threshold (see Table 3.2.2-2).

- Road Crossing Density (12.1/square mile)

A total of 319 acres of the Study Area are situated within the Nacrinomical drainage. Approximately 6 acres of the drainage are in a detrimental soil quality condition (about 5 percent of detrimental soils in the Study Area). The low erosion classes in portions of Alpental are the result of numerous inclusions of talus slopes and avalanche chutes, as well as shallow soils overlying the massive Snoqualmie batholith at upper elevations. Erodible sediments are generally a relatively small component of these profiles. WEPP-modeled sediment yields indicate that Nacrinomical has a relatively low unit-area rate of sediment

delivery, but that because of the larger drainage area it yields a greater total volume of sediment than any other 7th field drainage in the S.F. Snoqualmie Watershed. Although it is primarily forested, just over one-third of the total sediment volume discharged to the S.F. Snoqualmie River from drainages under ski area management comes from this drainage (see related discussion in Section 3.2.1.3 - Soils).

An additional source of sediment from managed ski areas is the Alpental road and parking areas near the upper S.F. Snoqualmie River. These areas have been observed to contribute traction sand and other fine sediment into the river, primarily through snow removal and erosion of the native roadbed material. As described in Section 3.4.2.3 - Fisheries, a large portion of this fine sediment is apparently transported through the S.F. Snoqualmie Watershed as sediments composing the river bed do not show an excess of deposited fine sediment.

Other South Fork Snoqualmie River

Other S.F. Snoqualmie River exhibits 2 parameters that exceed thresholds (see Table 3.2.2-1).

- Road Crossing Density (11.9/square mile)
- Bare Soils (0.2 acre)

A total of 215 acres of the Study Area are situated within the Other S.F. Snoqualmie drainage. This is actually a grouping of smaller “sliver” drainages near the Study Area boundary, but primarily includes the valley bottom containing the mainstem of the S.F. Snoqualmie River. In the vicinity of the Alpental base area, this drainage receives streamflow from the International Creek, and Nacrinomical drainages. Further downstream near Interstate 90, this drainage receives channel and surface inflows from Northside, Summit North, and Upper Alpental drainages. Two of the five parameters evaluated for this drainage exceed a threshold of concern, although the bare soil area reflected in this measurement is along the ridge west of Ski Acres and south of Interstate 90, and is not a direct risk to the upper S.F. Snoqualmie River (see Table 3.2.2-1). Interstate 90 does have a strong influence on the upper S.F. Snoqualmie River, particularly in the yield of traction sand to the stream. In addition, detrimental soil conditions compose about 9 acres of this drainage (about 8 percent of all detrimental soils in the Study Area).

3.3 WATER AND WATERSHED RESOURCES

Water resources include precipitation stored in snowpack, lakes, and soils; water discharged through stream channels; water that percolates to deeper ground water; and water used in the human environment. Watershed resources are defined in this analysis as the characteristics of a stream or river basin that affect the quantity and quality of these surface and ground water features, including their magnitude, duration, timing, and frequency. Geology and soils are watershed features considered separately in Section 3.2 - Geology and Soils. Similarly, vegetation and wetlands are presented in Section 3.5 - Vegetation.

This section describes the character and current conditions of both water and watershed resources in the analysis area, including watershed characteristics, stream channels, water quantity, water quality, and ground water. Equally important, this description includes the ecological and regulatory setting in which the impacts of the alternatives on these resources will be evaluated in Chapter 4. Because impacts at a given point may be transmitted downstream, and because ecosystem responses to an impact vary by the size of the landscape, regulatory guidelines require evaluation of effects at different spatial scales. These scales include, in order of increasing area: the project area (i.e., the Study Area), the S.F. Snoqualmie Watershed and U. Yakima Watershed. The analysis area expands beyond the SUP boundary to include these larger areas, but the intensity of analysis decreases and water resources are described in successively less detail. In general, the progression of analytical scale is described as follows, in order of increasing area:

- Drainages (7th field scale),
- Study Area,
- Subwatersheds (6th field scale), and
- Watersheds (5th field scale).

Three measures of water and watershed resources are applied to this variable analysis area. The measures are generally appropriate only for application at the scales described above. They are used to describe the affected environment in this section, and they will be used as appropriate to document effects of the alternatives in Section 4.3 - Water and Watershed Resources.

First are the preliminary management goals called Desired Future Conditions (DFCs). DFCs were first proposed for project area streams and rivers by Jones & Stokes Associates (2001, 2003), as directed by the *Northwest Forest Plan, as Amended* (USDA and USDI 1994), to assess water resources within the context of the specific objectives of the Aquatic Conservation Strategy (ACS). Generally applied at the subwatershed scale, environmental conditions are compared to these DFCs. The basis for DFCs is described in greater detail under Disturbance Mechanisms in Section 3.3.1 – Summary of Existing Conditions.

Second, and similar to DFCs, is the matrix of indicators developed by NOAA Fisheries and the USFWS to assess the status of fish habitat for species protected under the ESA (NMFS 1996; USFWS 1998). The matrix approach used by these agencies describes the existing conditions or environmental baseline for various parameters that are essential for meeting the biological requirements of listed species (e.g., sediment, floodplain connectivity, etc.). Evaluated at the S.F. Snoqualmie Watershed and U. Yakima Watershed scales, the environmental baseline for each indicator describes the contribution of that parameter to overall habitat quality using one of three functional classes: Functioning Appropriately; Functioning at Risk; or Functioning at Unacceptable Risk. These indicators are discussed within Section 3.4 - Fisheries.

Third are the parameters (such as Drainages of Particular Concern [DPCs] as described in Section 3.3.2 – Drainages of Particular Concern) developed in this FEIS to describe the impacts, or risk of impacts, of each alternative on water and watershed resources. Most of the DFCs and environmental baseline indicators referenced in this section cannot be accurately predicted under various management scenarios. Though they are useful tools for resource monitoring and evaluation, they cannot be used to predict changes in resource conditions that could occur if the MDP or one of its alternatives is implemented. Therefore, surrogate parameters that quantify or describe the mechanisms that create water and watershed impacts are presented (e.g., acres of forest harvested; miles of road constructed). These parameters are generally evaluated only for the project area.

Drainages may be considered the smallest compartments within subwatersheds, and subwatersheds are in turn grouped to compose even larger watersheds. The Study Area contains parts of two watersheds defined for this assessment (S.F. Snoqualmie Watershed and U. Yakima Watershed), and contains numerous, smaller drainages that help provide detail and spatial context to landscape descriptions that are provided. Some analyses in this FEIS expand beyond the Study Area to include the larger subwatersheds and watersheds, but the intensity of the analyses decrease and water resources are described in successively less detail. Section 3.3.2 – Drainages of Particular Concern describes water resources in greater detail for the smallest areas, the 7th field drainages.

Primary information sources consulted for the preparation of this section include the *Upper South Fork Snoqualmie River and Coal Creek Watershed Condition Assessment* (Jones & Stokes 2001); *Mill Creek Watershed Condition Assessmen*t (Jones & Stokes and SE GROUP 2003); *South Fork Snoqualmie River Watershed Analysis* (USFS 1995); *Upper Yakima Watershed Analysis* (USFS 1997); and the *Upper Yakima Watershed Environmental Baseline* (USFS 1999a). These publications were supported by extensive field data collection, literature reviews, analysis of aerial photos, and interviews with individuals with long-term experience in this area. Other sources are cited as appropriate throughout the text.

3.3.1 Summary of Existing Conditions

3.3.1.1 Introduction

Section 3.3.1 – Summary of Existing Conditions characterizes conditions within the Study Area, as well as distinguishing between the portions of the Study Area within the U. Yakima and S.F. Snoqualmie Watersheds. Areas of particular concern will be described in greater detail in a discussion of 7th field drainages in Section 3.3.2 – Drainages of Particular Concern.

Where appropriate, watershed characteristics will be described with reference to land ownership. Land ownership within the nearly 2,900-acre Study Area is identified as public NFSL or private, and is subject to different water and watershed resources management guidelines, accordingly. The more than 1,750 acres (60 percent) of private lands in the Study Area include land owned by Ski Lift, Inc, The Mountaineers, Plum Creek Timber Company, and other landowners, are all subject to State Forest Practices rules (WAC 222). East of the crest, private lands are subject to the Kittitas County Critical Areas Ordinance (94-22, Chapter 17A). West of the crest, private lands are subject to King County Critical Areas Ordinance (Chapter 21A.24).

The nearly 1,150 acres (40 percent) of public lands in the Study Area are NFSL, managed under the *MBSNF Forest Plan, as Amended* (USDA 1990a) west of the crest, and the *OWNF Forest Plan, as Amended* (USDA 1990b) east of the crest.

The water resources goals of the *MBSNF and OWNF Forest Plans*, as amended by the *Northwest Forest Plan* (USDA and USDI 1994) are intended to maintain and restore the ecological health of watersheds and aquatic ecosystems within the *Northwest Forest Plan* area. It is the role of the State of Washington to establish and regulate water quality standards. The *Northwest Forest Plan* meets the goal of maintenance or enhancement of riparian areas by establishing management standards and guidelines. These standards and guidelines state the bounds or constraints within which all practices will be carried out in achieving the resource objectives of alternatives for management. The standards and guidelines are intended to help land managers achieve the goals and objectives of the *Northwest Forest Plan*, while staying within constraints prescribed by law. Applicable within the Study Area are Forest-Wide standards and guidelines; Riparian Reserve standards and guidelines, and Key Watershed standards and guidelines. Consistency with ACS of the Northwest Forest Plan is determined by the effects of the alternatives as evaluated within the framework of the Riparian Reserve and Key Watershed standards and guidelines. The Snoqualmie Pass Adaptive Management Area standards and guidelines also incorporate the standards and guidelines of the Northwest Forest Plan.

All lands within the Study Area are required to meet other federal and state regulations regarding water quality, stormwater discharges, and discharges of sediment or fill material into waters of the United States, including wetlands. The Washington State Department of Ecology (WSDOE) and the U.S. Environmental Protection Agency (USEPA) require compliance with surface water quality standards

(SWQS). The National Pollution Discharge Elimination System requires any Project Activity with a stormwater discharge to a water of the U.S., including construction sites larger than 1 acre to be consistent with its permit requirements, including control of construction site runoff, post construction runoff, and pollution prevention and good housekeeping practices. Where a project requires dredging or filling of wetlands or other surface waters, certification of compliance with the Clean Water Act is required through a Section 401 Certification from WSDOE or USEPA and individual or general Section 404 permits through the USACE.

Watershed Descriptions

The nearly 2,900-acre Summit at Snoqualmie Study Area is located along Interstate 90 (I-90) along the crest of the Cascade Mountain range, within the headwaters of the 5th field scale S.F. Snoqualmie and U. Yakima Watersheds. Approximately 1,885 acres (65 percent) of the Study Area lies east of Snoqualmie Pass in the U. Yakima Watershed and includes the 6th field scale Coal Creek and Mill Creek, which are tributaries that flow into Keechelus Lake, an irrigation reservoir operated by the U.S. Bureau of Reclamation. Keechelus Lake discharges to the Yakima River, which then flows 214 miles to its confluence with the Columbia River, eventually discharging to the Pacific Ocean. Approximately 1,014 acres (35 percent) of the Study Area is situated west of Snoqualmie Pass within the S.F. Snoqualmie Watershed, and drains eventually to the Snohomish River and Puget Sound at Possession Sound, near Everett. Figure 3.0-1, Study Area shows the location of The Summit-at-Snoqualmie Study Area with respect to these regional features and watersheds. Use of these hierarchical conventions is consistent with federal naming conventions (Seaber et al. 1987; FEMAT 1995; McCammon 1994) and with management scales currently used in some protocols for managing threatened or endangered fish (e.g., USFWS 1998).

Maintaining the same watershed hierarchy, several of the tributary to Coal Creek are divided at the subwatershed level into Seventh-Field drainages. Table 3.3.1-1 describes the characteristics of 13 drainages within the S.F. Snoqualmie and U. Yakima Watersheds. Seventh-Field drainages are used primarily for geographic descriptions, identification and monitoring of sensitive cause-and-effect relationships affecting aquatic ecosystems, and documentation of most direct and some indirect impacts in Chapter 4. As described above, they are not generally appropriate for evaluation of watershed-based DFCs and environmental baseline indicators.

Table 3.3.1-1:
Existing Drainage Sub-Divisions
within The Summit-at-Snoqualmie Study Area

5th Field Watershed	7th Field Drainage
U. Yakima	Lower Mill Creek
	Upper Mill Creek
	Creek Run
	Summit South
	Hyak
	Tunnel
	Ski Acres
	Beaver
	Other Yakima River[a]
S.F. Snoqualmie	Northside
	Summit North
	International
	Upper Alpental
	Nacrinomical
	Other Snoqualmie River[a]

[a] Other Snoqualmie River and Other Yakima River represent portions of 7th field drainages that are largely outside the Study Area

Disturbance Mechanisms

Once disrupted by a natural disturbance, forested landscapes progress through a vegetative evolution toward a climax condition of self-sustaining structure and composition. This process is known as natural succession. Other landscape features such as stream channels, hillslopes, and various fish and wildlife habitats evolve concurrently. Physical features such as streams and slopes are generally considered to be increasingly stable within mature and climax forests.

Disturbance mechanisms are those features or processes which, occurring periodically, modify landscapes and set back the natural progression of plant succession. Natural disturbances such as wildfire and floods perpetually initiate plant succession on some portion or all of a landscape, and they often reset slope processes (erosion) and channel dynamics (morphological changes). The type and intensity of the disturbance determines the extent to which natural succession is set back. Given the link between vegetation and watershed health, disturbance mechanisms also influence channel conditions, water quantity and quality, and other ecosystem characteristics.

Human management of landscapes often involves various disturbances, which, akin to natural disturbances, also result in the setting back of natural succession. In doing so, land managers effectively make decisions to manage the landscape for an extended duration at some successional level less than the

climax condition. The *Forest Plan, as Amended* (USDA and USDI 1994) directs that this range of conditions should be within an acceptable range of the observed variability caused by natural disturbances during the successional process. This acceptable range is termed the ”range of natural variability.” This understanding of disturbance ecology and DFCs is the basis for describing resource conditions and evaluating resource impacts.

Natural Disturbance Mechanisms

Existing watershed conditions in and near the Study Area are the result of interactions between climate and geology (as discussed in Sections 3.1 – Climate and Snow and 3.2 – Geology and Soils), and natural disturbances such as wildfire, mass wasting, and floods. Stand-replacing fires occur approximately every 200 to 300 years in the U. Yakima Watershed (Jones & Stokes 2001). However, the incidence of fire is less pronounced in and near the Snoqualmie Pass vicinity than further east in the Yakima River basin, due to the greater annual rainfall. Mass-wasting events such as slumps, avalanches, and debris flows have occurred in the analysis area. Snow avalanche tracks are common, particularly where avalanche control activities are not implemented. Snow avalanches maintain the riparian areas of small tributaries, especially in the vicinity of Alpental, in early seral brush slopes.

Anthropogenic Disturbance Mechanisms

Human related disturbances include timber harvest, earth grading, and facility development. Road construction and timber harvest at Snoqualmie Pass followed the construction of the Chicago, Milwaukee, St. Paul, and Pacific Railroad in 1909 (Prater 1981). Tree removal for skiing on the slopes of what is now The Summit began in the 1930s, and at Alpental in 1967 (Prater 1981). The completion of I-90 and the establishment of the ski area accelerated the development of residential areas and a small commercial district adjacent to the Study Area. These historic activities in turn resulted in the downcutting or scouring of streams; sedimentation of streams and lakes; water quality degradation; rilling and gullying of cleared slopes; and reductions in the quantity and quality of fish habitat. Historic mining activities were common in the vicinity of Snoqualmie Pass, particularly in the S.F. Snoqualmie Watershed, but no mining sites that would impact water or watershed resources at The Summit-at-Snoqualmie are known to occur within the Study Area.

3.3.1.2 Hydrography

Stream Channel Classification and Conditions

The Study Area contains approximately 29.5 miles of natural streams that meet the definition of "Waters of the US" provided in 33 CFR 328.3 (a)(1-5) (see Table 3.3.1-1). Drainage density in the Study Area is 6.51 miles of stream per square mile of drainage area. The small variation in drainage densities for the U. Yakima and the S.F. Snoqualmie Watersheds indicate the Study Area streams are evenly distributed across these areas (see Table 3.3.1-1). Very few channels that are not regulated as Waters of the U.S. are mapped within the Study Area (see Table 3.3.1-1). These are ditches and water bars that provide surface

water drainage along roads and parking lots and on ski trails during runoff-producing storm events. The remaining discussions will focus only on natural (jurisdictional) streams unless indicated otherwise.

Streams within the Study Area are primarily intermittent or ephemeral channels comprising 17.5 miles (59 percent), which flow only seasonally or during storm events, respectively (see Table 3.3.1-1). The remaining 12.0 miles (41 percent) of streams in the Study Area are perennial streams that flow year-round except during periods of severe drought.

Table 3.3.1-1:
Existing Stream and Lake Characteristics within The Summit-at-Snoqualmie Study Area

Attribute	Upper Yakima	South Fork Snoqualmie	Study Area Totals
Study Area			
Acres	1,885.21	1,014.15	2,899.36
Square Miles	2.95	1.58	4.53
Stream Length by Jurisdiction			
Jurisdictional Streams (miles)	19.21	10.26	29.47
Drainage density of Jurisdictional Streams (mile/mile^2)	6.52	6.47	6.51
Non-jurisdictional channels (miles)	0	0.14	0.14
Drainage density of jurisdictional and non-jurisdictional channels (mile/mile^2)	6.52	6.56	6.54
Stream Length by Flow Regime[a]			
Perennial streams (miles)	9.66	2.36	12.02
Intermittent streams (miles)	9.47	7.90	17.37
Ephemeral streams (miles)	0.08	0.00	0.08
Stream Length by Channel Type[a]			
MS1 channels (miles)	4.75	1.84	6.59
MS2 channels (miles)	8.18	5.14	13.32
MS3 channels (miles)	1.03	0.00	1.03
VB1 channels (miles)	2.27	1.27	3.54
VB2 channels (miles)	0.25	0.09	0.34
Ditches conveying natural streamflow (miles)	0.89	1.70	2.59
Long culverted channels (miles)	1.84	0.22	2.07
Number of culverted channels	30	10	40
Lakes and pond area (acres)	1.34	0	1.34

[a] Includes Jurisdictional Streams only
Note: This table includes the Mill Creek portion of the Study Area within the U. Yakima Watershed.

Streams can be classified in a way that provides consistency in describing channel characteristics and understanding potential responses to land management activities. The Rosgen stream classification system (Rosgen 1994) is a method with an extensive number of channel types commonly used on NFSL. For purposes of this analysis, all channels have been classified into a simple system using landform, channel gradient, and confinement for use in describing the aquatic ecosystem in areas under ski area management (Jones and Stokes 2001; see Figures 3.3.1-1, Hydrography – The Summit, and 3.3.1-2, Hydrography – Alpental). The seven channel types and their corresponding equivalent types under the Rosgen system are:

MS1: high-gradient, confined mountain slope channels (Rosgen types Aa+ and A);

MS2: high-gradient, low-to-variable confinement mountain slope channels (Aa+, A);

MS3: moderate- to low-gradient, unconfined mountain bench channels (Aa+, A, B);

VB1: high- to moderate-gradient, confined valley bottom channels (A, B);

VB2: low-gradient, variable confinement valley bottom channels (B, C, E);

CV: long culverted segments and segments covered by timbers or similar material for extended lengths for the purpose of maintaining contiguous, skiable terrain; and

M: modified channels or ditches that convey natural streamflow, regardless of landscape position.

The geomorphic and management characteristics of the channel types are summarized in Table 3.3.1-2. More than two-thirds of the stream network consists of high gradient, confined and unconfined channels draining the mountain slopes and are considered MS1 and MS2 channel types. Approximately 13 percent of the stream network occurs in the lower gradient footslope and valley bottom segments, and this is typically where the best available fish habitat occurs.

Direct channel impacts associated with ski area management are channelization and road and ski trail crossings of streams. Channelization includes the realignment and containment of streams to meet objectives for the flow and safety of skiers, particularly during low snow conditions. In the existing stream network, 40 channel segments totaling 2.07 miles of stream (7 percent) have been placed in extended lengths of metal or concrete culverts, or they have been completely overlaid with railroad ties, timbers, or other materials side-by-side in corduroy fashion (see Table 3.3.1-3). In all cases, these streams have been isolated from many riparian processes that provide aquatic habitat and downstream channel stability, including large woody debris (LWD) recruitment, bank cover and stability, and inputs of fine organic matter, nutrients and insects.

Ski area management has resulted in the direct modification of another 2.59 miles (9 percent) of stream channels through excavation and re-alignment (see Table 3.3.1-1). These streams are generally degraded as a result of increases in gradient, vegetative conversion or removal, bank erosion, and/or LWD removal. The result has been the scour of bed and bank material, downstream sediment deposition, and the simplification of the channel cross-section and aquatic habitat. About 57 percent of the culverted and modified (straightened) streams in the Study Area are located on public lands, and the remaining 43 percent occur on privately owned lands.

Table 3.3.1-2:
Characteristics of Channel Types in The Summit-at-Snoqualmie Study Area

Attribute	Channel Type						
	MS1	MS2	MS3	VB1	VB2	CV	M
Percent of total channel length in Study Area	24	36	3	20	3	7	9
Gradient, range (percent)	7 to 55	6 to 42	5 to 18	3 to 7	<1 to 4	12 to 17	NA
Gradient, mean (percent) South Fork Snoqualmie Upper Yakima	 34 17	 25 17	 NA 13	 6 4	 NA 4	 NA 15	 NA NA
Incision depth (feet)	20	1 to 6	1 to 12	35	<1 to 4	NA	NA
Bankfull width, range (feet)	3 to 30	2 to 15	4 to 6	8 to 35	8	(2 to 8 diameter)	NA
Bankfull width, mean (feet) South Fork Snoqualmie Upper Yakima	 13 8	 5 4	 NA 5	 31 19	 NA 8	 NA NA	 NA NA
Bank and bed material (median particle type on bed)	bedrock and large cobble	small cobble	small cobble to gravel	Bedrock and large cobble	gravel to small cobble	NA	NA
Sediment function	scour, transport of coarse and fine sediment	scour, transport of coarse and fine sediment	transport of fine and most coarse sediment, transient storage	scour, transport of coarse and fine sediment	deposition and transient storage of most sediments; coarse sediments retained, fine sediments transported	transport of coarse and fine sediments	variable by landform; scour, transport, and deposition of coarse and fine sediments
Dependency of channel on LWD for stability / Dominant LWD transport process	Moderate / debris flow of all local tree sizes	Low / debris flow of all local tree sizes	Low / reduced debris flow potential	Moderate / fluvial transport of intermediate topped trees; dominant trees retained	High / fluvial transport of intermediate topped trees; dominant trees retained	None / negligible; intercepted at some culvert inlets	Generally maintained free of LWD; limited recruitment; some transport in steepest segments

Table 3.3.1-2:
Characteristics of Channel Types in The Summit-at-Snoqualmie Study Area

Attribute	Channel Type						
	MS1	MS2	MS3	VB1	VB2	CV	M
Management concerns	• steep, unstable sideslopes • bedrock limits depth or location of trenching • debris torrent potential	• streambank stability • potential to gully • debris avalanche and debris torrent potential	• streambank stability • sensitive riparian soils	• steep, unstable sideslopes	• streambank stability	• plugging and failure • reduced capacity • inlet and outlet erosion • potential to downcut	• streambank stability • potential to gully • recurring maintenance (debris cleaning)

Note: This table includes the Mill Creek portion of the Study Area.

Table 3.3.1-3
Existing Stream Channel Impacts within The Summit-at-Snoqualmie Study Area

Parameter (units)	Upper Yakima	South Fork Snoqualmie	Study Area Totals
Road Density (mile/mile^2)	6.43	1.96	4.87
Number of stream-road crossings by structure[a]:			
Culvert	75	12	87
Bridge	1	2	3
Ford	12	2	14
Total Crossings	88	16	104
Number of stream-road crossings by Flow Regime[a]			
Perennial	31	3	34
Intermittent/Ephemeral	57	13	70
Total Crossings	**88**	**16**	**104**

[a] Includes Jurisdictional streams only
Note: This table includes the Mill Creek portion of the Study Area.

Road-stream intersections provide opportunities for road-related sediment to be delivered directly to streams. This is directly observed within the Study Area which has both a high drainage density (6.51 miles per square mile; see Table 3.3.1-1) and high road density (4.87 miles per square mile, see Table 3.3.1-3). There are 104 road crossings within the Study Area (see Table 3.3.1-3). Approximately 85 percent of the stream crossings in the Study Area occur in the U. Yakima Watershed (see Table 3.2.1-2), and most are located on private land. Approximately 15 percent of all stream crossings in the Study Area occur in the S.F. Snoqualmie Watershed (see Table 3.3.1-3), and most of those crossings are located on public land.

Approximately 72 percent of the structures surveyed in 1997 were in fully functional condition, 18 percent were in fair condition, 9 percent were in poor condition and at high risk of failure, and one culvert had already failed (Jones & Stokes 2001). Most structures exhibited some degree of erosion at their inlet, outlet, or both. However, only three structures exhibited a high risk of sediment recruitment. Structures with high sediment recruitment risk were identified according to the following characteristics: raw, steep cutslopes; highly erodible soils; high gradient ditches clogged with sediment; exposed soil on fillslopes; and non-existent or non-functional erosion control measures. The Watershed Condition Assessment recommends 15 structures for replacement and routine maintenance, including erosion control work, inlet basin cleaning (Jones & Stokes 2001). Debris removal is recommended at 30 other structures.

Overall, channel conditions range from healthy to degraded depending on their location and adjacent management activities. Stream channels under ski area management in the vicinity of Alpental are generally in healthy condition and function very similarly to streams in natural conditions. In these

streams channel integrity is high and few detrimental effects of sediment on aquatic ecosystem functions have been observed. Instream surveys of fish habitat (USFS 1994), channel stability (Pfankuch 1975), and gravel and pool quality (Lisle and Hilton 1992; Wolman 1954) in 1994 and 1997 found a low occurrence of fine sediment in spawning gravels and pools in the S.F. Snoqualmie River (Jones & Stokes 2001). This is despite increased sediment production from winter road sanding, particularly along Alpental Road west of Parking Lot 6, gullies of some severely disturbed MS2 channels, and sheet and rill erosion associated with roads.

Similar surveys conducted during the same period near The Summit, however, indicate many stream channels do not meet objectives for geomorphic integrity and sediment processes (Jones & Stokes 2001 and Jones & Stokes and SE GROUP 2003). For example, gullying, downcutting, and bank erosion are commonly observed on managed mountain slopes, particularly MS2 channels. These impacts show the response to the historic clearing and grading of ski trails, and road and parking lot construction, resulting in increased runoff. Channel incision is understood to be a largely historic phenomenon with erosion rates declining as fine material was depleted, and leaving the bed and banks armored by residual coarse substrate (see Illustration 3.2.1-1 and related discussion). In addition, a single, large mass-wasting event occurred near Summit Central that impacted two MS2 stream segments after a failed water bar on a recontoured slope delivered water and fine sediment to a steep slope. Along the mainstem of Coal Creek, historic modifications of the riparian area for I-90 construction have reduced LWD recruitment. Coarse fragments associated with road fills, and large yields of sand and gravel from winter road sanding and upslope channel erosion and mass wasting, have resulted in some pool filling. The resulting channel structure has less LWD, fewer and shallower pools, and simplified morphology compared to streams under natural conditions.

Lake Conditions

The Study Area contains one lake, which is located at the west end of Summit West (see Table 3.3.1-1 and Figure 3.3.1-1, Hydrography – The Summit). At an elevation of 3,470 feet, 1.34-acre Beaver Lake forms the headwaters of Beaver Creek at Summit West within the U. Yakima Watershed. Much of the lake’s Riparian Buffer was cleared for ski area development, but the area is no longer in use and is now under young conifer and shrub cover. With the forest canopy removed, a southeast aspect, and relatively shallow depth (actual depth unknown), the lake outlet has been observed to reach elevated temperatures (as high as 26 degrees Celsius) with depressed dissolved oxygen concentrations (5.3 mg/L) during summer discharges (SE GROUP unpublished data). However, water temperatures typically decrease through evaporative cooling and increased shade as the water flows down steep MS2 channels.

Wetland Classification and Conditions

Wetlands are regulated by federal, state, and local laws and policies (i.e., Section 404 of The Clean Water Act, Executive Order 11990). Wetlands are defined as "areas that are inundated or saturated by surface or

groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33CFR 328.3, 40CFR 230.3). The identification and delineation of wetlands subject to federal jurisdiction under Section 404 uses a three-parameter approach whereby wetland hydrology, hydric soils, and hydrophytic vegetation must all be present (Environmental Laboratory 1987).

As part of the MDP planning process, wetlands within the Study Area were identified through field surveys, National Wetland Inventory maps, and interpretation of aerial photos from 1944, 1962, 1970, and 1994. Field surveys were conducted according to protocols in the USACE Wetland Delineation Manual (Environmental Laboratory 1987). A total of 227 wetlands with a combined area of 72.3 acres have been identified in areas surveyed. The vegetation, soil, and hydrologic conditions of the wetlands in the Study Area are described in the wetland report prepared to support watershed assessments for the S.F. Snoqualmie and U. Yakima Watersheds (Jones & Stokes 2001 and Jones & Stokes and SE GROUP 2003). The abundance and distribution of wetlands in the Study Area is displayed in Figures 3.3.1-1, Hydrography – The Summit, and 3.3.1-2, Hydrography – Alpental. Wetlands within the Study Area were classified using vegetation classes based on the USFWS wetland classification system (Cowardin et al. 1979), and by whether they are currently in natural or modified condition. Results of the wetland inventory within the Study Area are summarized in Table 3.3.1-4.

Table 3.3.1-4:
Existing Wetlands Characteristics Within The Summit-at-Snoqualmie Study Area

Wetland Type/Terrain Management	Upper Yakima		South Fork Snoqualmie		Study Area Totals	
	Number	Acres	Number	Acres	Number	Acres
Palustrine Emergent						
Natural	36	11.41	17	1.42	53	12.84
Modified	82	27.81	27	7.11	109	34.92
Palustrine Scrub-Shrub						
Natural	23	3.98	2	0.04	25	4.02
Modified	33	17.19	4	0.65	37	17.84
Palustrine Forested						
Natural	3	2.68	0	0.00	3	2.68
Modified	0	0.00	0	0.00	0	0.00
Total (all wetlands)	**177**	**63.06**	**50**	**9.23**	**227**	**72.29**
Total Natural Wetlands	**62**	**18.07**	**19**	**1.47**	**81**	**19.54**
Total Modified Wetlands	**115**	**44.99**	**31**	**7.76**	**146**	**52.75**

Note: This table includes the Mill Creek portion of the Study Area.

Wetland hydrology was utilized as a primary indicator to evaluate consistency of ski area management with watershed management for water tables and water surface elevations (Jones & Stokes 2001). Many wetlands are controlled by seasonally high groundwater seeps regardless of slope position, including mountain slopes, benches, and narrow valley bottoms. Consequently, baseflow functions of slope wetlands depend on maintenance of the current groundwater regime.

Ski area management activities have had the potential to reduce surface and shallow subsurface inflows to wetlands through construction of impervious surfaces, grading of ski trails, construction of water bars, and other activities and effects, including channel incision. However, field observations since 1994 have suggested no evidence of diminishing wetland area as a result of modified hydrology. Shallow water tables appear to maintain wetland hydrology, even in areas where residential, ski area, road, and other development activities have occurred. The Watershed Condition Assessment concluded that the water tables are being maintained throughout the Study Area (Jones & Stokes 2001). In addition, historic aerial photos taken in 1944, 1962, and 1970 were compared during this assessment with current aerial photos of the Study Area. No significant reductions of wetland area or distribution were observed in the larger wetlands, although the footprints of some wetlands were altered during site development.

Many of the wetlands that occur in natural conditions are located in open meadows, openings in the forest canopy, subalpine areas, at lake edges as wetland fringe, and along some streams at the base of the slopes. Approximately 19.54 acres of natural wetland areas were identified in all Cowardin classes within the Study Area (see Table 3.3.1-4). Palustrine emergent wetlands located outside maintained ski trails and other developed areas occur on 12.84 acres within the Study Area. Dominant wetland plants vary between the wetlands but common species include blue-joint reedgrass, sedges, dagger-leaf rush, and soft rush. Other herbaceous species that are dominants in some wetlands include marsh marigold, deer fern, lady fern, small-fruited bulrush, and bentgrass. A few palustrine emergent wetlands in a natural condition are considered bogs because of the presence of Sphagnum moss, scattered individuals of leafy white bog laurel plants (*Plantanthera dilatata*), and a peat soil. Other plants include cottongrass (*Eriophorum sp.*), beaked sedge (*Carex utriculata*), and Labrador-tea (*Rhododendron groenlandicum*).

Twenty-five palustrine scrub-shrub wetlands in natural condition, covering 4.02 acres, were identified within the Study Area (see Table 3.3.1-4). Scrub-shrub wetlands in relatively undisturbed areas are dominated by similar shrub species as the wetlands in modified areas. The scrub-shrub wetlands are generally located in swale-like areas where surface water collects. Salmonberry (*Rubus spectabilis*) is the most common shrub species; other shrub species that dominate some wetlands include Sitka alder, devil's club (*Oplopanax horridum*), or stink currant (*Ribes bracteosum*). Understory species that are typically present include skunk cabbage, small-fruited bulrush, blue-joint reedgrass, and lady fern.

Three palustrine forested wetlands in natural condition, totaling 2.68 acres, have the least presence of all wetland types within the Study Area (see Table 3.3.1-4). Forested wetlands are located in mixed conifer

forest dominated by mountain hemlock (*Tsuga mertensiana*), Pacific silver fir (*Abies amabilis*), with some western red cedar (*Thuja plicata*) present. Understory plants include salmonberry (*Rubus spectabilis*), deer fern, and oak fern (*Gymnocarpium dryopteris*).

All of the wetlands are located in Chinkman, Index, or Altapeak soil mapping units (see Section 3.2.1.3 – Avalanche Conditions). Wetlands at The Summit are in an area similar to the Chinkman soil mapping unit described for the Alpental area. The wetlands are generally too small to map as separate soil mapping units, and are considered inclusions of that upland mapping unit. Hydric soil conditions were assumed to be present based on different indicators of hydric soils. A sulfidic odor, indicating saturated soil conditions, was observed at many of the wetlands where soil was sampled. Other indicators of hydric soils include low chroma soil matrix colors, redoximorphic features, and presence of muck. Organic muck or peat was observed at some of the wetlands. The composition of mineral soils observed in modified wetlands ranged from sandy loams to loams. Some of the wetlands on modified slopes were likely created when grading activities removed surface soils that exposed groundwater to support surface wetland hydrology. Some of the wetlands in The Summit area have very shallow soils that appear to be subsurface soils based on color and minimal accumulation of organic content in the profile.

Most wetland area, approximately 87 percent is located within the U. Yakima Watershed. Approximately two-thirds of all wetland area is located on private land. The majority of wetlands located within the Study Area are slope wetlands, generally hillside seeps on bench terraces that percolate back into the soil or ultimately drain into small streams. Other wetlands are seasonally saturated moist and wet meadows, or are located in isolated depressions that are not connected to other wetlands or streams. Wetlands at The Summit-at-Snoqualmie generally are not associated with large wetland complexes, except for the wetland complex located in the base area in Summit Central between SR906 and I-90. Wetlands within the Study Area are largely dependent upon surface runoff and/or subsurface flow as the primary source of water to support wetland hydrology. Some wetlands may have been affected in terrain previously modified for ski trails; however, surface and subsurface flows meet the wetland criteria. The hydrologic conditions in the portions of wetlands that occur on both maintained ski trails and in adjacent unmodified areas indicate that clearing for ski trails has not significantly changed the timing and duration of wetland hydrology.

There are 146 wetlands (nearly two-thirds of all wetlands surveyed) that occur in areas modified by land management within the Study Area (see Table 3.3.1-4). Covering 34.9 acres, 109 palustrine emergent wetlands in a modified condition compose nearly half the total wetland area (see Table 3.3.1-4). Most modified wetlands in the Study Area are located in the U. Yakima Watershed on private land. The functions of these wetlands have reduced and in some cases eliminated because of the clearing and mowing necessary to maintain the ski trails. These activities can result in lower plant species diversity; however, most of the wetland vegetation includes native plant species that are considered dominant species. Other wetlands within the Study Area are not directly impacted by ski trails but may have roads, parking lots, hiking and biking trails, and ski trails in their adjacent riparian areas (riparian areas are

defined and discussed further in Section 3.3.1.6 – Riparian Resources). Land use, particularly historic timber harvest, may have affected some of the wetlands prior to the development of the ski areas.

Common wetland plants in palustrine emergent wetlands on maintained ski trails and other disturbed areas include soft rush (*Juncus effusus*), dagger-leaf rush (*J. ensifolius*), small-fruited bulrush (*Scirpus microcarpus*), and sedges (*Carex spp.*). Other wetland plants include marsh marigold (*Caltha biflora*) and common horsetail (*Equisetum arvense*). Some wetlands located in modified areas are also dominated by lady fern (*Athyrium filix-femina*), skunk cabbage (*Lysichitcum americanum*), and deer fern (*Blechnum spicant*).

A total of 37 palustrine scrub-shrub wetlands in modified condition, covering 17.8 acres, were identified within the Study Area (see Table 3.3.1-4). Palustrine scrub-shrub wetlands on slopes modified for skiing are small, generally less than 0.1 acre. Sitka alder (*Alnus sinuata*), Sitka willow (*Salix sitchensis*), and subalpine spirea (*Spiraea densiflora*) are shrub species common in scrub-shrub wetlands.

Wetlands provide a variety of functions that are dependent on factors such as the size of the wetland, topography, geology, hydrology, types and distribution of habitat present, condition of adjacent upland, and disturbance history. The functions of the wetlands located in modified areas at The Summit and Alpental are primarily limited because of their small size (generally less than 0.25 acre), and the developed nature of the area. However, these areas do provide habitat for several native wetland plant species, detention of overland flows, and baseflow support to small streams.

The functions of undisturbed wetlands can be limited by their size and surrounding land use. However, these wetlands generally provide low to moderate water quality improvement as well as moderate stream baseflow support. For example, undisturbed wetlands may retain sediment from adjacent ski trails, roads, or parking lots. Emergent wetlands provide natural biological support, and if associated with a stream, wetlands can provide organic input to streams that can be used by aquatic invertebrates that are a food base for other vertebrates (fish, amphibians, etc.). Scrub-shrub and forested communities provide greater plant community structure used by birds and other animals.

3.3.1.3 Surface Water Quantity

Runoff Patterns

Snoqualmie Pass receives approximately 105 inches of precipitation annually, including about 46 inches (44 percent) in December, January, and February (Western Regional Climate Center 2003). Approximately 440 inches of snow falls in the average year, accounting for about 45 to 60 percent of the annual precipitation.

The Summit-at-Snoqualmie currently has snowmaking capacity at Summit Central, using municipal water from the SPUD. The water used for snowmaking drains into the Upper Yakima River watershed.

Information about runoff patterns in the Study Area was obtained for this assessment from two sources. First, general processes influencing runoff patterns in the Cascades are well understood from the literature. Second, limited site-specific data are available from gaging stations installed in the S.F. Snoqualmie River and in Stream A in autumn 2002.

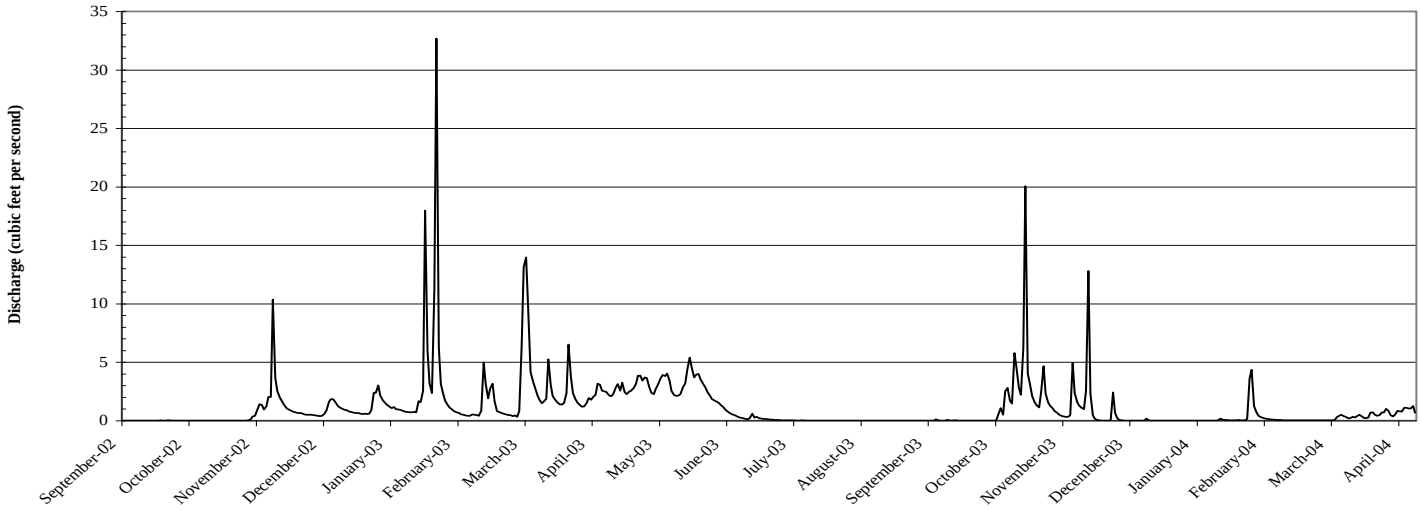
As autumn rains fill the storage capacity of the soil, streamflows in the headwater channels increase. But the greatest streamflows and most rapid increases in discharge are not controlled by rain, but by rates of snow accumulation and snowmelt. This is most prevalent in late October to mid-December, when frontal storms deliver warm rain and winds after the snowpack begins to develop. During these rain-on-snow events, all of the snowpack can melt during one storm event and contribute directly to very large peak flow events. Rain-on-snow events typically dominate runoff activity in the elevation range of about 1,200 to 4,000 feet (Harr 1986; WDNR 1994). All of the Coal Creek subwatershed and much of the S.F. Snoqualmie Watershed lie within this range.

With the onset of winter, the variability in the amount of streamflow begins to stabilize due to colder temperatures. Peak flows created by rain-on-snow events still occur, but not with the intensity of the late fall events. Low winter flows are sustained by melt generated by ground heat, and by alternating freezing and thawing at the snowpack surface. Snowmelt sustains streamflows through the spring months and into July. Groundwater storage controls most summer and early fall low flows, and the rate of water released to streams decreases with decreasing storage volume. Small intermittent channels on the mountain slopes run dry as groundwater storage decreases. Footslope and valley bottom channels are generally perennial, with larger contributing areas to sustain base flows.

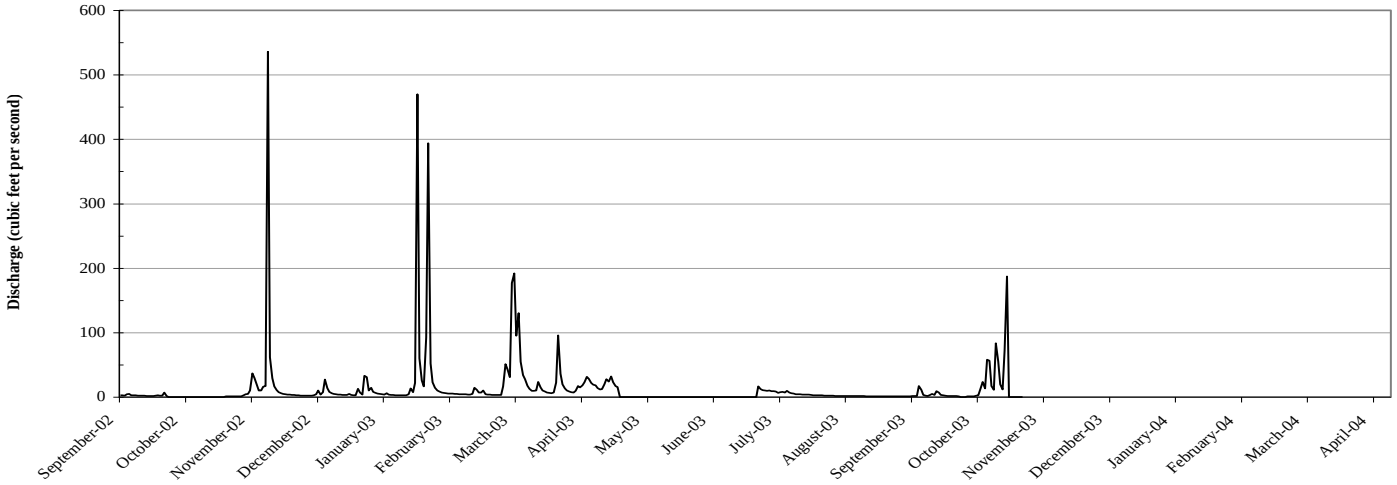
These general streamflow patterns are supported by data collected at two gaging stations in the Study Area. The S.F. Snoqualmie River is gaged immediately upstream of the bridge at the junction of Alpental Road and Alpental Parking Lot 1 (see Figure 3.3.1-2, Hydrography - Alpental). Stream A (in the Creek Run drainage of the U. Yakima Watershed) is gaged on the southern boundary of Section 16 just north of the power line right-of-way (see Figure 3.3.1-1, Hydrography – The Summit). Hydrographs for these two streams are shown in Illustration 3.3.1-1, and indicate that streams in the Study Area east of the crest behave similarly to streams west of the crest. Discharge patterns in the two streams are similar, including: peak flows observed between October and February associated with rain-on-snow events; high flows between March and June associated with snowmelt; and rates of decline in the summer months. The primary difference in the hydrographs of these two gauged streams is that the flat summer hydrograph for Stream A reflects the intermittent flow regime of this first order tributary to Coal Creek.

Illustration 3.3.1-1
Discharge Records for Two Streams in the Study Area

Stream A



South Fork Snoqualmie River



Hydrologic Response to Land Cover

Existing land management activities that could cause changes in the streamflow patterns of streams within the Study Area are limited primarily to changes in land cover. Land under some cover types, such as mature forest, generally retains more of the precipitation delivered to it and then releases the water slowly. This land cover type is considered hydrologically mature.[34] Other land under cover types such as herbaceous vegetation and partially developed facilities release more water to runoff at more rapid rates and are considered hydrologically immature.

Currently, the Study Area contains 1,061.4 acres of hydrologically immature vegetation caused by historic timber harvest and ski area development, which is about 37 percent of the Study Area (see Table 3.3.1-5). The amount of hydrologically immature vegetation has increased about 295 percent over natural conditions, with approximately 73 percent of this increase from ski trail construction and the remaining portion from timber harvest in the Mill Creek drainage (see Table 3.3.1-5). Most hydrologically immature vegetation in the Study Area occurs in the U. Yakima Watershed on private land. Another 94.6 acres of developed and impervious land cover is present in the Study Area which is typical for the base area of a ski area development. Most of this developed area is in the U. Yakima Watershed on private land.

Table 3.3.1-5:
Existing Land Cover Impacts within The Summit-at-Snoqualmie Study Area

Attribute	Upper Yakima	South Fork Snoqualmie	Study Area Totals
Study Area (acres)	1,885.21	1,014.15	**2,899.36**
Land Cover Types within the Study Area (acres)[a]			
Land Cover in Natural Conditions			
Forested - Mature (Mature)	574.25	478.86	**1,053.12**
Forested - Immature (Intermediate)	307.51	23.36	**330.86**
Naturally Non-forested (Immature)[b]	51.22	308.20	**359.41**
Land cover in modified conditions			
Forested - Sapling (Immature)	285.21	0.00	**285.21**
Modified herbaceous and shrub (Immature)	596.19	179.97	**776.16**
Developed	70.83	23.76	**94.59**

[a] Includes wetland landcover type.
[b] Includes 1.34 acres of lake landcover type.
Note: This table includes the Mill Creek portion of the Study Area within the U. Yakima Watershed.

[34] Hydrologic maturity is defined by mature forest, which are stands estimated to be greater than 80 years old (as described in Section 3.5.1.3 – Forest Stand Characteristics.

While relative changes in the hydrologic maturity of vegetation in a watershed are a good general indicator of potential changes to flow regimes, these comparisons do not provide a quantifiable method for estimating potential impacts to flow regimes from timber harvest and construction of impervious surfaces. The dominant type of land cover change that affects stream flow conditions is large-scale timber harvest, which increases residual soil moisture due to the excess water that would normally be used by trees through processes called evapo-transpiration. The increased soil moisture contributes additional groundwater flow to streams in the treated area, especially in riparian areas adjacent to streams (Keppeler 1998). Research conducted in the Pacific Northwest indicates that timber harvest in small watersheds (60-300 acres) can increase annual water yield by as much as 26 to 43 percent in completely clear-cut watersheds and can increase annual water yield in partially cut watersheds by 3 to 15 percent (Harr et al. 1979; Harr et al. 1982; Keppeler, 1998). The construction of impervious surfaces (e.g., roads and parking lots) can also significantly increase stream flow by preventing rainfall from percolating into the soil, creating stormwater runoff that, depending on location, can contribute surface flow directly to streams (Wright et al. 1990).

Since stream flow conditions can be analyzed in an infinite number of temporal and spatial scales, it is useful to describe changes in flow conditions at a few key recurrence intervals that are of most concern for a specific stream flow study. The concept of recurrence interval is commonly used to describe the statistical probability that a particular flow event will be exceeded in any given year. For the purposes of this analysis, the existing stream flow conditions were calculated and presented as annual low flow, average annual flow, and the two-year peak flow for the gauged watersheds in the Watershed Scale Analysis Area. These specific flow conditions were selected for analysis because, according to published literature, these are the flow conditions most likely to be affected at the Watershed Scale by land cover changes at the Site Scale from the implementation of the Proposed Action (Beschta et al. 2000; Burton 1997; Keppeler 1998; Hicks et al. 1991).

A thorough review of published literature was conducted in order to establish relationships between the size and type of watershed treatments (clear-cutting, road construction, etc.) and the measured effects on various stream flow parameters. Out of the 17 studies that were reviewed, 7 were selected to be included in this model because they were conducted locally in the Pacific Northwest and typically involved watersheds with similar characteristics (climate, elevation, slope, stand composition, etc.) to the analysis drainages for this EIS. The data contained in the seven selected studies was synthesized for each of the three flow parameters in this flow regime analysis. The synthesized data was then plotted on a scatter plot and trend lines were fit to the data (see Illustrations 3.3.1-2, 3.3.1-3, and 3.3.1-4).

Illustration 3.3.1-2:
Changes to Low Flow Discharge Due to Various Watershed Treatments

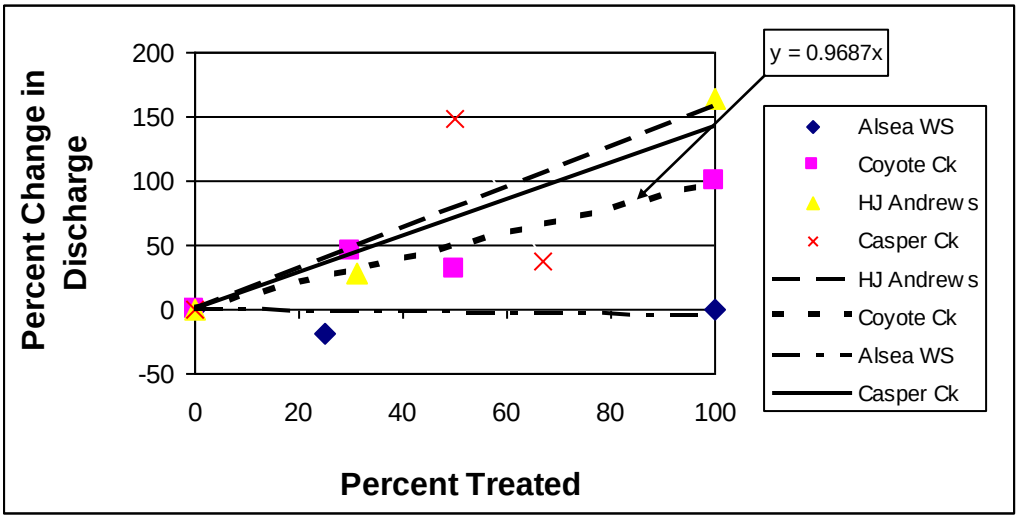


Illustration 3.3.1-3:
Changes to Mean Annual Flow Discharge Due to Various Watershed Treatments

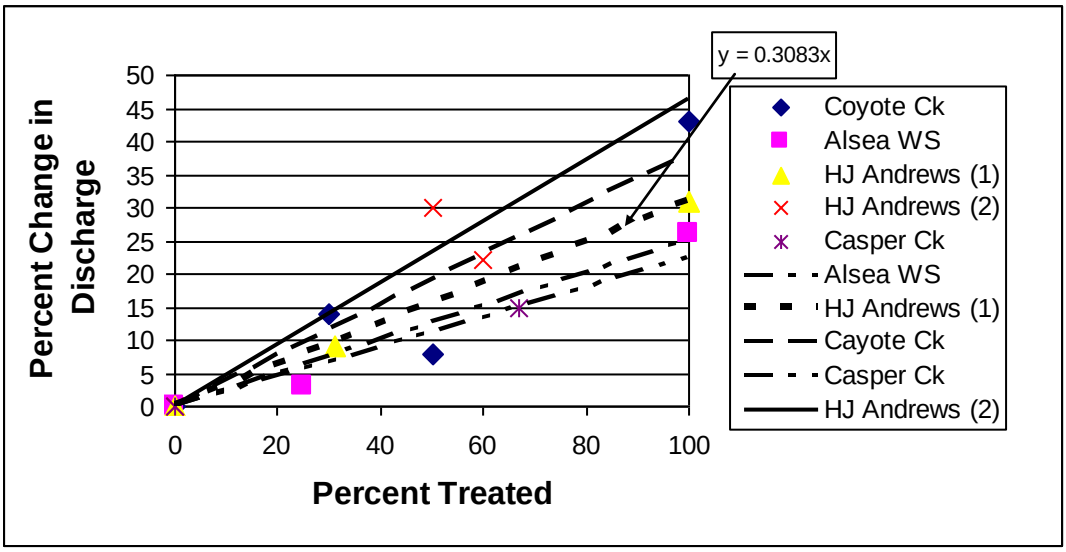
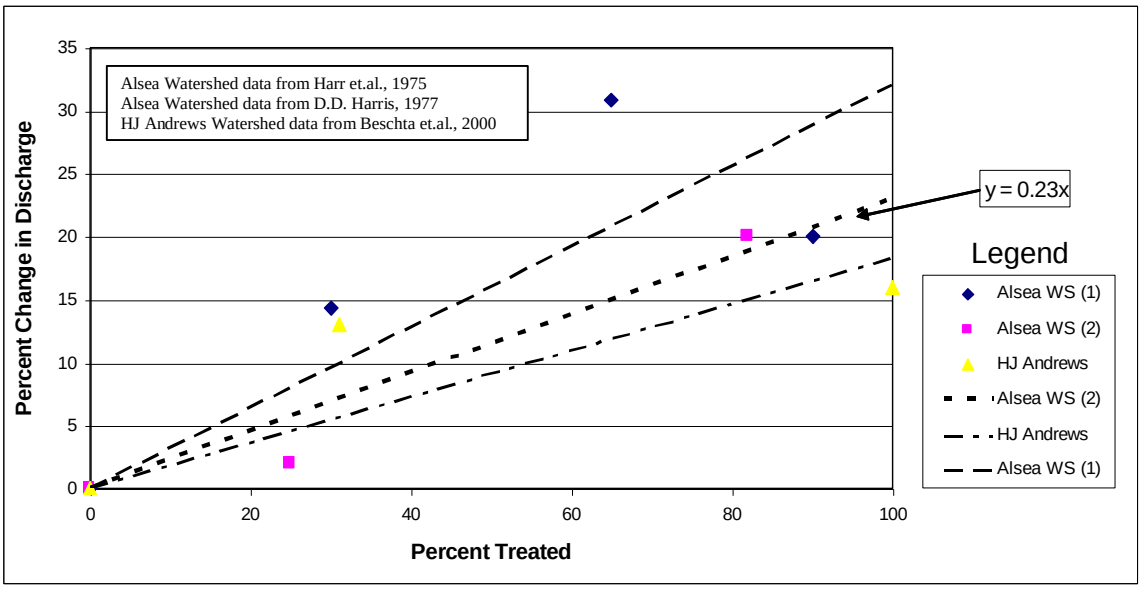


Illustration 3.3.1-4:
Changes to Two-Year Peak Flow Discharge Due to Various Watershed Treatments



The most representative study for each parameter was chosen based on the characteristics of the watersheds in the study, the location of the trend line relative to the trend lines from other studies, and the fit of the trend line to the data. Once a trend line was selected for each flow parameter, an equation was developed to describe the equation so that the percent change in flow (discharge) could be calculated under any treatment scenario. The selected trend line is identified in each table by an arrow that connects the equation to the trend line (see Illustrations 3.3.1-2, 3.3.1-3, and 3.3.1-4). Finally, the change in flow from natural conditions was calculated for each drainage in the Study Area based on current land cover mapping of hydrologically immature vegetation created by historic disturbance. The table below displays the percent change in flow from natural conditions for the three flow events that are most sensitive to human disturbance (see Table 3.3.1-6).

Table 3.3.1-6:
Estimated Increase in Streamflow above Natural Conditions due to Historic Timber Harvest and Ski Area Development

5th Field Watershed	7th Field Drainage	Low Flow	Mean Annual Flow	Two-Year Peak Flow
U. Yakima	Lower Mill Creek	46.6%	14.8%	11.1%
	Upper Mill Creek	6.0%	13.6%	1.4%
	Creek Run	13.9%	4.4%	3.3%
	Summit South	49.9%	19.8%	11.8%
	Hyak	34.0%	10.8%	8.1%
	Tunnel	42.8%	24.8%	10.2%
	Ski Acres	62.3%	1.7%	14.8%
	Beaver	63.9%	20.3%	15.2%
S.F. Snoqualmie	Northside	48.9%	15.6%	11.6%
	Summit North	77.8%	6.7%	18.5%
	International	17.0%	5.4%	4.0%
	Upper Alpental	5.9%	15.9%	1.4%
	Nacrinomical	15.4%	4.9%	3.6%

Based on the amount of development and timber harvest that has occurred within in the Study Area, the Summit North, Ski Acres, Beaver, Summit South, and Lower Mill Creek drainages have experienced the greatest relative increase in low flow, mean annual flow and two-year peak flow. Based on type of flow event, the largest increases in flow are observed during the low flow conditions. Based on flow measurements taken in Beaver Lake Creek, Tunnel Creek, and Stream A during these conditions, it is estimated that low flow discharge is approximately 0.3 cubic foot per second. Using this rough estimate, it is likely that these streams went dry more often in the summer than they do currently. The estimated low flow discharge of Coal Creek, Mill Creek, and S.F. Snoqualmie River are large enough (approximately 5 to 11 cubic feet per second) as to not be significantly affected by the projected increases in low flow conditions from development. Based on the streamflow estimates presented in the table, changes in flow from tree removal and development activities have a much greater effect on the low flow discharge than the mean annual and two-year peak discharge.

3.3.1.4 Surface Water Quality

Water Quality Standards

In July 2003, revisions to State of Washington SWQS were adopted by the WSDOE (WAC 1997). The revised SWQS required review by the USEPA to assure consistency with Clean Water Act Section 303(c) (and the implementing regulations in 40 CFR 131.5 and 131.21) and by NOAA Fisheries and the USFWS to assure consistency with the Endangered Species Act (WSDOE 2007). On August 6, 2004 and December 1, 2004, the WSDOE received two letters from the USEPA requesting additional review and clarification of the SWQS provisions. Two additional letters from the USEPA were received by the WSDOE on January 12, 2005 and February 14, 2005, which approved portions of the SWQS revision

submittal (WSDOE 2007). In August 2006, WSDOE held hearings on proposed revisions to the SWQS (Chapter 173-201A WAC). WSDOE developed this supplemental revision to the 2003-adopted water quality standards in response to the USEPA disapproval of the State's standards in March 2006. This revision set colder temperature standards for specific streams, and increased the amounts of dissolved oxygen is required in those streams.

After considering the written and oral testimony provided, WSDOE's director signed the final rule on November 20, 2006. This revised rule went into effect on December 21, 2006, and replaced the version of the rule adopted in 2003. USEPA approved the antidegradation section of the standards rule in May 2007, however the dissolved oxygen and temperature standards had not been approved by the USEPA at the time this FEIS was released. Conversations with WSDOE staff indicate that no substantive change relative to the current 2006 aquatic life standards would occur, as applied to the waters in the Study Area. WSDOE staff further indicated that approval of the SWQS adopted in 2006 is imminent. This assessment assumes, therefore that the December 2006 version of the SWQS is appropriate for the characterization of surface water quality.

The water quality standards adopted in December 2006 changed the designated uses, under the 2003 SWQS, for many rivers from "spawning and noncore rearing" to "core summer salmonid habitat". This resulted in requirements for many rivers, including the S.F. Snoqualmie River, to be changed from a seven-day average daily maximum temperature of 17.5 degrees Celsius to a seven-day average daily maximum of 16 degrees Celsius. The 2006 rule also changed a small number of rivers to the "char spawning and rearing" designated use type. This resulted in requirements for some rivers, including the U. Yakima River, to be changed to a seven-day average maximum of 12 degrees Celsius from the old daily seven-day average maximum of 16 degrees Celsius or 17.5 degrees Celsius (WSDOE 2007).

In 173-201A WAC, the WSDOE has established the following designated uses for fresh water in the state: aquatic life, recreation, water supply, and miscellaneous uses including wildlife habitat, harvesting, commerce and navigation, boating, and aesthetics. Aquatic life uses are identified from a list of six categories that reflect a range of generally more stringent habitat requirements reflected by the fish populations, habitat needs, and regions of the state. It is the intent of the SWQS to protect all indigenous fish and nonfish aquatic species. Recreation uses are identified from a list of three categories that reflect a range of contamination levels by fecal coliform bacteria (shown here in decreasing stringency order): extraordinary primary contact recreation; primary contact recreation; and secondary contact recreation.

Each designated use and use/category is protected through the establishment of quantitative and/or narrative criteria for a number of parameters, some of which include: water temperature, dissolved oxygen, turbidity, pH, fecal coliform bacteria, toxic substances, radioactive substances, and aesthetics. All water bodies in the State are expected to provide all of the designated uses by meeting the appropriate criteria. Water supply, whether for domestic, agricultural, industrial, or livestock uses, and the other

miscellaneous uses identified above are goals for all applicable water bodies. Aquatic life uses may be protected by meeting the criteria for the appropriate fish population and habitat needs, and contact recreation uses may be protected by meeting the criteria for the appropriate, accepted level bacterial contamination.

SWQS apply to all streams in the vicinity of Snoqualmie Pass. SWQS vary by watershed, but no distinction is made for public or private ownership (173-201A WAC). As outlined below, all streams in the U. Yakima Watershed are held to the more restrictive standards for char spawning and rearing (see Table 3.3.1-7). In the S.F. Snoqualmie Watershed, aquatic life uses are managed for core summer salmonid habitat. Note that the SWQS naming conventions imply the level of protection—determined by species and life stage requirements—and are not intended to imply the fish species are actually present in the system. The S.F. Snoqualmie River contains resident trout but no species of salmon because of the barrier downstream at Snoqualmie Falls. All streams are managed to the most stringent fecal coliform standard, to support the designated extraordinary primary contact recreation beneficial use.

Table 3.3.1-7:
Surface Water Quality Standards Applicable within the Study Area

Watershed	2006 Water Quality Standards—Aquatic Life Beneficial Uses	2006 Water Quality Standards—Recreational Uses
Upper Yakima	Char spawning and rearing	Extraordinary primary contact recreation
South Fork Snoqualmie	Core summer salmonid habitat	Extraordinary primary contact recreation

When surface water bodies do not meet established standards, they are identified as impaired under Section 303(d) of the CWA. The WSDOE regularly reviews and determines the water quality status of polluted water bodies within Washington and publishes them in a 303(d) list. For each water body listed, WSDOE then develops a pollutant management plan where total maximum daily loads (TMDLs) are established to rectify and maintain water quality within standards for those exceeded parameters. A more complete TMDL discussion is presented later in this section.

Results of Water Quality Monitoring

Water quality monitoring at The Summit-at-Snoqualmie was conducted from November 1994 through October 1995, October 1997 through May 1998, and July 2002 to the present. The objective of this monitoring was to establish baseline conditions in order to evaluate potential impacts associated with MDP implementation. As described in greater detail below, water samples or in-situ measurements were collected at various locations across the Study Area, including upstream and downstream locations on streams passing through SUP boundaries. Sample locations, shown in Figure 3.3.1-1, Hydrography – The Summit, and Figure 3.3.1-2, Hydrography – Alpental, are intended to detect the influences of ski area management, including clearing, road maintenance, and base area development, but do not necessarily

isolate the Study Area from all other adjacent influences. Sample data were collected to reflect a variety of hydrologic and climatological conditions, including winter low flow, winter rain-on-snow, spring melt, summer low flow, and rain-on-bare-ground. Data through 1998 are summarized in the *South Fork Snoqualmie River and Coal Creek Watershed Condition Assessment* (Jones & Stokes 2001), and more recent data (2002 through the present) are summarized in this document (SE GROUP unpublished data).

Table 3.3.1-8:
Water Quality Monitoring Locations within the Study Area

Identifier	Station	Location	Watershed
S-1	South Fork Snoqualmie	Alpental	S.F. Snoqualmie
S-2	Lower South Fork Snoqualmie	Alpental	S.F. Snoqualmie
B-1	Upper Beaver Lake Creek	Summit West	U. Yakima
B-2	Lower Beaver Lake Creek	Summit West	U. Yakima
T-1	Upper Tunnel Creek	Summit Central	U. Yakima
T-2	Lower Tunnel Creek	Summit Central	U. Yakima
A-1	Upper Stream A	Summit East	U. Yakima
A-2	Lower Stream A	Summit East	U. Yakima
C-1	Coal Creek	Nr. Summit East	U. Yakima

Water quality within the Study Area supports the beneficial use for all recreation classes. No exceedences of water quality standards have been observed for fecal coliform, indicating these beneficial uses are supported (Jones & Stokes 2001). Water quality within the Study Area supports aquatic life uses in the S.F. Snoqualmie River (core summer salmonid habitat). However, data indicate concerns in streams within the U. Yakima Watershed, which is managed to more stringent criteria for char spawning and rearing, particularly for temperature and dissolved oxygen. Primary parameters evaluated for aquatic life uses, including temperature, dissolved oxygen, turbidity, and pH are addressed below, and are summarized in Table 3.3.1-9.

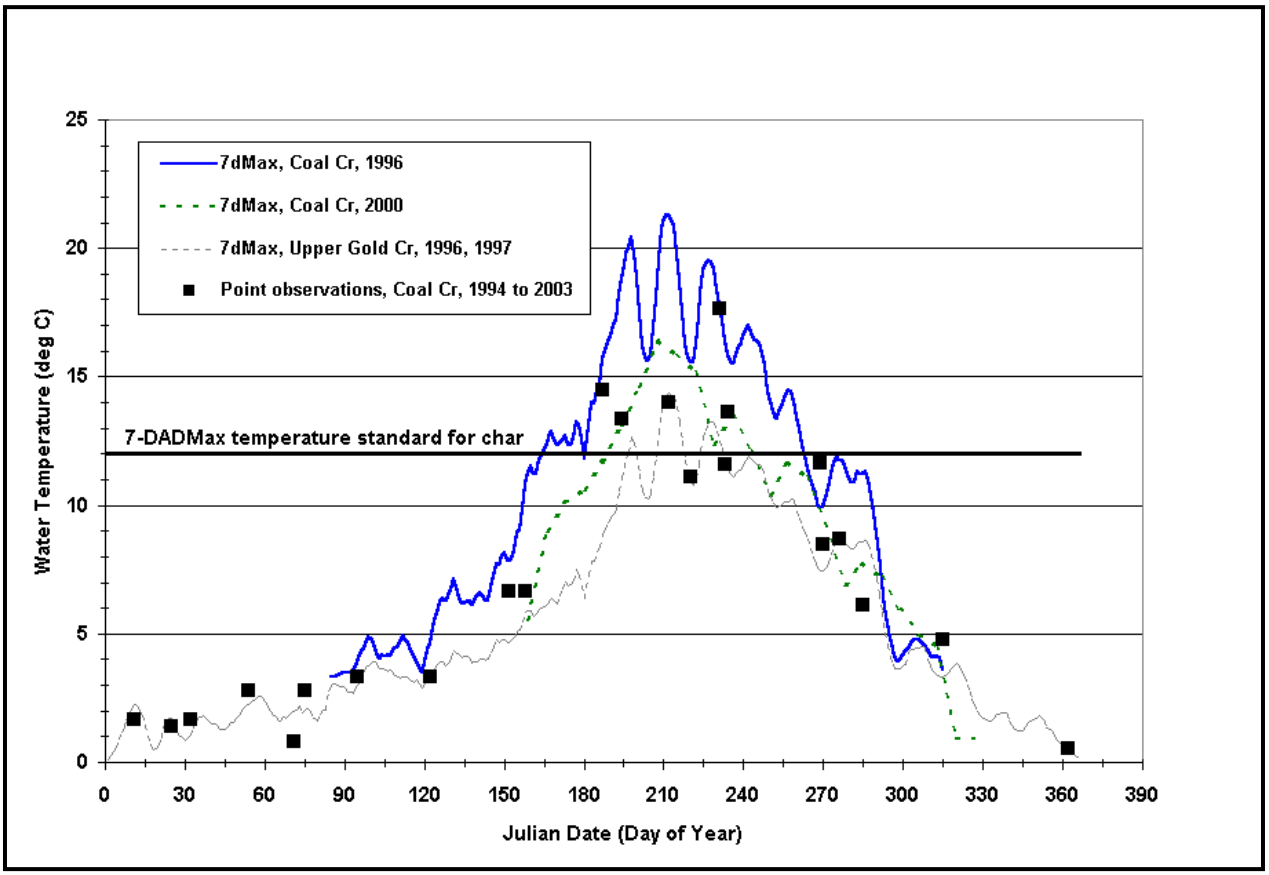
During water quality monitoring for this EIS, the 16 degree Celsius maximum temperature for the S.F. Snoqualmie River was never exceeded in approximately 31 point observations made at two different stations on the S.F. Snoqualmie River (Jones & Stokes 2001; SE GROUP unpublished data). The three highest observations of 13.5, 12.4, and 9.0 degrees Celsius occurred during summer base flow events in the month of August. However, 5 of 24 observations in Coal Creek exhibit exceedences of the more restrictive 12 degree Celsius criterion during the summer rearing window. Studies conducted by Craig (1997) and Thomas (2001) confirm that exceedence of temperature standards is a common summer occurrence in Coal Creek (see Illustration 3.3.1-5).

Table 3.3.1-9:
Summary of Study Area Water Quality Monitoring Data

Parameter	Units	Identifier	Period of Record	No. of Samples	Average	Minimum	Maximum	Standard
Temperature	ºC	S-1	1994 - 1998, 2002 - present	12	5.1	1.2	12.4	<16 ºC 7-DADMax
		S-2	1994 - 1998, 2002 - present	13	5.2	0.7	13.5	<16 ºC 7-DADMax
		B-1	1995 - 1998, 2002 - present	17	7.1	0.5	17.9	<12 ºC 7-DADMax
		B-2	1994 - 1998, 2002 - present	29	5.4	0.6	14.4	<12 ºC 7-DADMax
		T-1	2002 - present	12	5.6	0.1	14.6	<12 ºC 7-DADMax
		T-2	1994 - 1998, 2002 - present	30	5.5	0.6	14.2	<12 ºC 7-DADMax
		A-1	2002 - present	7	4.7	0.1	10.2	<12 ºC 7-DADMax
		A-2	2002 - present	13	6.1	1.0	12.2	<12 ºC 7-DADMax
		C-1	2002 - present	12	8.2	0.8	14.5	<12 ºC 7-DADMax
Dissolved Oxygen	mg/L	S-1	2002 - present	12	11.9	10.1	15.1	> 9.5 mg/L
		S-2	2002 - present	13	11.6	9.4	15.3	> 9.5 mg/L
		B-1	2002 - present	7	7.4	5.3	11.1	> 9.5 mg/L
		B-2	2002 - present	12	9.9	6.9	13.3	> 9.5 mg/L
		T-1	2002 - present	11	9.7	7.2	13.6	> 9.5 mg/L
		T-2	2002 - present	12	10.0	7.0	12.7	> 9.5 mg/L
		A-1	2002 - present	6	10.4	6.2	13.2	> 9.5 mg/L
		A-2	2002 - present	12	10.7	7.7	15.8	> 9.5 mg/L
		C-1	2002 - present	11	10.6	8.9	13.5	> 9.5 mg/L

Parameter	Units	Identifier	Period of Record	No. of Samples	Average	Minimum	Maximum	Standard
Turbidity	NTU	S-1	1994 - 1998, 2002 - present	35	0.1	0.0	0.9	Turbidity < 50 NTU: <5 NTU increase above background; Turbidity > 50 NTU: <10% increase above background
		S-2	1994 - 1998, 2002 - present	36	0.5	0.0	2.7	As above.
		B-1	1994 - 1998, 2002 - present	20	9.4	0.0	160.0	As above.
		B-2	1994 - 1998, 2002 - present	30	5.8	0.0	93.0	As above.
		T-1	2002 - present	12	0.3	0.0	1.1	As above.
		T-2	1994 - 1998, 2002 - present	35	1.5	0.0	16.0	As above.
		A-1	2002 - present	7	0.1	0.0	0.3	As above.
		A-2	2002 - present	13	0.0	0.0	0.0	As above.
		C-1	2002 - present	12	1.5	0.0	6.7	As above.
pH	N/A	S-1	2002 - present	13	7.2	6.5	8.0	6.5 - 8.5
		S-2	2002 - present	13	7.1	6.6	7.8	6.5 - 8.5
		B-1	2002 - present	8	6.6	6.2	7.2	6.5 - 8.5
		B-2	2002 - present	13	6.9	6.4	7.3	6.5 - 8.5
		T-1	2002 - present	12	6.8	6.1	7.2	6.5 - 8.5
		T-2	2002 - present	13	6.9	6.5	7.3	6.5 - 8.5
		A-1	2002 - present	7	6.7	6.0	7.5	6.5 - 8.5
		A-2	2002 - present	13	7.2	6.6	7.8	6.5 - 8.5
		C-1	2002 - present	11	7.4	6.5	7.9	6.5 - 8.5
Conductivity	S/cm	S-1	2002 - present	13	7.7	3.1	13.4	N/A
		S-2	2002 - present	14	9.0	3.6	16.3	N/A
		B-1	2002 - present	8	16.0	5.4	28.8	N/A
		B-2	2002 - present	13	19.0	5.4	54.7	N/A
		T-1	2002 - present	12	12.1	4.2	22.6	N/A
		T-2	2002 - present	13	21.2	4	41.2	N/A
		A-1	2002 - present	7	8.9	5.2	15.4	N/A
		A-2	2002 - present	13	17.9	6.4	35.8	N/A
		C-1	2002 - present	12	58.2	25.2	94.7	N/A

Illustration 3.3.1-5:
Maximum Temperature Data From Various Sources for Coal Creek and Upper Gold Creek by Julian Date



Notes: Seven-day maximum temperatures for Coal Creek in 1996 and Upper Gold Creek in 1996 and 1997 are from Craig (1997); seven-day maximum temperatures reported on a weekly basis for Coal Creek in 2000 are from Thomas (2001); point observations are instantaneous Coal Creek temperatures obtained during field surveys in 1994, 1995, 1997, 2002, and 2003 for this assessment; temperature standard shown is the 12 degree C spawning limit (7-DAD Maximum) for char (WAC 173-201A-200[1][c]).

Temperatures exceed the 12 degree Celsius temperature standard in Tunnel Creek, Beaver Creek, and Stream A (all tributary to Coal Creek), commonly during summer base flows in the months of July and August (Jones & Stokes 2001; SE GROUP unpublished data). All exhibit varying degrees of riparian vegetation removal associated with ski area management, and all three generally increase in temperature by approximately 1 to 4 degrees Celsius as the streams pass through ski trails and other facilities. Beaver Creek is an exception during hot summer days where warmer waters discharged from Beaver Lake cool as they flow downhill. Hyak Creek, also tributary to Coal Creek, has a riparian corridor that is generally intact. In 21 point observations, Hyak Creek has never been observed to exceed 11 degrees Celsius, suggesting that it typically meets water quality standards (Jones & Stokes 2001).

Dissolved oxygen refers to the volume of oxygen contained in water. Dissolved oxygen is partly dependent on water temperature, with colder temperatures enabling higher dissolved oxygen concentrations. Both the char spawning and rearing and core summer salmonid habitat aquatic life uses

carry the same one-day minimum criterion of 9.5 mg/L. In samples collected since 2002, 1 of 17 point observations at two locations in the S.F. Snoqualmie River, and three of eight point observations at one location in Coal Creek exceeded this standard (SE GROUP unpublished data). Lowest dissolved oxygen concentrations observed include 9.37 mg/L on S.F. Snoqualmie River and 8.86 mg/L on Coal Creek, and in all cases exceedences of the dissolved oxygen standard are associated with summer base flow events. Dissolved oxygen concentrations in Beaver and Tunnel Creeks and Stream A commonly increase as streamflows tumble down the steep channels, but have been observed to meet the dissolved oxygen criterion in 17 of 40 observations (SE Group unpublished data). It is important to note that this is a natural occurrence in these tributaries, as none of the 17 summer base flow samples have met the criterion, including a number of samples from upslope of ski area development.

Turbidity is a measure of refracted light passing through a water column, and typically is indicative of the amount of sediment and other particles entrained in the streamflow. Both the char spawning and rearing and core summer salmonid habitat aquatic life uses have the same criteria of a 5 NTU increase over background when background is 50 NTUs or less, or a 10 percent increase over background when background is greater than 50 NTUs. The S.F. Snoqualmie River has complied with SWQS for turbidity in approximately 30 paired, in situ point observations recorded. Data in Coal Creek have been collected in situ at only one reference station since 2002, so paired observations are not available. However, no exceedences of turbidity SWQS were observed during four rain-on-snow, four base flow, and one spring melt events, where the maximum observation was 6.7 NTUs during a rain-on-snow event, and no other samples exceeded five NTUs (SE Group unpublished data). Beaver Creek, a tributary to Coal Creek at Summit West, exceeded turbidity standards in 2 of 18 paired samples, and likely would have exceeded standards on 2 of 11 other occasions when upstream background samples were not available. Rain-on-snow events are responsible for most of the observed turbidity increases (including those that do not result in exceedences), but the highest turbidities measured were in Beaver Lake Creek during one base flow event and one rain-on-bare-soil event, when soil was not protected by snow cover.

Ski Lifts, Inc. applies sand and/or deicing compounds to all parking lots, maintenance areas, and arterial roads across The Summit-at-Snoqualmie for winter traction control. Applications occur on private land, NFSL, and state rights-of-way, including the Alpental Road and SR 906. In addition, the WSDOT applies sand and deicing compounds to I-90, SR 906, and other public facilities outside of the Study Area. In 2000-2001, The Summit applied 665 cubic yards of sand and 10 yards of magnesium chloride (MgCl) de-icer/ice-inhibitor to all of the above surfaces (including public and private lands both in and adjacent to the Study Area in both watersheds). The sand is an additional source of road-related sediment that may be discharged to ditches and streams, with effects on channel conditions, fish habitat, and ditch maintenance requirements. For the 1999-2000 and 2000-2001 winter seasons, WSDOT applied approximately 8,400 cubic yards of road sand, 1,360 tons of solid de-icer/ice-inhibitor, and 25,400 gallons of liquid de-icer/ice-inhibitor to I-90, SR 906, and other public facilities outside of the Study Area. Although these latter applications occur outside of the Study Area, they are included in the analysis area because the sand

application is identified as a significant contributor to a recognized Study Area issue. Traction sand becomes instream sediment as a result of runoff, snow blowing, and plowing, and results in sediment delivery within the Study Area in the U. Yakima Watershed and the S.F. Snoqualmie Watershed.

The pH of streamflow affects the solubility of industrial, domestic, and agricultural contaminants carried in the water column. When the pH is too low, it can increase the toxicity of contaminants in solution such as metals and ammonia. When pH is too high, it can precipitate these elements and other minerals and form sediments. Both the char spawning and rearing and core summer salmonid habitat aquatic life uses define the desired range of pH from 6.5 to 8.5, and limit human-caused variation within this range to 0.2 unit. All 17 point observations of pH in the S.F. Snoqualmie River since 2002 meet the range criterion (SE GROUP unpublished data). Differences between upstream and downstream monitoring stations vary and appear to reflect background variability within the river. The maximum difference observed is a. 0.44-unit increase from upstream to downstream during a summer base flow event. All seven observations of pH in mainstem Coal Creek during summer base flow and fall rain-on-snow events since 2002 meet the range criterion. Approximately 6 of 40 other observations fall below the range criteria and all are recorded at upstream locations (SE GROUP unpublished data). The general trend in Beaver Lake and Tunnel Creeks and Stream A is an increase in pH during all types of flow events, from upstream, where the range is generally 6.0 to 6.5, to downstream, where the range is generally 6.5 to 7.4. However, this is common in forested basins where high-elevation soils that have limited acid-buffering capacity result in headwaters that tend to be somewhat acidic.

Other water quality observations include low total phosphorus and nitrate and nitrite concentrations for all types of events and all streams surveyed (Jones & Stokes 2001). Oil and grease were detected in two different samples from lower Beaver Creek streamflows during one spring snowmelt and one rain on bare soil events. Other samples detected diesel in one low flow event at the upper and lower Beaver Lake Creek stations and in Coal Creek (Jones & Stokes 2001). These data are typically just above detection limits for oil and grease and for diesel, and suggest the containment and clean-up of diesel fuel, oil, and hydraulic fluid spills in the vehicle maintenance area or on roads have not always kept these contaminants from washing to streams.

The *South Fork Snoqualmie River Watershed Condition Assessment* (Jones & Stokes 2001) suggested management objectives for water quality were met under current ski area operations for all parameters in S.F. Snoqualmie and U. Yakima Watersheds, except for turbidity in some streams in the U. Yakima Watershed. Additional temperature data reported in the literature (Craig 1997; Thomas 2001) and recent temperature and dissolved oxygen data collected for this assessment (SE GROUP unpublished data) suggest that the streams of the U. Yakima Watershed within the Study Area may also impaired for temperature and dissolved oxygen.

Basis for Evaluating the Effects of the Alternatives on Surface Water Quality

MDP activities that are most likely to have an effect on surface water quality within the Study Area are those that may occur within the riparian areas of streams, such as changes in riparian vegetation and the construction of roads and other ski area facilities. These parameters are discussed in the Section 3.3.1.6 - Riparian Resources.

Water Quality Concerns Downstream of the Study Area

Water quality in the S.F. Snoqualmie River near Alpental (approximate river mile 29) is excellent, but the South Fork is impaired for temperature at river mile 17.3 and for pH at river miles 10.0 and 13.6. Further downstream, the Snoqualmie River is impaired for fecal coliform, dissolved oxygen, and temperature. Selected segments on these rivers are included in the 1998 303(d) list (WSDOE 2000a). A TMDL has been prepared for biochemical oxygen demand, ammonia, and fecal coliform in the Snoqualmie River segments (Joy 1994), but no TMDL is currently under development for the S.F. Snoqualmie River.

Although several streams within the Study Area exhibit exceedence events of SWQS for turbidity, temperature, and DO, none of these streams are included on the 1998 303(d) list (WSDOE 2000a). The U. Yakima River is listed as impaired for temperature in two separate segments located approximately 10 and 20 miles downstream of the Keechelus Lake dam. The dam is approximately 7 miles down gradient of the Study Area. No TMDL is currently under development to address this impairment. Even further downstream in the Yakima River, a draft TMDL has been prepared to correct impairments associated with suspended sediment and pesticides in the agricultural basin (Creech 2003).

3.3.1.5 Groundwater

Groundwater is the primary source of water for domestic and commercial uses at Snoqualmie Pass. The Alpental Community Club, which provides local public water supplies to the Alpental valley, including the Alpental ski area, holds rights to consumptive groundwater use from two wells (and also a surface water right for the S.F. Snoqualmie River) (Lenihan pers. comm.). The Swanson well and the Dyer well, both located west of the divide near the center of the subdivisions south of the ski area, have rights to instantaneous withdrawals of 200 gpm and 185 gpm, respectively. The combined withdrawals from the two wells and the surface water right cannot exceed 112 acre-feet per year.

Three other wells, also in the S.F. Snoqualmie Watershed, have rights owned by the SPUD (Lenihan pers. comm.). Well 1 (near the Fire Department building near Summit-West ski area) produces 70 gpm, and well 2 (near Commonwealth Creek) yields 160 gpm. Recent reductions in yields with these wells prompted construction of well 3 approximately 200 feet south of well 2. Well 3 yield is about 150 gpm and serves as an auxiliary/replacement well within the existing water right, consistent with RCW 90.44.100. These three wells are permitted to withdraw no more than 230 gpm, and up to 56 acre-feet annually. The Summit West, Summit Central, and Summit East ski areas, located primarily within the

Coal Creek subwatershed, are included within the SPUD service area. An intertie agreement between the SPUD and the Alpental public water system would allow sharing of water supplies only during emergency drought conditions.

3.3.1.6 Riparian Resources

Riparian resources see lands immediately adjacent to streams, lakes, and wetlands. Land management entities ensure riparian protection through various policies that include designating Riparian Buffers to protect these resources. On federal lands, including those permitted to Ski Lifts, Inc, the ACS delineates variable-width strips of vegetation along various classes of streams, lakes, wetlands, inner gorges, unstable soils, 100-year floodplains, and other areas into protective riparian zones called Riparian Reserves (USDA and USDI 1994). Similar areas, called buffers in Kittitas and King Counties (Kittitas County Code 17A.02.050, King County Code 21A.24), are defined for lands under Kittitas and King County jurisdictions. Areas so demarcated are essentially land use designations having clear, administratively defined boundaries. Within those boundaries, a mosaic of ecological settings exist, where each unique type of habitat blends gradually into the next. Table 3.3.1-8 defines some of the classes and protective widths of Riparian Reserves and stream and wetland buffers (hereafter jointly referred to as Riparian Buffers unless otherwise specified) in the above authorities. Figures 3.3.1-3, Existing Riparian Conditions – The Summit, and 3.3.1-4, Existing Riparian Conditions – Alpental show the distribution of Riparian Buffers within the Study Area.

This section discusses the current conditions and functions of the approximately 801 acres of Riparian Buffers within the Study Area, including stream shading, LWD recruitment, and sediment filtration and stabilization (see Table 3.3.1-9). As suggested by these functions, Riparian Buffers protect watershed resources through the management of vegetation adjacent to these features. Riparian conditions are addressed according to dominant vegetation type. For purposes of this discussion, dominant vegetation types include: Naturally forested - mature; Naturally forested - immature (includes second and third-growth forests, except sapling forest); Naturally non-forested; Modified (sapling forest, shrub, and herbaceous); and Developed. The majority of Riparian Buffers occur in the U. Yakima Watershed, reflecting the larger size of this watershed compared to the S.F. Snoqualmie watershed (see Table 3.3.1-9).

Table 3.3.1-8:
Definition of Riparian Resources by Jurisdiction within the Study Area[a]

Jurisdiction/Authority	Classification	Riparian Buffer Width (feet)
Streams		
National Forest System Land (classified according to *Northwest Forest Plan* [USDA and USDI 1994])	Fish bearing	300
	Perennial, non-fish bearing	150
	Intermittent	100
Private Land in King County (classified according to King County Code [KCC] 21A.06.1240; buffer widths defined by KCC 21A.24.360)	Class 1	100
	Class 2, with salmonids	100
	Class 2, without salmonids	50
	Class 3	25
Private Land in Kittitas County (classified according to Washington Forest Practices Water Typing System [WDNR 2002]; buffer widths defined by Kittitas County Ordinance 17A.07.010)	Type I	200
	Type II	100
	Type III	50
	Type IV	20
	Type V	0
Wetlands		
National Forest System Land (classified according to *Northwest Forest Plan* [USDA and USDI 1994])	Wetlands > or = 1 acre	150
	Wetlands <1 acre	100
Private Land in King County (classified according to KCC 21A.06.1415; buffer widths defined by KCC 21A.24.320)	Class 1	100
	Class 2	50
	Class 3	25
Private Land in Kittitas County (classified according to Wetlands Rating System for Western Washington [WSDOE 1993]; buffer widths defined by Kittitas County Ordinance 17A.04.020)	Category I	200
	Category II	100
	Category III	80
	Category IV	0

[a] Table presents generalized information for streams and wetlands as applied to the Study Area for this EIS only. Reader is referred to authorities identified for each jurisdiction for additional information regarding classification definitions, additional sensitive areas such as steep slopes and floodplains, and implementation guidance.

Table 3.3.1-9:
Existing Riparian Vegetation Conditions within The Summit-at-Snoqualmie Study Area

Parameter (units)	Upper Yakima	South Fork Snoqualmie	Study Area Totals
Study Area (acres)	1,885.21	1,014.15	**2,899.36**
Riparian Buffer Area (acres)	523.49	277.35	**800.84**
Land Cover Types within Riparian Buffers (acres)[a]			
Natural Condition			
Forested - Mature	211.29	108.28	**319.57**
Forested –Sapling	73.05	0.00	**73.05**
Naturally Non-forested[b]	19.73	52.02	**71.75**
Sub-total	304.07	160.3	**464.37**
Non-Natural Condition			
Forested – Immature	37.00	6.24	**43.24**
Modified	165.22	97.64	**262.86**
Developed	17.20	13.18	**30.38**
Sub-total	219.42	117.06	**336.48**
Land Cover Along Stream Length (miles)[c]			
Naturally Forested - Mature	7.10	3.98	**11.09**
Forested – Immature	1.36	0.28	**1.64**
Forested - Sapling	3.11	0.00	**3.11**
Naturally Non-forested[b]	0.85	2.80	**3.65**
Modified	4.70	2.85	**7.55**
Developed	0.25	0.27	**0.52**
Total Length (miles)[c]	**17.36**	**10.19**	**27.55**
Road Length within Riparian Buffers			
Native (miles)	4.79	1.55	**6.34**
Paved (miles)	0.41	0.32	**0.73**
Total Length within Riparian Buffers (miles)	**5.20**	**1.87**	**7.07**

[a] Includes wetland landcover types.
[b] Includes lake landcover type.
[c] Includes jurisdictional streams (except culverted streams)
Note: This table includes the Mill Creek portion of the Study Area.

Riparian Buffers in Natural Vegetation Condition

Riparian Vegetation

Riparian Buffers in natural vegetation condition include all reserves covered in natural forest (including mature and second and third growth forests) and natural nonforest vegetation types. Such buffers cover 464 acres, approximately 58 percent of the total Riparian Buffer acreage within the Study Area (see Table 3.3.1-9). The percentage of Riparian Buffers in natural, non-modified land cover is greater in the S.F. Snoqualmie Watershed (60 percent) than in the U. Yakima Watershed (51 percent) (see Table 3.3.1-9). Within these areas, riparian functions are determined primarily by whether the natural Riparian Buffer is composed of mature forest (40 percent), immature forest (5 percent), or nonforest vegetation (9 percent). A secondary, locally important consideration is the type of stream channel adjoined by the buffer. Riparian Buffer vegetation includes both riparian vegetation and upland vegetation growing within the Riparian Buffer. Riparian vegetation is commonly dominated by species such as Sitka alder, willow species, salmonberry, elderberry, currant, horsetail, and other herbaceous species found in moist areas.

In both naturally forested and naturally nonforested areas, primary functions of vegetation in Riparian Buffers include providing habitat for riparian animal species, filtering fine sediment, providing fine litter inputs (e.g., small leaves and twigs) to the stream, stabilizing streambanks via root structure, maintaining habitat structure for hyporheic functions, and riparian shading. In naturally forested areas, additional primary functions of riparian vegetation include providing LWD to the stream channel, providing shade from the forest canopy, and attenuating microclimatic variation. In areas where the stream gradient is sufficient to initiate or propagate debris flows (i.e., MS1 and MS2 channel types), riparian forest vegetation may also help to attenuate debris flow impacts.

Large Woody Debris Recruitment

Sustainable LWD recruitment is recognized as a dominant riparian function in low-order mountain channels. LWD has several important functions:

Standing dead trees provide habitat for nesting species in the riparian zone and contribute detritus and insects to streams.

Once in streams, LWD maintains channel structure by storing sediment and encouraging pool scour. It helps reduce stream energy by interrupting the continuous slope of channel beds and creating turbulence.

LWD also helps provide stable fish habitat by retaining spawning gravel and by serving as rearing cover.

Near-term LWD recruitment potential was assessed using methods adapted from watershed analysis protocols used by the WDNR (Washington Forest Practices Board 1997). Naturally forested areas within the Study Area are dominated by both mature and immature forest types as described in Section 3.5 - Vegetation. The types are distinguished on the basis of dominant species composition and dominant tree

size and age. All mature forests are assumed to have full LWD recruitment potential, while immature forests have impaired LWD recruitment potential. In all, about 320 acres (40 percent) of Riparian Buffers within the Study Area have full recruitment potential (see Table 3.3.1-9). Approximately 11.1 miles of streams (40 percent of the natural stream network with Riparian Buffers) are bordered by mature stands and are subject to the full recruitment potential (see Table 3.3.1-9). Many of these channels are non-fish-bearing MS1, MS2, and MS3 channels, but LWD in these channels can provide sediment storage, habitat structure, substrate, and a nutrient source for amphibians and macroinvertebrates.

LWD delivered to MS1, MS2 and MS3 channels will rarely be transported to downstream VB1 or VB2 channel types. There are three reasons for this. First, these channels have low flow volumes and thus have limited capacity to transport LWD. Second, these channels may have low LWD loading, particularly in avalanche chutes and brush slopes such as those common at Alpental. Third, many of these channels have culverts and bridges that obstruct LWD transport. Because these culverts and bridges must be periodically cleared of obstructions caused by large and small woody debris, they constitute sites of net LWD loss from the stream system.

Impaired LWD recruitment potential occurs in immature, naturally forested areas on 43 acres (5 percent) of Riparian Buffers within the Study Area. More of the impaired LWD recruitment potential occurs in the U. Yakima Watershed (37 acres,) than in the S.F. Snoqualmie Watershed (6.2 acres). All areas with impaired recruitment potential are dominated by immature forest stands that are regenerating after disturbance by logging and/or historic development. Approximately 1.6 miles of streams (5 percent of the natural stream network with Riparian Buffers) are bordered by these immature stands and are subject to impaired recruitment potential (see Table 3.3.1-9). Many of the valley bottom channel types (VB1 and VB2) are currently experiencing reduced LWD recruitment potential.

Naturally non-forested conditions dominate 72 acres (9 percent) of Riparian Buffers and 3.5 miles of streams (13 percent of network). These areas, including parkland, rock/talus, open water, natural shrub, and natural herbaceous communities, have limited to no LWD recruitment potential.

Shading

Shading is an important control of water temperature in lakes and streams. Water temperatures that are too high can exceed water quality criteria and may cause stress to fish and other animals living in the stream.

Qualitative shade evaluations were conducted in nine mature or immature forested stands and three modified areas as part of riparian surveys for the Watershed Condition Assessment (Jones & Stokes 2001). Generally speaking, those forested stands that were fully effective in providing overhead and/or oblique shade (where nearly all light reaching a stream is diffuse and indirect) had greater than 75 to 100 trees per acre, had canopy cover exceeding 70 percent, and were at least 80 feet tall. These characteristics

are most prevalent in mature, forested communities. Partially effective shading, where a mix of direct and diffuse light reached the stream, and less than about one-half of the stream received direct light, was achieved in forested stands that had between 20 and 100 trees per acre, canopy cover between 10 and 60 percent, and overstory heights of 40 to 80 feet. The mature forested stands and many of the immature forested stands shown in Figures 3.3.1-3, Existing Riparian Conditions - The Summit and 3.3.1-4, Existing Riparian Conditions – Alpental, meet or exceed these characteristics for fully effective shading.

Riparian Buffers in Modified Vegetation Condition

Riparian Vegetation

Riparian Buffers in modified vegetation condition include all Riparian Buffers cleared by historic timber harvest and for ski area operations (i.e., areas maintained in early-successional conditions of grassland or shrub cover). Some areas retain their original soils, but grading has occurred in other areas. Although some graded areas may no longer be capable of developing a closed-canopy, multi-story forest within a reasonable time frame (e.g., 100 years), it is assumed that all modified vegetation areas do have the potential to support natural forest vegetation types. This is a conservative assumption that ensures the analysis will not underestimate the loss of potential forest habitat due to past habitat modification.

Riparian Buffers in modified shrub and herbaceous vegetation total 263 acres, approximately one-third of the total Riparian Buffers acreage within the Study Area (see Table 3.3.1-9). More than one-third of the modified Riparian Buffer area occurs on private land in the U. Yakima Watershed and on NFSL in the S.F. Snoqualmie Watershed. Another one-quarter occur on NFSL in the U. Yakima Watershed.

These Riparian Buffers all adjoin mountain slope channels (primarily channel types MS2 and MS3) in areas that, in the absence of human activity, would be dominated by forest types varying from western hemlock forest at the lowest elevations (approximately 4,400 to 5,000 feet) to mixtures of Pacific silver fir and mountain hemlock forest at middle elevations (approximately 4,800 to 5,600 feet), to a parkland consisting of sparsely dispersed tree clumps of mountain hemlock at the highest elevations (approximately 5,300 to 6,500 feet).

Under current conditions, these modified reserves are primarily dominated by either: (1) montane and subalpine shrubs such as huckleberries, salmonberry, Sitka alder, and willows, or (2) a grassland dominated by native and non-native seeded grasses and some herbs (e.g., lupines). In parklands, the modified grassland merges into a native nonforest herb and low shrub plant community. In all these Riparian Buffers, there is minimal riparian vegetation is present because steep channel slopes and thin soils produce an abrupt soil moisture gradient in riparian areas. Thus, riparian vegetation is primarily composed of early-seral species such as Sitka alder and willow, and salmonberry, growing less than 0.25 SPTH from the channel.

Another 73 acres (9 percent) of Riparian Buffers in modified vegetation condition consist of sapling forests. Dominant overstory vegetation in these buffers, primarily in the Mill Creek drainage, is approximately 20-year old Douglas fir.

As described previously in Section 3.3.1.3 – Surface Water Quality, approximately 2.1 miles of mountain slope channels in modified vegetation areas have been channelized in culverts (see Table 3.3.1-1), thereby negating most riparian functions. However, compared with open channel flow with no vegetation for shading, culverted flow is expected to maintain or lower stream temperatures because of the absence of direct solar heating and the decrease in the range of daily temperature fluctuations.

Large Woody Debris Recruitment

Because all modified vegetation areas are either nonforested or a sapling forest, these areas have no near-term LWD recruitment potential. Since these areas are assumed to be capable of supporting mature forest vegetation, this condition represents the absence of LWD recruitment potential relative to natural conditions. Approximately 10.7 miles of streams (39 percent of the stream network) are situated within ski trails and other areas of modified vegetation (see Table 3.3.1-9). The affected streams are primarily mountain channel types MS2 and MS3. Most of these channels are non-fish-bearing, but any LWD that is stabilized in these channels can provide sediment storage, habitat structure, substrate, and a nutrient source for amphibians and macroinvertebrates. All these ecosystem functions have been reduced because of the removal of mature and immature riparian forest.

Shading

Lack of shading in tributaries to Coal Creek is a primary reason for the temperature problems identified in those streams in Section 3.3.1.3 – Surface Water Quality. The modification of riparian vegetation for the maintenance of ski trails results in this loss of thermal regulation (except for channelized segments in extended culverts as described earlier in this subsection).

The Watershed Condition Assessment documented characteristics of riparian vegetation that achieved some shading success for stream channels (Jones & Stokes 2001). Although limited, some channel segments with modified vegetation in Riparian Buffers can attain fully- or partially-effective shading (primarily diffuse light, with less than half the length of narrow channel segments receiving direct light) with the maintenance of dense shrub cover on narrow stream channels within ski trails. Dense willow and Sitka alder, in the absence of overstory forest vegetation, are able to fully cover and shade the stream.

Riparian Buffers in Developed Condition

Riparian Vegetation

Developed areas include ski area access/maintenance roads, SR906, parking lots, buildings, and maintenance areas. Riparian Buffers in developed condition include all areas entirely or largely cleared of

vegetation. Such reserves may contain patches of grass, shrub, or trees, but most areas are covered by pavement, gravel road surfaces, roofs, or similar surfaces. The developed condition is present on about 30 acres, representing 4 percent of Riparian Buffers within the Study Area (see Table 3.3.1-9). The distribution of Riparian Buffers between watersheds is approximately equivalent on a percent area basis.

The road network must frequently pass through the Riparian Buffers associated with mountainslope channels and valley bottom channels. Roads within the Riparian Buffers are generally more likely to contribute sediment to streams because of their proximity to the channels and the tendency for roads and road ditches to intercept and route water, sometimes effectively becoming extensions of the stream network. Table 3.3.1-9 indicates that 7.1 miles (32 percent) of the roads within the Study Area lie within Riparian Buffers. Within the U. Yakima Watershed, 5.2 miles of road (27 percent of the roads in the watershed) lie within Riparian Buffers. Approximately 60 percent of the Study Area roads in the S.F. Snoqualmie watershed (a total of 1.9 miles of roads) lie within Riparian Buffers (see Table 3.3.1-9).

Some of the culverted stream length (channel type CV) referred to under "Riparian Buffers in Modified Condition" above actually are situated in developed areas such as parking lots. As described previously, extended culverts negate most riparian functions.

Large Woody Debris Recruitment

Developed areas have little to no forest cover. Moreover, any LWD entering channels in these areas may be removed and placed securely in upland locations in order to avoid flooding and damage to facilities. Thus, developed areas have negligible near-term LWD recruitment potential.

Approximately 0.5 mile of streams (2 percent of the natural stream network with Riparian Buffers) are situated within or adjacent to developed areas with sparse or no vegetation (see Table 3.3.1-9). Ecosystem functions provided by LWD (e.g., sediment storage, habitat structure, substrate, and a nutrient source for fish, amphibians and macroinvertebrates) have been reduced because of removal of the riparian forest.

Shading

Lack of shading in channels within developed areas is common within the Study Area. Resulting water quality issues include elevated stream temperatures and depressed dissolved oxygen concentrations (see Section 3.3.1.3 – Surface Water Quality).

3.3.2 Drainages of Particular Concern

Study Area results presented in Section 3.3.1 – Summary of Existing Conditions are based on a 6th-field subwatershed scale analysis. At this scale, the size of the ski area suggests that a 6th-field scale is too large of an area to adequately describe existing conditions relative to the four different ski areas (Summit West, Summit Central, Summit East, and Alpental). In addition, in order to adequately evaluate potential impacts from proposed activities described in Chapter 2, it is necessary to display conditions in smaller

geographic areas. Therefore, the EIS presents information that describes existing conditions in smaller area, the 7th-field drainage, to provide a better understanding of the differences in physical and biological features associated with soils, water, and fisheries resources. Describing site conditions at this scale provides a basis to understand how impacts may affect resources, especially where sensitive resources are concentrated in a smaller area.

The Study Area includes portions of 15 smaller, 7th-field drainages that make up the two larger 6th-field subwatersheds. This section describes conditions in the 7th-field drainages for watershed resources. It is important to understand some of the drainages are in relatively undisturbed conditions whereas other drainages have more disturbed conditions from historic development relative to the watershed resources. A description of the existing condition in each drainage is required to understand how an activity proposed in the Action Alternatives may detrimentally affect watershed conditions in specific drainages, beneficially impact watershed conditions through restoration, or not affect watershed conditions if a proposed activity does not occur in a specific drainage.

3.3.2.1 Process for Evaluation of Drainages of Particular Concern

A quantitative and qualitative process was used to describe existing conditions in the 7th field drainages and to identify where the drainages occur along a continuum of relatively undisturbed to degraded conditions. Tables 3.3.2-1 and 3.3.2-2 show the 15 drainages that occur within the U. Yakima Watershed and the S.F. Snoqualmie Watershed and a set of parameters used to measure conditions in the drainages. Key parameters were selected to evaluate conditions that influence sediment production, stream temperatures, stream flow, and the amount and quality of fish habitat. These parameters were selected because of their relevance to the ongoing processes within the 7th field drainages in the Study Area, types of land use that occur in the Study Area, and their importance in describing soil, water, and fish resources. DPCs are those 7th field drainages that have a majority of the key parameters over established thresholds due to degraded watershed conditions.

To understand the condition of the drainage relative to naturally functioning conditions for each parameter, a threshold value was identified for each parameter. Thresholds were determined from a variety of published sources applicable to the setting found in the Study Area, and from site-specific data gathered in the Study Area. If a threshold is exceeded in a drainage, it indicates that the resource conditions are of low quality due to degraded biological and physical factors for that specific parameter. See the DPC Parameter and Threshold Rationale Matrix in Appendix I - Physical and Biological Resource Data Tables, for a detailed description of how the thresholds where established.

For this specific analysis of watershed resources, the most important parameters to consider are Riparian Buffers in a non-natural condition, stream length with management concerns, road density, road crossing density, impervious cover, modified channel length, and culverted channel length. These parameters were

selected because they are the ones that most directly affect watershed resources (see rationale in Appendix I - Physical and Biological Resource Data Tables).

3.3.2.2 Upper Yakima River Watershed

Lower Mill Creek

The Lower Mill Creek drainage exhibits three parameters that exceed thresholds of concern (see Table 3.3.2-1):

- Riparian Buffers in a non-natural condition (83.16 percent)
- Road density (7.42 mile/mile^2)
- Road crossing density (27.50 mile^2)

A total of 396 acres of the Study Area are situated within the Lower Mill Creek drainage. Three of the seven parameters evaluated for this drainage exceed thresholds of concern, indicating a moderate level of alteration to watershed processes including a reduction of riparian functions, the effects of a debris torrent on channel form, and potential sediment yield from soils under management (see Table 3.3.2-1). Although only 8 percent of the channel network has modified land cover immediately adjacent to its banks, about 83 percent of all Riparian Buffer area is in modified, second-growth forest (see Table 3.3.2-1). A high score on the Pfankuch index for bed scour and deposition in mainstem Mill Creek indicates the influence of a debris flow in maintaining bedrock morphology. Aerial photos indicate the debris flow initiated in a mid-basin gorge prior to timber harvest in the drainage. The presence of three parameters over threshold articulates the potential for high sediment yields to streams, due to factors including high road densities, high density of road crossings, and identified areas of bare soils (1.46 acres total; see Table 3.2.2-1). Specific problem areas identified in managed ski areas in the drainage include the failure of water bars and minor gullying downslope of roads accessing the upper terminal of the Backside chairlift.

Table 3.3.2-1:
DPC Analysis of Watershed Conditions for Existing Conditions in the Upper Yakima Watershed Portion of The Summit-at-Snoqualmie Study Area[a]

Parameter	Threshold	U. Yakima Watershed								
		L. Mill Creek	U. Mill Creek	Creek Run	Sum-mit South	Hyak	Tun-nel	Ski Acres	Beaver	Other
Riparian Buffers in a Non-Natural Condition (% of total)	30	83.16	100.0	18.87	45.06	27.37	42.00	52.78	56.38	44.52
Stream Length w/ Management Concerns (% of total)	10	7.78	18.33	1.89	6.60	5.81	27.23	44.48	48.63	32.40
Road Density (miles/square mile)	3	7.42	2.90	2.52	5.66	2.78	12.34	9.28	8.65	1.66
Road Crossing Density (number/square mile)	6	27.50	0.00	20.34	14.29	9.96	85.71	50.04	33.61	4.11
Impervious Cover (% of total)	8	2.25	0.88	0.76	4.33	1.28	7.03	8.16	4.29	1.16
Modified Channel Length (% of total)	8	0.00	0.00	0.00	1.69	0.00	5.60	12.68	10.45	0.00
Culverted Channel Length (% of total)	8	0.00	0.00	0.00	0.00	5.76	26.07	16.09	21.96	38.46
Parameters over threshold		**3**	**2**	**1**	**3**	**1**	**5**	**7**	**6**	**3**

[a] The value stated for each drainage is in terms of the metric used to compare to the threshold. A complete breakdown of the DPC analysis can be found in Appendix I- Physical and Biological Resource Data Tables and includes the area of impact and analysis area for each DPC parameter.

Upper Mill Creek

Upper Mill Creek exhibits two parameters that exceed thresholds of concern (see Table 3.3.2-1):

- Riparian Buffers in a non-natural condition (100 percent)
- Stream length with management concerns (18.33 percent)

About 33 acres of the approximately 573-acre upper Mill Creek drainage are situated lower in the drainage within the Study Area. About two-thirds of the area within the Study Area contains regenerating sapling forest within Riparian Buffers. Approximately 18 percent of the total stream length has modified land cover on its banks. These two parameters exceed established thresholds, but do so because of the small drainage area evaluated (see Table 3.3.2-1). Most of the drainage, however, is largely forested and generally in an undisturbed condition. None of the thresholds for the soils parameters are exceeded for upper Mill Creek (see Table 3.2.2-1). No specific watershed problems have been identified in the upper Mill Creek drainage.

Summit South

The Summit South drainage exhibits three parameters that exceed thresholds of concern (see Table 3.3.2-1):

- Riparian Buffers in a non-natural condition (45.06 percent)
- Road density (5.66 miles/square mile)
- Road crossing density (14.29/square mile)

A total of 224 acres of the Study Area are situated within the Summit South drainage. Three of the seven parameters evaluated for this drainage exceed thresholds of concern, including developed or modified land cover in Riparian Buffers, bed scour and deposition, and road density and bare soils (see Table 3.3.2-1). About 45 percent of the buffer area along 0.87 mile of streams in the drainage is in developed or modified land cover. Bed scour and deposition was observed over 30 to 50 percent of the streambed during Pfankuch channel stability surveys. Road density and the presence of severely eroded soils in managed areas (near the summit of Mount Hyak, downslope of the *Dinosaur* chairlift) indicate an elevated risk of erosion and sedimentation.

Creek Run

The Creek Run drainage exhibits 1 parameter that exceeds thresholds of concern (see Table 3.3.2-1):

- Road crossing density (20.34/square mile)

A total of 220 acres of the Study Area are situated within the Creek Run drainage. Only one of the thresholds for the seven parameters is exceeded in this drainage, indicating a relatively low level of alteration to watershed processes. The road crossing density is 20.3 per square mile and the threshold is 6 (see Table 3.3.2-1). No specific existing problems have been identified in the Creek Run drainage during this assessment.

Hyak Creek

The Hyak Creek drainage exhibits 1 parameter that exceeds thresholds of concern (see Table 3.3.2-1):

- Road crossing density (9.96/square mile)

A total of 193 acres of the Study Area are situated within the Hyak drainage. One of the seven thresholds for the parameters evaluated in Table 3.3.2-1 is exceeded in the drainage, indicating a relatively low level of alteration to watershed processes. The exceeded parameter is road crossing density, but the density is 10.0, which is much closer to the threshold than the density in Creek Run. Both Pfankuch channel stability were low as a result of significant bank cutting and active scour and deposition processes covering more than half of the channel bed. Specific areas of concern identified in managed ski areas in

the drainage include sediment production associated with the Silver Fir parking lot and with gullies under the Silver Fir chairlift and in a ski trail near a small tributary to Hyak Creek.[35]

Tunnel Creek

The Tunnel Creek drainage exhibits 5 parameters that exceed thresholds of concern (see Table 3.3.2-1):

- Riparian Buffers in a non-natural condition (42.00 percent)
- Stream length with management concerns (27.23 percent)
- Road density (12.34 miles/square mile)
- Road crossing density (85.71/square mile)
- Culverted channel length (26.07 percent)

A total of 134 acres of the Study Area are situated within the Tunnel Creek drainage, a tributary to Hyak Creek. Five of the seven parameters evaluated for this drainage exceed thresholds of concern, indicating a moderate to high level of alteration to watershed processes (see Table 3.3.2-1). In addition to the elevated potential for sediment yield from soils under intensive management, Tunnel Creek is affected by a marked reduction of riparian functions. This is the result of more than one-fourth of the channel network being channelized via routing through extended culverts, modification of vegetation along the streambanks of another 26 percent of the stream network, and modification or development of 42 percent of Riparian Buffer area (see Table 3.3.2-1). This increased runoff and adjacent clearing resulted in gullying and severe bank erosion in the mainstem channel that ceased when the stream was placed in an extended culvert in 1995. The downstream segment of Tunnel Creek is still subject to sediment delivered from the Silver Fir parking lot, however.

Ski Acres

The Ski Acres drainage exhibits 7 parameters that exceed thresholds of concern (see Table 3.3.2-1):

- Riparian Buffers in a non-natural condition (52.78 percent)
- Stream length with management concerns (44.48 percent)
- Road density (9.28 miles/square mile)
- Road crossing density (50.04/square mile)
- Impervious cover (8.16 percent)
- Modified channel length (12.68 percent)

[35] Replacement of the existing *Silver Fir* chairlift was approved in a CE by the USFS in 2008. Replacement of the chairlift includes an upgrade to a detachable quad and moving the bottom terminal closer to the parking lot. For the purposes of this FEIS, the replacement of the *Silver Fir* chairlift is considered an existing condition.

- Culverted channel length (16.09 percent)

A total of 358 acres of the Study Area are situated within the Ski Acres drainage. All seven of the parameters evaluated for this drainage exceed thresholds of concern, the only drainage to do so in the U. Yakima Watershed. The risk of high sediment yields to streams is evident through high values for road density, road-crossing density, and severely eroded soils. The interruption of riparian processes is evident through the development or modification of more than half of the Riparian Buffer area and along 45 percent of the total channel network (see Table 3.3.2-1). Instream effects are observed through the alteration of 29 percent of streams to modified or culverted channel types, and the instability of streambanks and the streambed recorded in the Pfankuch parameters. One specific area of concern is the volume of sediment yielded to streams from several sources, including a debris flow and a large area of severe erosion near the ridge in the west-center of the drainage, and the main parking lot.

Beaver Lake Creek

The Beaver Lake Creek drainage exhibits 6 parameters that exceed thresholds of concern (see Table 3.3.2-1):

- Riparian Buffers in a non-natural condition (56.38 percent)
- Stream length with management concerns (48.63 percent)
- Road density (8.65 miles/square mile)
- Road crossing density (33.61/square mile)
- Modified channel length (10.45 percent)
- Culverted channel length (21.96 percent)

A total of 171 acres of the Study Area are situated within the Beaver Lake Creek drainage. Six of the seven parameters evaluated for this drainage exceed thresholds of concern, making it second only to Ski Acres as the drainage with the highest number of exceedences in the U. Yakima Watershed (see Table 3.3.2-1). The only threshold of concern not exceeded in Beaver Lake Creek is the impervious cover parameter. The streams in the Beaver Lake Creek drainage have the highest streambank cutting scores, which is supported by an exceedence in the stream length with management concerns parameter (see Table 3.3.2-1). Specific concerns identified in managed ski areas in the drainage include the effects of the existing maintenance facility on water quality; sediment from gullying near the Little Thunder chairlift; and bank erosion in and impaired riparian condition along Beaver Lake Creek.

Other Upper Yakima River

The Other Upper Yakima River group of drainages exhibits 3 parameters that exceed thresholds of concern (see Table 3.3.2-1):

- Riparian Buffers in a non-natural condition (44.52 percent)
- Stream length with management concerns (32.40 percent)
- Culverted channel length (38.46 percent)

Totaling 156 acres, this drainage is actually a grouping of smaller sliver drainages within the Study Area boundary, but primarily includes the valley bottom containing the mainstem of Coal Creek. Even though there are no projects proposed within these areas, analysis was performed and included in the DPC tables to provide a thorough analysis of the entire Study Area. In the vicinity of The Summit, this drainage receives streamflow from the Creek Run, Hyak, Tunnel, Ski Acres and Beaver Lake drainages. Three of the seven parameters evaluated for this drainage exceed a threshold of concern, with the greatest effects resulting in the reduction of riparian functions. About 39 percent of the channel network has been placed in extended culverts, about one-third of the streambanks in the channel network are developed or under modified vegetation, and about 41 percent of the Riparian Buffer area has also been modified or developed (see Table 3.3.2-1). As described for Section 3.2.2.2 - Other Upper Yakima River, Interstate 90 is recognized as having a strong detrimental influence on Coal Creek, particularly in the yield of traction sand to the stream.

3.3.2.3 South Fork Snoqualmie River Watershed

Northside

Only about 49 acres of the Study Area are situated within the Northside drainage. Two of the seven parameters evaluated for this drainage exceed thresholds of concern. The high value for road density reflects the approximately one-third-mile road segment located on a small area (see Table 3.3.2-2). About 6 of the 7 acres of Riparian Buffers along small wetlands and 0.16 mile of stream are either developed or under modified vegetation (see Table 3.3.2-2). No site-specific problems have been identified in the Northside drainage, however.

Table 3.3.2-2:
DPC Analysis of Watershed Conditions for Existing Conditions in the South Fork Snoqualmie Watershed Portion of The Summit-at-Snoqualmie Study Area[a]

Parameter	Threshold	South Fork Snoqualmie Watershed					
		North side	Summit North	Inter-national	Upper Alpental	Nacri-nomical	Other
Riparian Buffers not in a Non-Natural Condition (% of total)	30	81.47	83.90	41.12	27.22	38.97	11.32
Stream Length w/ Management Concerns (% of total)	10	0.00	49.76	2.44	3.89	21.40	3.98
Road Density (miles/square mile)	3	4.88	7.02	0.50	0.68	1.70	2.34
Road Crossing Density (number/square mile)	6	0.00	26.62	4.76	7.16	12.05	11.93
Impervious Cover (% of total)	8	1.65	14.26	0.21	0.23	1.93	2.68
Modified Channel Length (% of total)	8	0.00	88.43	1.96	0.00	25.17	5.49
Culverted Channel Length (% of total)	8	0.00	11.57	0.00	0.00	3.84	0.36
Parameters over threshold		**2**	**7**	**1**	**1**	**4**	**1**

[a] The value stated for each drainage is in terms of the metric used to compare to the threshold. A complete breakdown of the DPC analysis can be found in Appendix I – Physical and Biological Resource Data Tables and includes the area of impact and analysis area for each DPC parameter.

Summit North

Only about 72 acres of the Study Area are situated within the Summit North drainage, but all seven of the parameters evaluated for this drainage exceed thresholds of concern. This is far more than any other drainage in the S.F. Snoqualmie Watershed—Summit North is one of only 2 of the 15 drainages studied for which all DPC thresholds are exceeded. Road density in the drainage is more than 7 miles per square mile, the most dense road network in the S.F. Snoqualmie Watershed. Summit North is one of only two drainages in the Study Area to exceed the impervious area threshold of concern, and it exceeds the other (Ski Acres) by 75 percent (see Table 3.3.2-1). Parking Lot 1 at Summit West is located in this relatively small drainage and contributes to this threshold exceedence. One stream discharges from the drainage, passing under the Summit West base area in a series of ditches and culverts before it flows into an unnamed tributary to the S.F. Snoqualmie River. In fact, the entire channel network has been either culverted or straightened (modified), and exhibits continuous bank cutting and scour and deposition on much of the streambed. Although the Summit North drainage has obvious drainage scale concerns, no site-specific problems have been identified for particular evaluation in this EIS.

Upper Alpental

A total of 89 acres of the Study Area are situated within the upper Alpental drainage. One of the thresholds for the seven parameters are exceeded in this drainage (see Table 3.3.2-2). No specific existing problems have been identified in the upper Alpental drainage during this assessment.

International Creek

A total of 270 acres of the Study Area are situated within the International Creek drainage. Despite the creation and maintenance of several ski trails and other facilities, only the threshold for percent of Riparian Buffer area modified or developed is exceeded (41 percent; see Table 3.3.2-2). One site-specific problem area identified in managed ski areas in the drainage is a small debris flow and subsequent chronic erosion that yields sediment to a tributary of International Creek, and eventually the S.F. Snoqualmie River.

Nacrinomical

A total of 319 acres of the Study Area are situated within the Nacrinomical drainage. Four thresholds of the seven parameters in the Nacrinomical drainage evaluated in Table 3.3.2-2 are exceeded. Riparian functions are primarily affected, as indicated by 22 percent of the stream network under modified vegetation or in developed areas. In addition, several small wetlands and streams in ski trails and just upslope of the base area are reflective of 39 percent of modified area in Riparian Buffers. About one-fourth of the entire stream network is in a modified channel type. As described in Section 3.2.2.3 - Nacrinomical, just over one-third of the total sediment volume discharged to the S.F. Snoqualmie River from drainages under ski area management comes from this drainage (see related discussion in Section 3.2.1.3 - Soils). One primary source within the managed ski area is yield of winter traction sand from the Alpental road and parking areas to the S.F. Snoqualmie River. A large portion of this fine sediment is apparently transported through the S.F. Snoqualmie Watershed as sediments composing the river bed do not show an excess of deposited fine sediment (see Section 3.4 - Fisheries).

Other South Fork Snoqualmie River

A total of 215 acres of the Study Area are situated within the Other S.F. Snoqualmie drainage. This is actually a grouping of smaller sliver drainages near the Study Area boundary, but primarily includes the valley bottom containing the mainstem of the S.F. Snoqualmie River. One of the seven thresholds for the parameters evaluated in Table 3.2.2-2 is exceeded. Road crossing density indicates some elevated risk of sediment yield to streams. As described for Nacrinomical drainage above, no detrimental effects of increased sediment loads have been observed in the vicinity of the Alpental base area. Further downstream, the yield of traction sand from Interstate 90 to the S.F. Snoqualmie River is understood to have a detrimental effect.

3.4 FISHERIES

This section describes the fish populations supported and fish habitat present within the Study Area that are potentially affected by alterations in The Summit-at-Snoqualmie ski area landscapes, resulting from the proposed MDP. The MDP affects areas within both the Puget Sound and Columbia River basins. Fish use and habitat quality data are presented for the S.F. Snoqualmie Watershed, which drains to Puget Sound; and Coal Creek and Mill Creek, two streams in the U. Yakima Watershed that drain to the Columbia River (see Section 3.3 – Water and Watershed Resources). This assessment addresses all surface waters within the Study Area. It also considers conditions downstream to Franklin Falls (River Mile 27) along the S.F. Snoqualmie River and to the confluence of Coal Creek with Keechelus Lake.

The *Upper South Fork Snoqualmie and Coal Creek Watershed Condition Assessment* (Jones & Stokes 2001) presents detailed fish habitat information and stream reach definitions for the S.F. Snoqualmie River and for Coal Creek. An addendum to the report also describes conditions in Mill Creek (Jones & Stokes and SE GROUP 2003). The report defines stream reaches based on changes in stream gradient and morphology. Other data sources include the South Fork Snoqualmie Watershed Analysis (USFS 1995a) the U. Yakima Watershed Assessment (USFS 1997), and the U. Yakima Watershed Steelhead, Bull Trout, Westslope cutthroat Trout Watershed Biological Assessment (MacDonald and Mayo 1999). Other documents regarding fish species presence and threatened and endangered species are referenced throughout the text.

3.4.1 Summary of Existing Conditions

3.4.1.1 Introduction

The Study Area is located at the headwaters of the S.F. Snoqualmie Watershed and U. Yakima Watershed (see Figure 3.0-1, Study Area). The extent of fish distribution and habitat is limited by the steep headwater conditions within the Study Area. Natural and human-made barriers to fish passage in both watersheds prevent access by anadromous and adfluvial fish species. Resident fish are primarily the descendants of fish stocked in the streams and lakes in and upstream of the Study Area. Fish habitat and barriers to passage are shown in Figures 3.4.1-1, Existing Fisheries Conditions - The Summit, and 3.4.1-2, Existing Fisheries Conditions - Alpental.

As described in Section 3.2 – Geology and Soils, the Study Area can be divided into separate watersheds, sub-watersheds, and drainages. Watersheds, subwatersheds, and drainages are also referred to as 5th, 6th, and 7th-field watersheds, respectively.

The S.F. Snoqualmie Watershed and U. Yakima Watershed each include NFSL and privately owned lands. Land use restrictions and resultant vegetative conditions vary with land ownership. Vegetative conditions in turn affect habitat conditions for fish and other aquatic species. NFSL have more restrictive management of Riparian Buffers as compared to private lands under the Standards and Guidelines of the

MBSNF and *OWNF Forest Plans, as Amended* (USDA 1990a, 1990b). Generally, riparian forest cover is more extensive on public land in the Study Area. Overall, the narrow Riparian Buffers generally required on private land has resulted in reduced shade and reduced LWD recruitment in Riparian Buffers.

Private lands include those owned by Ski Lifts, Inc., The Mountaineers, Plum Creek Timber Co., and owners of smaller parcels. The Snoqualmie Ranger District of the MBSNF administers all NFSL within the Study Area.

The NFSL within the Study Area are subject to the Standards and Guidelines of the *MBSNF Forest Plan, as Amended* and the *WNF Forest Plan, as Amended* (USDA 1990a, 1990b). Those regulations that pertain to fish and fish habitat include the ACS, Section 7 of the federal Endangered Species Act, as well an agreement between the USFS and the WDFW regarding culvert replacement projects (USFS and WDFW 2005). Under this agreement, the USFS commits to using guidelines for culverts that are consistent with standards for fish passage and conveyance of flows and debris (i.e., 100-year flow and associated debris) that would otherwise be required by WDFW under an individual Hydraulic Project Approval. While the same requirements apply on NFSL and privately owned land, in-stream projects that are located on private land require individual Hydraulic Project Approval permits, while those on NFSL are covered under the existing agreement.

Project elements that include instream work or alteration of stream bed, banks, or flow; or filling or dredging of wetlands, require the submission of a Joint Aquatic Resources Permit Application to local, state, and federal agencies as an application for the relevant aquatic resource permits. Agencies that regulate aquatic resources include county government (shoreline permits), WDFW (Hydraulic Project Approval), WSDOE (water quality certification), and US Army Corps of Engineers (Section 404 Clean Water Act, and Section 10 Rivers and Harbors Act permits).

Any construction activity with ground disturbance of 1 acre or larger that would have a stormwater discharge to a water of the U.S. is subject to National Pollutant Discharge and Elimination System (NPDES) regulations. The DOE administers NPDES and requires compliance with water quality standards (WAC 173-201a). Where the project requires dredging or filling of wetlands or other surface waters, certification of compliance with the Clean Water Act (Section 404 Permit and Section 401 Certification) is required. Compliance with water quality and NPDES regulations ensures that long-term impacts to fish habitat are minimized through the maintenance of water quality standards.

Riparian Buffers specified for streams and wetlands limit the proximity of clearing and grading to these features. Buffer widths vary according to stream type and land ownership. The MBSNF and OWNF Plans, as amended (USDA 1990a, 1990b) specify Riparian Buffers (i.e., Riparian Reserves) two times the site potential tree height for fish-bearing streams. This Riparian Reserve width is designated as 300 feet within the Study Area. Clearing and grading within Riparian Reserves is not precluded, but must be consistent with Standards and Guidelines for Riparian Reserves as described in the *Northwest Forest Plan*

ROD (USDA and USDI 1994). Private lands in the S.F. Snoqualmie Watershed are subject to King County Riparian Buffer requirements, while private lands in the U. Yakima Watershed are subject to those of Kittitas County (see Table 3.2.7-2).

3.4.1.2 Fish Species Present

Fish presence data are based on visual surveys from streambanks and daytime snorkel and electrofishing surveys (Jones & Stokes 2001, 2003), and a nighttime snorkel survey for bull trout of lower Coal Creek (Jones & Stokes 2002). Snorkel surveys used the methods of Thurow (1994). Night snorkel surveys are the preferred method for detecting bull trout presence, as this species often hides under banks and in substrate during the day. Night snorkel surveys included a total of 18, 50-meter survey segments upstream of the confluence of Coal Creek and Gold Creek surveyed in late September and early October when adult bull trout would be expected to have entered streams used as spawning habitat. Using the methods of Petersen et al. (2002), the probability of detecting bull trout, if present, would be about 0.78 for the number of segments surveyed (Jones & Stokes 2002). The night snorkel surveys diverged from the methods of Peterson et al. (2002) in two ways; block nets were not used, and sample segments included virtually the entire stream (rather than isolated, randomly selected segments). The use of block nets may have resulted in additional sightings. However, sampling the majority of the stream increased the probability of observations from sampling only in randomly selected segments. Table 3.4.1 – 1 lists the methods and dates of fish surveys.

Table 3.4.1-1:
Fish Presence Survey Methods and Dates

Streams	Survey Method	Dates	Fish Observed	Number of Samples
Upper Yakima Watershed				
Coal Creek (between upstream most and downstream most culverts), Hyak Creek (Coal Creek to Hyak Falls), Beaver Lake Creek (I-90 on ramp to culvert at maintenance shop).	Streamside observations during stream habitat surveys.	October 1994	Yes	Single pass
Coal Creek (Lake Keechelus to I-90 crossing upstream-most crossing)	Daytime snorkel and electro-fishing survey.	October 1994	Yes	Single pass
Coal Creek (Lake Keechelus to 100 meters upstream of I-90 bridge at Summit East).	Nighttime snorkel survey	September, October 2001	Yes	Single pass
All perennial stream channels >2 feet wide within Study Area.	Streamside observations during channel stability surveys.	August 1994 – October 1994	Coal, Lower Hyak, and Lower Beaver Lake Creek only.	Single pass
Portions of Hyak Creek, Pulse Creek, Stream A, Stream B, and Beaver Lake Creek (I-90 on ramp to maintenance shop)	Streamside observations during amphibian surveys	Summers 1997-1999	Lower Beaver Lake Creek only	Three passes
Mill Creek (Keechelus Lake to Forest Rd 9070)	Streamside observations during stream habitat reconnaissance.	September, 2003	Yes	Single pass
South Fork Snoqualmie Watershed				
South Fork Snoqualmie River (Road crossing at Alpental Lot 1 to water tank upstream of Alpental)	Streamside observations during habitat surveys.	August 1994 – October 1994	Yes – below falls downstream of Alpental bridge	Single pass
South Fork Snoqualmie River (Road crossing at Alpental Lot 1 to water tank upstream of Alpental)	Daytime snorkel and electro-fishing survey.	October 1994	Yes – below falls downstream of Alpental bridge	Single pass
All perennial stream channels >2 feet wide within Study Area.	Streamside observations during channel stability surveys.	August 1994 – October 1994	No	Single pass

Based on the surveys described in Table 3.4.1-1 two fish species have been documented within the Study Area, cutthroat trout (*Oncorhynchus clarki*) and shorthead sculpin (*Cottus confusus*), neither of which are listed as threatened, endangered or sensitive species. Typically, fish distribution is limited to the perennial valley bottom streams, with occasional use of mountainslope channels where access is available. In the

vicinity of the Study Area, the most commonly found species is cutthroat trout, with resident populations of the coastal cutthroat trout (*O. clarki*) in the S.F. Snoqualmie Watershed and resident populations of presumed westslope cutthroat trout (*O. clarki lewisi*) in the U. Yakima Watershed. Based on their appearance and distribution, it is presumed that the cutthroat trout in the Yakima basin are westslope cutthroat trout. However, genetic analysis would have to be conducted to determine for certain if the cutthroat trout are of this sub-species. Additional species are present downstream of the Study Area. Stream locations, fish presence, and key fish barriers within the Study Area are shown in Figure 3.4.1-1, Existing Fisheries Conditions – The Summit, and Figure 3.4.1-2, Existing Fisheries Conditions - Alpental. A summary of stream length with fish presence (known, presumed, or non-existent) in each watershed is shown in Table 3.4.1-2.

Table 3.4.1-2:
Summary of Stream Length with Fish Presence by Watershed

Drainage	Adfluvial Accessible and Resident Fish Bearing	Resident Only	No Fish Habitat	Presumed Fish Bearing	Presumed Fish Bearing Above Human-Made Barriers	Presumed Fish Bearing Above Natural Barriers
Upper Yakima Watershed[a] (miles)	0.28	2.92	19.66	2.39	1.14	1.15
South Fork Snoqualmie Watershed[a] (miles)	0.00	2.23	14.56	1.60	0.00	1.60

[a] Includes jurisdictional and non-jurisdictional streams inside and outside the Study Area

Upper Yakima Watershed

Electroshocking and snorkel surveys indicated that cutthroat trout and shorthead sculpin occur in Coal Creek, downstream of The Summit ski areas. Cutthroat trout were also present in the lower reaches of Hyak Creek and Beaver Lake Creek within the Study Area (see Figures 3.4.1-1, Existing Fisheries Conditions – The Summit, and 3.4.1-2, Existing Fisheries Conditions – Alpental). No other fish species were found in surveys of Coal Creek above the downstream-most I-90 culvert or in Coal Creek tributaries. Downstream of I-90, cutthroat trout, eastern brook trout (*Salvelinus fontinalis*), mountain whitefish *(Prosopium williamsoni*), redside shiner (*Richardsonius balteatus*), burbot (*Lota lota*), shorthead sculpins (*Cottus confusus*), unidentified sculpins, kokanee trout (*Oncorhynchus nerka*), and Pacific giant salamanders (*Dicamptodon tenebrosus*) were observed (Jones & Stokes 2001, 2002).

Cutthroat trout are found in all fish-bearing streams in the U. Yakima Watershed; rainbow trout are also reported to be found throughout the watershed (USFS 1997). Rainbow trout have been planted in Divide Lake, Hyak Lake, and the three Kendall Peak Lakes. However, no rainbow trout have been reported specifically in Coal Creek or it's tributary streams.

Within the Study Area, vertical falls prevent upstream fish passage to most of Hyak Creek and to all of Tunnel Creek, which is a Hyak Creek tributary with extensive culverted sections. Impassable culverts are present in Beaver Lake Creek, Mill Creek, Pulse Creek, and Coal Creek. However, upstream reaches provide little viable habitat above impassable culverts on Beaver Lake Creek or Pulse Creek due to previous management activities. Mill Creek and Coal Creek have resident fish upstream and downstream of the impassable culverts. There are no plans to replace these culverts. No fish have been observed in Hyak Creek upstream of Hyak Falls, located about 200 feet upstream of the confluence with Coal Creek, during channel stability and amphibian surveys of Hyak Creek. Likewise, no fish have been observed in Tunnel Creek during amphibian and channel stability surveys of that stream.

A population of bull trout is present in Keechelus Lake, and low numbers are known to spawn in nearby Gold Creek (USFS and WDFW 1997). However, no bull trout or native char have been observed in Coal Creek during day or night snorkel.

Fish presence data for Mill Creek are based on visual surveys from streambanks by Jones & Stokes and SE GROUP (2003) and Cupp (1997). No snorkel survey or electrofishing data are available for Mill Creek. Cutthroat trout (presumably westslope) have been observed in Mill Creek from it's confluence with Keechelus Lake up to a natural waterfall upstream of the proposed Mill Creek chairlift, and are presumed to be present to at least 1,000 feet upstream of the Forest Rd. 9070 road crossing. No future survey work to document fish presence in Mill Creek is planned at this time.

South Fork Snoqualmie Watershed

Within the Study Area, a snorkel and electroshocking survey of the S.F. Snoqualmie River adjacent to the Alpental ski area found only cutthroat trout (*O. clarki*). Downstream of the Study Area, fish in the S.F. Snoqualmie Watershed include cutthroat trout, rainbow trout (*Oncorhynchus mykiss*), eastern brook trout (*Salmo fontinalis*), shorthead sculpin (*Cottus confusus*), longnose dace (*Rhinichthys cataractae*), mountain whitefish (*Prosopium williamsoni*), and largescale sucker (*Catastomus macrocheilus*) (USFS 1995a).

Barriers to fish passage downstream of (USFS 1995a) and within The Summit-at-Snoqualmie Study Area isolate resident trout populations within a relatively small section of the river. Source Lake, at the headwaters of the S.F. Snoqualmie River, has been stocked with cutthroat trout (Jones & Stokes 2002, Swayne 1997 pers. comm.). Although the upper reach of the river has some potential fish habitat, no fish were found upstream of the falls below the bridge to Alpental (see Figure 3.4.1-2, Existing Fisheries Conditions – Alpental). No significant habitat is provided within any tributaries of the S.F. Snoqualmie River (Jones & Stokes 2001). These small, high gradient streams are typically a series of boulder and bedrock dominated cascades.

No threatened, endangered or sensitive fish species are found in the S.F. Snoqualmie Watershed. Surveys in the Snoqualmie River watershed upstream of Snoqualmie Falls have failed to find bull trout upstream

of the falls (Berge and Mavros 2001). WDFW biologists working in the watershed have never encountered native char (bull trout or Dolly Varden) upstream of Snoqualmie Falls, despite handling of thousands of trout during various studies over many years. As a result, WDFW and the USFS do not consider native char to be present upstream of Snoqualmie Falls (Kraemer 1996, Gall 2003 pers. comm.).

3.4.1.3 Fish Habitat

Fish habitat within the Study Area is limited by natural and human-made barriers, high gradient, and naturally low productivity of headwater stream conditions. The quantity of aquatic habitat distributed by flow regime and fish presence is shown in Table 3.4.1-3. The length of stream channels in each of the morphologically distinct channel types found in the Study Area may be found in the Water Resources section (see Table 3.3.1-1).

Table 3.4.1-3:
Aquatic Habitat within The Summit-at-Snoqualmie Study Area

Attribute	Upper Yakima Watershed	South Fork Snoqualmie Watershed	Total
Study Area (acres)	1,885.21	1,014.15	2,899.36
Total stream length (miles)[a]	25.24	18.39	43.64
Lakes and Ponds (acres)	1.34	0.00	1.34
Riparian Buffers (acres)[b]	523.49	277.36	800.85
Stream Length by Flow Regime[a]			
Perennial streams (miles)	11.82	4.83	16.65
Intermittent streams (miles)	13.34	13.57	26.91
Ephemeral streams (miles)	0.08	0.00	0.08
Stream Length by Fish Presence [a]			
None (miles)	19.66	14.56	34.22
Adfluvial and Resident (miles)	0.28	0.00	0.28
Resident Only (miles)	2.92	2.23	5.14
Presumed present (miles)	2.39	1.60	3.99

[a] Includes conditions outside, but influencing conditions within the Study Area
[b] Includes Riparian Buffers within the Study Area
Note: This table includes the Mill Creek portion of the Study Area within the U. Yakima Watershed.

Fish habitat is characterized as both the physical and chemical environments inhabited by fish. Physical requirements may include riffle areas for spawning, pools and woody debris for cover and holding areas, and an adequate temperature regime. Chemical requirements include water free from detrimental concentrations of toxic or otherwise harmful substances, sufficient dissolved oxygen, and a moderate pH range.

LWD plays a very important role in defining the quantity and quality of fish habitat in a stream. Large woody debris can be an important factor in creating dammed pools, plunge pools, and scour pools. Additionally, LWD adds complexity and cover to pool habitat, contributes to sediment retention, and promotes bank stability. Any tree growing within its own height of the stream channel can potentially contribute LWD to the stream. Riparian clearing prevents or delays LWD recruitment to the stream. Where LWD is limited, streams typically have a lower frequency of pools, and the pools that are present are often shallow and may be lacking in adequate cover.

Food web interactions are those links between predatory organisms such as trout and the prey organisms that support their nutritional needs. While these interactions are not defined as habitat, they are linked to it as predator and prey species are affected by alterations in the physical and chemical attributes of habitat. Habitat variables are affected not only by in-water activities, but also by changes in the condition of the surrounding riparian zone. Additionally, changes in the physical, chemical or biological components at the watershed scale may also affect the aquatic ecosystem. Invertebrate prey species may be predators themselves, or they may consume plant material that originates in or outside of the stream. Changes in sunlight or organic material entering a stream can alter the composition of the aquatic invertebrate community that forms the food base for resident and adfluvial fish populations.

Roads, timber harvest, and ski area development have altered conditions of the streams within the Study Area. Road sand is present in streams and on the banks of streams adjacent to I-90, SR 906, and the Alpental and Silver Fir parking areas. A discussion of the relative contributions of sediment from unpaved roads, hill-slope erosion, and traction sand to the sediment load of Study Area streams is presented in Sections 3.2 – Geology and Soils, and 3.3 – Watershed Resources. Due to the location of fish bearing segments in valley bottoms, they receive sediment from all of these sources. Interstate-90 is the dominant source of sediment yield to Coal Creek and the S.F. Snoqualmie River (see Table 3.2.1-4 and Figure 3.2.1-2, Soil Erosion Potential - Alpental). Other management related sediment sources include ski trails, roads, bare soil areas, and developed areas.

Riparian Buffers include naturally forested and naturally non-forested areas, as well as areas of cleared vegetation, buildings, roads, parking areas, and ski trails. Development in the functional riparian zone interferes with the natural function of riparian zones, introducing pollutants into the streams, removing or reducing natural pollutant filtering capabilities, reducing stream bank stability, and reducing LWD recruitment potential. Some stream segments located in ski trails have been covered by railroad ties or placed in culverts, preventing these segments from providing functional aquatic habitat.

The existing watershed condition as it relates to fish and aquatic habitat is affected by land use including ski area features, roads, and natural areas. The existing conditions of those quantifiable watershed conditions that will be evaluated in Chapter 4 are described here in Table 3.4.1-4.

Table 3.4.1-4:
Existing Conditions of Parameters to Be Used in Evaluation of Impacts to Fish and Fish Habitat Within The Summit-at-Snoqualmie Study Area

Parameter (units)	Upper Yakima Watershed	South Fork Snoqualmie Watershed	Total
Study Area			
Acres	1,885.21	1,014.15	**2,899.36**
Square Miles	2.95	1.58	**4.53**
Culverted Stream Length (miles)[a]	1.84	0.22	**2.07**
Road Length within the Study Area (miles)[b]			
Native (miles)	17.81	2.70	**20.51**
Paved (miles)	1.12	0.41	**1.53**
Total Roads (miles)	18.93	3.11	**22.04**
Total Road Density (miles/square mile)	6.43	1.96	**4.87**
Road Length within Riparian Buffers (miles)[b]			
Native (miles)	4.79	1.55	**6.34**
Paved (miles)	0.41	0.32	**0.73**
Total Road Density (miles/square mile)	6.36	4.31	**5.65**
Number of Fish Bearing Stream Crossings[a]			
Culvert	7	6	**13**
Bridge	4	3	**7**
Ford	0	0	**0**
Number of Presumed Fish Bearing Stream Crossings[a]			
Culvert	10	1	**11**
Bridge	0	0	**0**
Ford	0	0	**0**
Number of Non Fish Bearing Stream Crossings[a]			
Culvert	81	17	**98**
Bridge	0	0	**0**
Ford	12	2	**14**
Land Cover Types within Riparian Buffers (acres)[b]			
Forested – Mature (acres)	211.29	108.28	**319.57**
Forested – Immature (acres)	37.00	6.24	**43.24**
Forested – Sapling (acres)	73.05	0.00	**73.05**
Naturally Non-forested (acres)	19.73	52.02	**71.75**
Modified (acres)	165.22	97.64	**262.86**
Developed (acres)	17.20	13.18	**30.38**
Total Riparian Buffer (acres)	**523.49**	**277.36**	**800.85**
Total Riparian Buffer (square miles)	**0.82**	**0.43**	**1.25**

Table 3.4.1-4:
Existing Conditions of Parameters to Be Used in Evaluation of Impacts to Fish and Fish Habitat Within The Summit-at-Snoqualmie Study Area

Parameter (units)	Upper Yakima Watershed	South Fork Snoqualmie Watershed	Total
Large woody debris recruitment potential by channel type (miles)[b, c]			
MS1 Channels (miles)			
Adequate LWD Recruitment	3.17	0.83	**3.99**
Inadequate LWD Recruitment	1.58	1.01	**2.60**
MS2 and MS3 Channels (miles)			
Adequate LWD Recruitment	4.08	1.72	**5.80**
Inadequate LWD Recruitment	5.13	3.42	**8.55**
VB1 Channels (miles)			
Adequate LWD Recruitment	0.97	1.12	**2.09**
Inadequate LWD Recruitment	1.30	0.15	**1.45**
VB2 Channels (miles)			
Adequate LWD Recruitment	0.09	0.04	**0.14**
Inadequate LWD Recruitment	0.15	0.04	**0.20**

[a] Includes jurisdictional and non-jurisdictional streams inside and outside of the Study Area (Study Area and channels downstream to Keechelus Lake in U. Yakima Watershed and to Franklin Falls in S.F. Snoqualmie Watershed). Does not include temporary crossings.
[b] Includes jurisdictional streams and conditions within the Study Area only.
[c] Adequate LWD recruitment potential includes all forested land cover types except for sapling forests. Inadequate includes all other landcover types.
Note: This table includes the Mill Creek portion of the Study Area within the U. Yakima Watershed.

Upper Yakima Watershed

Fish habitat data for the U. Yakima Watershed portion of the Study Area is summarized in the *Upper Snoqualmie and Coal Creek Watershed Condition Assessment* (Jones & Stokes 2001) and its addendum (Jones & Stokes and SE GROUP 2003). Viable fish habitat is limited to Mill Creek, Coal Creek, and lower segments of Hyak and Beaver Lake Creeks.

The Study Area is at the upstream limit of naturally occurring fish populations where fish use is naturally limited to the few lower gradient segments. The U. Yakima Watershed contains less than 2 miles of fish-bearing streams on public land in the Study Area. Construction of the Keechelus Dam, in 1913 isolated all Keechelus Lake tributaries, including Coal Creek and Mill Creek, from anadromous and Yakima River adfluvial fish populations. Adfluvial populations from Keechelus Lake have access to a portion of Coal Creek downstream of the Study Area, but are blocked from accessing the Study Area by an impassable culvert under I-90.

In the U. Yakima Watershed there are several long stream segments that are either in culverts or covered, removing these segments from the extent of viable aquatic habitat. However, these streams are typically too small or steep to provide fish habitat, so the effect can be beneficial to maintaining habitat downstream of the culvert (e.g., thermal shading, isolation from sediment generating uses). No in-stream

construction has been performed in fish bearing stream segments on public land in the Study Area in recent years.

Coal Creek is located adjacent and parallel to I-90. It is heavily affected by traction sand deposition from I-90 and limited riparian vegetation. Construction of the highway altered the location of this stream, as well as its former riparian zone. In the past, WSDOT used a 5:1 ratio of sand and salt for improving traction on I-90 during winter conditions. However, WSDOT used a 1:1 ratio of sand and chemical de-icer/ice-inhibitors during the winter of 2004-2005, and plans to use chemical de-icer/ice-inhibitors only in the future (Cernick 2005 pers. comm.), although elimination of road sanding for traction has not been specifically scheduled or verified for the winter of 2005-06. As a result, this analysis assumes that road sanding will continue in the future. The absence of riparian vegetation has resulted in a lack of LWD and shade in Coal Creek between the ski area and I-90. A culvert under I-90 near the Hyak exit isolates Coal Creek and its tributaries from the lower portion of Coal Creek and Keechelus Lake. This culvert acts as a complete barrier to resident fish and a partial barrier to adfluvial fish at low flows. Large woody debris is limited and complex habitat associated with debris jams is absent. The ratio of pool to riffle habitat is low and the number of high quality of pools in Coal Creek and the accessible portions of Hyak and Beaver Lake creeks is low. Suitable spawning gravel conditions are poor in streams with a high proportion of fine sediment.

Thomas (2001) and Craig (1997) independently recorded seven-day average daily temperatures well above 53.6 degrees Fahrenheit (12 degrees Celsius) and seven-day average temperature maximums of greater than 59 degrees Fahrenheit (15 degrees Celsius) in Coal Creek during 1996 and 2000 respectively. Likewise, temperature monitoring data collected for the I-90 Snoqualmie Pass East improvements project showed that the temperature of Coal Creek frequently exceeds the Washington State temperature standard for temperature of 60.8 degrees Fahrenheit (16 degrees Celsius) for Class AA waters with a maximum recorded temperature of 68.2 degrees Fahrenheit (20.1 degrees Celsius) during the period of March to October, 2001 (Tetra Tech 2002). These temperature maxima are well above the appropriate range for bull trout (USFWS 1998) and above the optimal range for cutthroat and rainbow trout.

Operation of the ski area has resulted in maintenance of a modified vegetative condition in the Study Area, including riparian zones. The modified vegetative condition effects fish habitat by altering the hydrologic response, LWD recruitment, and shade conditions in stream channels. Shade is important in maintaining cool stream temperatures that are required for native trout species to survive and thrive. In the U. Yakima Watershed, a 39 percent of the Riparian Buffer is maintained in a non-forested condition (see Table 3.4.1-2). However, the immediate stream edge is forested along most stream segments.

Water temperatures in Coal Creek can be high during summer; however, this is not necessarily due to ski area operation. Spot measurements of water temperature taken during summer low flow conditions indicate good conditions in Hyak Creek and Beaver Lake Creek (for more details on water quality see Section 3.3 – Water Resources). High temperatures in the mainstem of Coal Creek are likely due to

several factors. Kendal Peaks Lake at the headwaters of this stream warms after snow has melted off in the spring. Timber harvest, exacerbated by a southwestern facing aspect, has likely resulted in reduced shade along Coal Creek between Kendal Peaks Lake and I-90. Shade is also reduced along Coal Creek parallel to Yellowstone Road and I-90. Thus, warm temperatures in Coal Creek are a result of numerous natural and man-induced factors.

Water quality data has been collected *in situ* in Coal Creek at one reference station since 2002. As a result, paired observations are not available. However, no violations of turbidity State Water Quality Standards were observed during four rain-on-snow, four base flow, and one spring melt events, where the maximum observation was 6.7 NTUs during a rain-on-snow event, and no other samples exceeded 5 NTUs (SE GROUP unpublished data). Beaver Creek, a tributary to Coal Creek at Summit West, violated turbidity standards in 2 of 18 paired samples, and likely would have violated standards on 2 of 11 other occasions when upstream background samples were not available. Rain-on-snow events are responsible for most of the observed turbidity increases (including those that do not result in violations), but the highest turbidities measured were in Beaver Lake Creek during one base flow event and one rain-on-bare-soil event, when soil was not protected by snow cover. These turbidity increases were measured during construction monitoring, specified in the SWPPP for the Summit West Rental Building. As specified in the SWPPP, remedial actions were taken immediately, including a stoppage of construction, until the source of increased turbidity was rectified.

The density of roads within the U. Yakima Watershed portion of the Study Area is relatively high at 6.43 miles/square mile, with 6.36 miles/square mile road density in Riparian Buffers (see Table 3.4.1-4). By comparison, National Oceanic and Atmospheric Administration-Fisheries (NOAA-Fisheries [formerly the National Marine Fisheries Service] 1996) considers a 5th-field watershed (e.g., entire U. Yakima Watershed) to be “not properly functioning” with a road density of greater than 3 miles/square mile, and the USFWS (USFWS 1998) considers a watershed to be “functioning at unacceptable risk” with a road density greater than 2.4 miles/square mile. For purposes of this analysis, standards established at the 5th Field watershed scale were applied to the Study Area. Therefore, since the Study Area road density exceeds the value identified by NOAA-Fisheries as a properly functioning watershed, and considering the ski area roads are primarily access roads with native surface soil material, these roads are thought to be significant sediment sources within the watershed. Although traffic is low, the surface area of the native soil material is generally unprotected from surface erosion.

Previous in-stream construction in the Study Area has included culvert installations in non-fish-bearing and fish-bearing streams, as well as culverting some headwater streams that run through ski trails. One tributary to Hyak Creek, Tunnel Creek, was placed in a culvert in the mid 1990s to address a severe erosion and downcutting situation. Since this stream segment was too small and steep to provide fish habitat, the effect of this construction has been generally beneficial, reducing sediment transport to lower Hyak Creek and Coal Creek. One possible adverse affect is that placing the stream in a culvert may have

altered the hydrologic response, increasing peak flows and reducing base flows downstream from the culvert.

The culverts in the MDP area are mostly on non-fish-bearing stream segments. One exception is the culvert where an access road crosses Mill Creek approximately 500 feet upstream of the mouth. This culvert is well designed and placed, is not a barrier to fish, and appears adequate to pass high flows and associated debris.

Operation of the ski area has resulted in the maintenance of an altered landscape that has an impact on the hydrologic response and water quality of the streams that drain the area. Reduced forest cover results in increased discharge during fall rainstorms and spring snowmelt, compared to a naturally occurring condition. Sediment in stormwater runoff from roads and bare soil in the Study Area contribute to elevated turbidity observed in Coal Creek during rain on bare soil events (see Section 3.3 - Water Resources).

Maintaining cleared ski trails also has increased solar exposure in some stream channels. This effect is moderated by the dense growth of shrubs and small trees such as willows, alders, and huckleberry that are common along most stream channels in the Study Area. However, in addition to its effect on shade, reduced forest area in Riparian Buffers also has reduced the recruitment of LWD to stream channels and may reduce bank stability and filtration of sediment from overland flow during spring snow melt and rain events.

The extent of fish habitat in the U. Yakima Watershed includes approximately 2 miles of habitat in the Study Area, with approximately half of this habitat located in Coal Creek adjacent to I-90. Because of the influence of the highway on Coal Creek habitat (e.g., road sand and hydrocarbon runoff), it is not possible to determine precisely what effect the ski area has had on fish habitat in this stream.

Mill Creek has no exposure to major roadways and fish habitat in this stream is generally less disturbed than in Coal Creek or the fish bearing segments of Hyak Creek and Beaver Lake Creek. However, passage barriers and intermittent flow in the seasonally inundated portion of Keechelus Lake isolate fish in the upper reaches of Mill Creek. The quantity of LWD in Mill Creek is adequate and sediment condition is good. Pool frequency is good, though the number of deep pools is limited. A culvert under the John Wayne Trail blocks upstream fish migration, isolating most of Mill Creek from Keechelus Lake. Two natural falls also block upstream and limit downstream migration within Mill Creek (see Figure 3.4.1-1, Existing Fisheries Conditions – The Summit).

South Fork Snoqualmie Watershed

Fish habitat in the S.F. Snoqualmie Watershed is primarily limited to the mainstem of the S.F. Snoqualmie River. However, fish have been observed in a small tributary in the vicinity of the I-90 off ramp to Summit West as well. Fish habitat in this stream is relatively poor with limited shade, woody debris, and

pool quality. Fish habitat and production in the headwater lakes and streams of the S.F. Snoqualmie Watershed are limited by natural barriers to upstream migration, frequent catastrophic events (fire, floods, debris flows), lack of suitable habitat (spawning sites), and the low productivity of these post-glacial streams. Though fish occur in the mainstem S.F. Snoqualmie River, information on the upstream extent of these fish is limited.

In 1994, habitat of the S.F. Snoqualmie River at Alpental was surveyed using USFS Region 6 Stream Survey methods (USFS 1994) from the bridge at the southern end of the permit area to the mouth of a tributary stream just upstream of the northern permit area boundary (Jones & Stokes 2001). These physical habitat survey methods included measurements and estimates of habitat unit dimensions, substrate, gradient, cover type and quality, and bank condition. Substrates in the S.F. Snoqualmie River reaches are of good quality (i.e., cobbles less than 35 percent embedded with fine sediment and substrate comprised of less than 15 percent fines measured by Wolman [1954] pebble count), the frequency of pools, frequency of deep pools, and available cover in those pools are good, and there is an adequate supply of woody debris (Jones & Stokes 2002). There is very little off-channel habitat in this confined high-gradient stream.

The S.F. Snoqualmie River within the Study Area appears to have good water quality, based on 31 events sampled for temperature and turbidity between 1994 and 2003 (Jones & Stokes 1995a; SE GROUP unpublished data). As described in Section 3.3 – Watershed Resources, the S.F. Snoqualmie River has complied with SWQS for turbidity in approximately 30 paired, *in situ* point observations recorded. As with many other headwater streams, the S.F. Snoqualmie River is clear and appears to be relatively unproductive, limiting the prey base and subsequent growth and reproduction of fish in the river. Cool temperatures, large fluctuations in flow, and low nutrient levels probably contribute to this condition. Little aquatic vegetation, algae, and few aquatic insects and fish were seen during the surveys.

Road crossings and parking areas adjacent to the stream contribute to the fine sediment load, especially from traction sand that enters the stream during snow removal, which is evident along Parking Lots 4, 5, and 6 at Alpental. High velocity flows during spring snowmelt help transport this sediment through the Study Area. Upstream of the Study Area, the S.F. Snoqualmie River is completely forested and appears to contain high quality habitat for resident trout. However, no fish were seen between the upstream most road crossing and the upstream Study Area boundary when this reach was surveyed in 1994 (Jones & Stokes 2001). Fish use of this segment of the stream is presumed, but undocumented.

The heavy snow common in the headwaters of the S.F. Snoqualmie Watershed contributes to a variable flow regime in the S.F. Snoqualmie Watershed characterized by low flow in late summer and mid winter, and very high flow during spring snowmelt.

Operation of the ski area has resulted in the conversion of portions of Riparian Buffers from naturally forested conditions to modified or developed conditions. Maintenance of ski trails for ski area operation has also limited the hydrologic maturity of the Study Area.

The significance of these existing operational impacts to fish is relatively small in the S.F. Snoqualmie River, especially given the naturally limited fish population in the upper reaches of the river.

Historic construction and operation of roads, parking areas, and a foot bridge in the Study Area on the privately owned portion of the S.F. Snoqualmie Watershed probably contributed some sediment to the S.F. Snoqualmie River, given the proximity of these facilities to the Riparian Buffers. Maintenance and snow removal from the roads and parking areas also contribute fine sediment to the S.F. Snoqualmie River. However, road density in this watershed is not high (1.99 miles/square mile of road) and as stated above, water quality monitoring data have not shown turbidity to be a problem during sampling events.

3.4.1.4 Proposed, Endangered, Threatened, and Sensitive Fish Species

There are four species listed as threatened or endangered that have the potential to occur within the Study Area (see Table 3.4-FEIS-1). Two fish species that are present within the S. F. Snoqualmie Watershed, but outside of the Study Area, have been listed as Threatened under the federal endangered species act. These species are limited by a natural barrier, Snoqualmie Falls, and are not further discussed in this section. The westslope cutthroat trout, which is candidate species, is present throughout the U. Yakima Watershed, including Coal Creek and Mill Creek in the Study Area. Westslope cutthroat trout were found to be not warranted for listing under Endangered Species Act as either threatened or endangered by USFWS on August 7, 2003 (FR68 No.152:46989-47009). They are discussed as a USFS Sensitive below. No other fish species in the U. Yakima or S.F. Snoqualmie Watersheds are proposed for listing under the Endangered Species Act at this time.

Table 3.4-FEIS-1:
Threatened and Endangered Species Known or Suspected to Occur within the Study Area

Species	Distribution	Occurrence
Puget Sound Chinook Salmon[a] (*Oncorhynchus tshawytscha*)	South Fork Snoqualmie River	Limit of anadromy in Snoqualmie River is Snoqualmie Falls, Species not present within Study Area.
Bull Trout (*Salvelinus confluentus*)	South Fork Snoqualmie River	Limit of anadromy in Snoqualmie River is Snoqualmie Falls, Species not present within Study Area.
	Upper Yakima River, Keechelus Lake	Known resident population in Keechelus Lake.
Middle Columbia River Steelhead[a] (*Oncorhyncus mykiss*)	Upper Yakima River	Excluded from Study Area by Keechelus Lake dam.
Puget Sound Steelhead[a] (*Oncorhyncus mykiss*)	South Fork Snoqualmie River	Limit of anadromy in Snoqualmie River is Snoqualmie Falls, Species not present within Study Area.

[a] Denotes species is also included as MIS

Bull Trout

USFWS listed the Columbia River distinct population segment of bull trout as threatened on June 10, 1998 (63 FR 31647). All naturally spawning populations of bull trout in the continental United States are included in the listing. Critical habitat for Columbia River bull trout was listed on September 21, 2004 (50 CFR 17:59996-60076). Designated Critical Habitat includes Gold Creek and the Yakima River downstream from Keechelus Lake. Neither Keechelus Lake nor its tributaries are listed as critical habitat.

Nine bull trout stocks occur in the Yakima River basin (WDFW 1998). Two stocks occur downstream of the Study Area: the Yakima River stock and the Keechelus Lake stock. The Keechelus Lake stock is considered a distinct stock due to its geographic isolation. The Yakima River stock is prevented from accessing Keechelus Lake or the Study Area by the Keechelus Dam.

The Keechelus Lake population (stock) of Bull trout is present in Keechelus Lake, and has potential access to the lower 0.5 mile of Coal Creek, and the lower 500 feet or less of Mill Creek. This segment of Mill Creek is intermittent in late summer and fall. These two stream segments are downstream of the Study Area. Gold Creek, located opposite I-90 from the Study Area, is another Keechelus Lake tributary that provides the only known spawning habitat for the Keechelus population.

As described earlier, day (Jones & Stokes 2001) and night time (Jones & Stokes 2002) snorkel surveys have been conducted in Coal Creek within and downstream of the Study Area, without detection of any bull trout or native char.

No snorkel surveys have been completed in Mill Creek. However, this stream is intermittent near its mouth at Keechelus Lake, and natural and human-made passage barriers exist in Mill Creek. Therefore, Mill Creek would be unsuitable for supporting an anadromous population. Habitat for isolated resident fish extends from the mouth upstream to at least 1000 feet upstream of FS Road 9070, although bull trout have never been reported from Mill Creek and are not expected to be present.

Bull trout are present in the Snoqualmie River, but have not been observed upstream of Snoqualmie Falls at Snoqualmie, WA. In addition to Snoqualmie Falls, there are several other impassible natural barriers located at river miles 10, 11, 24, 26, and 27 (Williams et al. 1975). The closest of these is Franklin Falls located approximately 0.5 mile downstream of the Study Area at river mile 27. In other watersheds, bull trout have been observed upstream of complete passage barriers, so their presence in the S.F. Snoqualmie River cannot be completely dismissed (Chan 2003 pers. comm.). However, in a reconnaissance survey, King County conducted bull trout surveys on 90 stream reaches upstream of Snoqualmie Falls with no native char detection, suggesting that they are not present above Snoqualmie Falls (Berge and Mavros 2001). Based on the collective experience of professionals working in the watershed, the probability of bull trout presence above Snoqualmie Falls is so low that biologists of the USFS and WDFW assume that bull trout are not present for the purposes of managing federal lands in this area (Kraemer 1996, Gall

2003 pers. comm.). This conclusion is consistent with single pass daytime snorkel surveys conducted in 1994, which also detected no bull trout in the Study Area (Jones & Stokes 2001).

Middle Columbia Steelhead

The Middle Columbia River steelhead (*Oncorhynchus mykiss*) was listed by NOAA Fisheries as threatened on March 25, 1999 (64 FR 14517). The Middle Columbia River Ecologically Significant Unit includes all naturally spawning populations of steelhead in streams from above the Wind River, Washington and the Hood River, Oregon upstream to and including the Yakima River, Washington. An Ecologically Significant Unit is the designation given to a specific population that is considered a distinct species by NOAA Fisheries for the purposes of administering the Endangered Species Act.

Critical habitat for the Middle Columbia River steelhead was designated on February 16, 2000 (65 FR 7764) and withdrawn on April 30, 2002 by a court ordered consent decree in response to litigation challenging the process by which NOAA Fisheries designated critical habitat (Kollar and Kotelly 2002). Currently, the designation of critical habitat is under development. Formerly designated critical habitat included all river reaches accessible to listed steelhead in the Columbia River tributaries (except the Snake River) between Mosier Creek in Oregon and the Yakima River in Washington. Also included were adjacent riparian zones up through the Yakima River in Washington. Excluded were tribal lands above specific dams or longstanding naturally impassable barriers.

Currently, Middle Columbia steelhead are prevented from accessing Keechelus Lake or the Study Area streams by the Keechelus Dam which is a complete barrier to fish passage. The US Bureau of Reclamation (USBR) has completed a feasibility study evaluating the costs and benefit in terms of miles of potential salmon stream habitat) that would be gained by re-establishing passage to anadromous fish at each of the five Yakima River reservoirs, including Keechelus (USBR 2003). Conceptual design options have been completed. However, at this time the USBR is exploring restoration of passage at Cle Elum and Bumping reservoirs, but not at Keechelus (Hudson 2003 pers. comm.). Although anadromous fish passage could be restored in the future, giving Middle Columbia Steelhead access to lower Coal and Mill Creeks, it does not appear that this would occur within the lifetime of the MDP.

USFS Sensitive Species

The following ten species have been identified as USFS Sensitive by the Regional Forester (USFS 2008a). USFS Indicator Species (MIS) per the forest plans are included in this table as noted. These species are also identified as sensitive and have therefore been combined into a single grouping.

Table 3.4-FEIS2:
USFS Sensitive Species known or suspected to occur within the Study Area

Species	Distribution	Occurrence
Cutthroat trout[b] (*Oncorhynchus clarki*)	South Fork Snoqualmie River	Detected during stream surveys (Jones & Stokes 2001)
Westslope Cutthroat trout[b] (*Oncorhynchus clarki lewsii*)	Upper Yakima River, Coal Creek	Assumed present in Keechelus Lake. Detected during stream surveys of Coal Creek. (Jones & Stokes 2001)
Coho Salmon[b] (*Oncorhynchus kitsuch*)	South Fork Snoqualmie River	Limit of anadromy is Snoqualmie Falls, Species not present within Study Area (Jones & Stokes 2001).
Sockeye Salmon[b] (*Oncorhynchus nerka*)	South Fork Snoqualmie River	Limit of anadromy is Snoqualmie Falls, Species not present within Study Area (Jones & Stokes 2001).
Pink Salmon[a] (*Oncorhynchus gorbuscha*)	South Fork Snoqualmie River	Limit of anadromy is Snoqualmie Falls, Species not present within Study Area (Jones & Stokes 2001).
Puget Sound Chum Salmon[a] (*Oncorhynchus keta*)	South Fork Snoqualmie River	Limit of anadromy is Snoqualmie Falls, Species not present within Study Area (Jones & Stokes 2001).
River Lamprey (*Lampetra ayresi)*	Upper Yakima River, Coal Creek	Not detected during surveys, assumed to not be present within the Study Area (Jones & Stokes 2001).
Redband Trout[b] (*Oncorhynchus mykiss*)	Upper Yakima River, Coal Creek	Not detected during surveys, assumed to not be present within the Study Area (Jones & Stokes 2001).
Pygmy Whitefish (*Prosopium coulteri*)	Upper Yakima River, Coal Creek	Not detected during surveys, assumed present in Keechelus Lake (Jones & Stokes 2001).
Umatilla Dace (*Rhinichthys umatilla*)	Upper Yakima River, Coal Creek	Not detected during surveys, assumed to not be present within the Study Area (Jones & Stokes 2001).

[a] MIS listing only
[b] MIS and Sensitive listing

3.4.2 Drainages of Particular Concern

Study Area results presented in Section 3.4.1 – Summary of Existing Conditions are based on a 6th-field subwatershed scale analysis. At this scale, the size of the ski area suggests that a 6th-field scale is too large of an area to adequately describe existing conditions relative to the four different ski areas (Summit West, Summit Central, Summit East, and Alpental). In addition, in order to adequately evaluate potential impacts from proposed activities described in Chapter 2, it is necessary to display conditions in smaller geographic areas. Therefore, the EIS presents information that describes existing conditions in smaller area, the 7th-field drainages, to provide a better understanding of the differences in physical and

biological features associated with soils, water, and fisheries resources. Describing site conditions at this scale provides a basis to understand how impacts may affect resources, especially in 7th field drainages in which sensitive resources are concentrated in a smaller area.

The Study Area includes portions of 15 smaller, 7th-field drainages that make up the two larger 6th-field subwatersheds. This section describes conditions in the 7th-field drainages for fisheries resources. It is important to understand some of the drainages are in relatively undisturbed conditions, whereas other drainages have more disturbed conditions from historic development relative to the fisheries resources. A description of the existing condition in each drainage is required to understand how an activity proposed in the Action Alternatives may detrimentally affect fish habitat conditions in specific drainages, beneficially impact fish habitat conditions through restoration, or not affect fish habitat conditions if a proposed activity does not occur in a specific drainage.

3.4.2.1 Process for Evaluation of Drainages of Particular Concern

A quantitative and qualitative process was used to describe existing conditions in the 7th field drainages and to identify the condition of drainages along a continuum of relatively undisturbed to degraded conditions. Tables 3.4.2-1 and 3.4.2-2 show the 15 drainages that occur within the U. Yakima Watershed and the S.F. Snoqualmie Watershed and a set of parameters used to measure fish habitat conditions in the drainages. Key parameters were selected to evaluate conditions that influence sediment production, stream temperatures, stream flow, and the amount and quality of fish habitat. These parameters were selected because of their relevance to the ongoing processes within the 7th field drainages in the Study Area, types of land use that occur in the Study Area, and their importance in describing soil, water, and fish resources. Drainages of particular concern (DPC) are those 7th field drainages that exhibit a majority of the key parameters above established thresholds due to degraded watershed conditions. Figures 3.4.1-1, Existing Fisheries Conditions – The Summit and 3.4.1-2, Existing Fisheries Conditions – Alpental display the 15 drainages within the Study Area.

To understand of the current condition of the drainage relative to naturally functioning conditions for each parameter, a threshold value was identified for each parameter. Thresholds were determined from a variety of published sources applicable to the setting found in the Study Area, and from site-specific data gathered in the Study Area. If a threshold is exceeded in a drainage, it indicates that the resource conditions are of low quality due to degraded biological and physical factors for that specific parameter. See the DPC Parameter and Threshold Rationale Matrix in Appendix I - Physical and Biological Resource Data Tables, for a detailed description of how the thresholds were established.

For this specific analysis of fish resources, the most important parameters to consider are:

- Riparian Buffers in a non-natural condition,
- Stream length with management concerns,

- Road density,
- Road crossing density, and
- Modified channel length.

These parameters were selected because they are the ones that most directly affect fish habitat (see rationale in Appendix I - Physical and Biological Resource Data Tables).

3.4.2.2 Upper Yakima Watershed

Lower Mill Creek

The Lower Mill Creek Drainage has three out of five parameters that exceed the thresholds for concern (see Table 3.4.2-1).

- Riparian Buffers in a non-natural condition (83.2 percent)
- Road density (7.42 miles per square mile)
- Road crossings density (27.5 per square mile)

Additionally, areas of high erosion soils and bare soils in the drainage may contribute to an increased risk of sediment impacts in Lower Mill Creek. The high number of parameters that are over threshold are supported by observations of stream channel scour and deposition, and reduced pool quality evidence some sediment impact in this stream.

Lower Mill Creek includes the greatest length of fish habitat of any 7th-field drainage in the Study Area, 1.78 miles. Although natural and human made barriers block passage to this habitat, resident trout are present in the mainstem of Lower Mill Creek throughout the drainage. A culvert at the John Wayne Trail (downstream of the Study Area) blocks passage from Keechelus Lake to most of the fish habitat in Mill Creek. In addition, the mouth of this stream is intermittent during summer low flow conditions and natural waterfalls within the Study Area block passage at two locations along this stream.

Much of the drainage has been logged in recent years. While the drainage was replanted and is regenerating, 83 percent of the Riparian Buffer area is in a modified or immature (primarily sapling) condition. The result is a loss of shade or increased solar exposure and LWD recruitment in Lower Mill Creek. Although the quantity of LWD in Lower Mill Creek is adequate, new recruitment of LWD will not take place until the replanted trees reach maturity. Limited temperature data indicate that temperature may exceed the optimal range for bull trout.

Table 3.4.2-1:
DPC Analysis of Fish Habitat Conditions for Existing Conditions in the Upper Yakima Watershed Portion of The Summit-at-Snoqualmie Study Area[a]

Parameter	Thres-hold	Upper Yakima Watershed								
		L. Mill Creek	U. Mill Creek	Creek Run	Sum-mit South	Hyak	Tun-nel	Ski Acres	Bea-ver	Other
Riparian Buffers in a Non-Natural Condition (% of total)	30	83.16	100.00	18.87	45.06	27.37	42.00	52.78	56.38	44.52
Stream Length with Management Concerns (% of total)	10	7.78	18.33	1.89	6.60	5.81	27.23	44.48	48.63	32.40
Road Density (miles/square mile)	3	7.42	2.90	2.52	5.66	2.78	12.34	9.28	8.65	1.66
Road Crossing Density (number/square mile)	6	27.50	0.00	20.34	14.29	9.96	85.71	50.04	33.61	4.11
Modified Channel Length (% of total)	8	0.00	0.00	0.00	1.69	0.00	5.60	12.68	10.45	0.00
Parameters over Threshold		**3**	**2**	**1**	**3**	**1**	**4**	**5**	**5**	**2**
Fish Habitat										
Length of Fish Bearing Streams (miles)		1.78	0.60	0.00	0.00	0.12	0.12	0.00	0.25	0.33
Length of Presumed Fish Bearing Stream (miles)		0.00	0.00	0.00	0.10	0.96	0.00	1.14	0.19	0.00
Blocked by Human Barriers (miles)		0.96	0.00	0.00	0.00	0.00	0.00	1.14	0.00	0.19
Percent of Total Potential Fish Habitat		53.8	0.0	0.0	0.0	0.0	0.0	100.0	0.0	57.7
Human Caused Fish Barriers										
Fish Bearing Stream		1	0	0	0	0	0	0	0	3
Presumed Fish Bearing Stream		0	0	0	0	0	0	0	0	1

[a] The value stated for each drainage is in terms of the metric used to compare to the threshold. A complete breakdown of the DPC analysis can be found in Appendix I – Physical and Biological Resource Data Tables and includes the area of impact and analysis area for each DPC parameter.

Upper Mill Creek

Overall, two parameters in Upper Mill Creek exceed established thresholds (see Table 3.4.2-1).

- Riparian Buffers in non-natural conditions (100 percent)
- Stream length with management concerns (18.3 percent)

The Upper Mill Creek drainage is almost entirely forested with saplings and contains approximately 0.6 mile of fish habitat. There are no human-made fish barriers in this drainage. However, the entire drainage is upstream of the barriers in the Lower Mill Creek Drainage (described above). The vegetated condition of the Riparian Buffer of this drainage is primarily sapling, limiting LWD recruitment in the near future.

Creek Run

The Creek Run drainage is in relatively pristine condition, with one parameter exceeding the threshold for concern (see Table 3.4.2-1).

- Road crossing density (20.3 miles/square mile)

Although the Creek Run drainage has no fish habitat, approximately 1.3 miles of fish habitat are located in Coal Creek downstream of the Creek Run drainage.

Summit South

A total of three parameters exceed threshold for the Summit South drainage (see Table 3.4.2-1).

- Riparian Buffers in a non-natural condition (45.06 percent)
- Road density (5.66 miles/square mile)
- Road crossing density (14.29 per square mile)

One stream, Pulse Creek, drains the Summit South drainage. This small creek is intermittent in summer months and passes through a number of culverts, and is presumed to provide approximately 0.10 mile of fish habitat, though no surveys have been conducted to verify that fish use these channels.

Areas of bare soil have been mapped in this drainage indicating that sediment erosion is actively occurring. While Pulse Creek could transport soil from erosion or road related sources downstream, the volume of sediment transported would be considerably less than most of the drainages in the Study Area because of the low capacity of the channel and the low channel gradient in the lower reaches. Any sediment impacts from the Summit South drainage would affect fish habitat only in the lowest 0.1 mile of Pulse Creek, and a short segment of Coal Creek downstream of Pulse Creek (approximately 0.3 mile during high pool conditions in Keechelus Lake). Although this drainage exceeds three thresholds, a relatively short length of presumed fish bearing stream is located within the drainage in comparison to other drainages.

Hyak

Like the Creek Run drainage, the Hyak drainage is relatively undeveloped. One parameter exceeds the threshold of concern (see Table 3.4.2-1).

- Road crossing density (9.96 per square mile)

A natural barrier to fish passage (falls) prevents access to and from Coal Creek to almost all of Hyak Creek. Upstream of the falls fish presence is presumed. No fish have been observed in Hyak Creek, and it is quite possible that there are no fish in Hyak Creek above the falls. Conditions in the 0.12-mile segment of Hyak Creek downstream of the falls indicate deficiencies in pool quality, sediment, and LWD. This segment is also downstream of the confluence with Tunnel Creek, a tributary to Hyak Creek at the base of the falls that mark the upstream limit of known fish use in Hyak Creek.

Tunnel

The Tunnel Creek drainage, located in the Summit Central portion of the Study Area, exceeds the thresholds of concern for four parameters; however, a natural falls at the mouth of Tunnel Creek prevents fish from entering this stream (see Table 3.4.2-1).

- Riparian Buffers in a non-natural condition (42 percent)
- Stream length with management concerns (27.23 percent)
- Road density (12.34 miles per square mile)
- Road crossing density (85.71 per square mile)

The net effect of these conditions contributes to a relatively high risk of sedimentation in Tunnel Creek, and ultimately in Coal Creek where it could contribute to the impaired fish habitat condition found in that stream.

In addition, about 26 percent of the stream is contained in long culverted sections that can increase peak runoff rates as well as removing these segments of the stream from fully functional Riparian Buffer. This probably has a relatively small effect on fish, since fish are prevented from entering Tunnel Creek by the natural barrier at the mouth of the creek. One benefit of the long culverted segment that should be noted is that it has stopped downcutting and erosion that was continuous along both banks of the stream prior to the installation of this culvert. Any effect of alterations in flow or sediment dynamics from this culvert would only affect fish downstream of Tunnel Creek.

An additional source of sediment in the Tunnel Creek drainage is the Silver Fir parking area. The lot is surfaced with gravel and traction sand is transported into this lot by vehicles. Subsequent snow removal and stockpiling in the lot concentrates road sand and gravel in the floodplain and riparian zone near Tunnel Creek. A portion of this sand is deposited along the banks of Tunnel Creek where surface runoff

and snowmelt transport it to the stream. Likewise, snowmelt and precipitation runoff from the Silver Fir Lot contribute to the sediment load of this stream and downstream to Coal Creek where fish are present.

A 0.12-mile segment of Coal Creek is included in this drainage area. This segment of Coal Creek is heavily influenced by Interstate I-90. Pool frequency and quality are poor, there is a high proportion of fine sediment, and LWD is inadequate (Jones & Stokes 2001). This segment of Coal Creek is bounded by culverts upstream and downstream that are barriers to passage at certain flows (the downstream culvert is a complete barrier to upstream passage at all flows, while the upstream culvert is barrier to upstream passage at low flows and possibly at high flows).

Ski Acres

The Ski Acres drainage exceeds the threshold for concern for all five parameters related to fish habitat (see Table 3.4.2-1).

- Riparian Buffers in non-natural conditions (52.78 percent)
- Stream length with management concerns (44.48 percent)
- Road density (9.28 miles per square mile)
- Road crossings density (50.04 per square mile)
- Streams with a modified channel length (12.68 percent)

The Ski Acres drainage has no confirmed fish habitat. However, there are 1.14 miles of perennial stream habitat associated with wetlands on private lands in the lower portion of this drainage that is presumed to be fish bearing.

Large gravel parking areas are also present in this drainage, including the 10.9–acre Summit Central Lot 1. The streams flowing through the wetland areas in the lower portion of the drainage have low velocity flows allowing deposition of a considerable fraction of the fine sediment that is generated within the drainage. This sediment has been observed to impact wetlands through deposition in these low velocity areas (SE GROUP unpublished data). Some sediment is, however, likely transported downstream to Coal Creek where fish presence has been confirmed.

Beaver

All five parameters exceed threshold in the Beaver drainage (see Table 3.4.2-1).

- Riparian Buffers in a non-natural condition (56.38 percent)
- Stream length with management concerns (48.63 percent)
- Road density (8.65 miles per square mile)
- Road crossings density (33.61 per square mile)

- Modified channel length (10.45 percent)

Beaver Lake Creek contains a 0.25-mile segment that is fish bearing between I-90 on the downstream side and the outlet of a culvert near the maintenance shop at the Summit West ski area. Upstream of this culvert the channel of Beaver Lake Creek is modified and covered with railroad ties. However, this segment of the stream is too steep to provide habitat even if it were not covered. Above the covered 0.19-mile segment of Beaver Lake Creek, located downstream of Beaver Lake is presumed to be fish bearing, although fish have never been observed in this stream segment.

Fish habitat is limited to the lower segment of Beaver Lake Creek that has a low frequency of pools, no deep pools, a high proportion of fine sediment and a limited quantity of LWD. A stream of this size would not be expected to have a large number of deep pools or pieces of LWD. The proportion of fine sediment, however, indicates excessive sediment loading, presumably from road and parking lot runoff and snow removal at Summit West.

Other Upper Yakima

Two parameters exceed established thresholds for the Other Upper Yakima drainage (see Table 3.4.2-1).

- Riparian Buffers in a non-natural condition (44.52 percent)
- Stream length with management concerns (32.4 percent)

Totaling 156 acres, this drainage is actually a grouping of smaller “sliver” drainages within the Study Area boundary, but primarily includes the valley bottom containing the mainstem of Coal Creek. Even though there are no projects proposed within these areas, analysis was performed and included in the DPC tables to provide a thorough analysis of the entire Study Area.

The Other Upper Yakima drainage includes confirmed fish habitat in Coal Creek. Coal Creek is the valley bottom stream that receives flow from the Creek Run, Hyak, Tunnel, Ski Acres and Beaver drainages. Fish habitat in this drainage is, therefore, influenced by conditions in all of the tributary drainages as well as conditions with the Other Upper Yakima drainage itself.

Interstate I-90 has a strong influence on Coal Creek, since the stream runs parallel and close to the highway, with three culvert crossings and one bridge crossing. Fish passage is blocked or severely impaired at the three culvert crossings. One of these culverts is located in the Study Area and runs under I-90. This long culvert section displaced fish habitat when it was constructed. Shade and LWD in Coal Creek are impaired by a lack of large trees between the stream and I-90. Coal Creek also receives a large sediment load from traction sand that is cleared or washed from the roadway. In addition to the effects of riparian modification along Coal Creek and the sediment load from roadways, a small quantity of bare soil in the drainage may contribute to the sediment load in this stream.

Temperature, water quality (see Section 3.3 – Watershed Resources), pool frequency, pool quality, fine sediment, and LWD are all impaired from proper function in Coal Creek. While the effects of I-90 are an obvious source of these impacts, timber harvest outside of the Study Area and conditions in the tributary drainages inside the Study Area also contribute.

3.4.2.3 South Fork Snoqualmie Subwatershed

Northside

Two parameters exceed the thresholds of concern in the Northside drainage (see Table 3.4.2-2).

- Riparian Buffers in a non-natural condition (81.47 percent)
- Road density (4.88 miles per square mile)

This drainage contains a limited length of mountain slope and ditch channels and no fish habitat other than the S.F. Snoqualmie River which is located on the opposite side of I-90 from Summit West (see Table 3.4.2-2). With respect to fish and fish habitat, the condition of this drainage is not a concern.

Table 3.4.2-2:
DPC Analysis of Fish Habitat Conditions for Existing Conditions in the South Fork Snoqualmie Watershed Portion of The Summit-at-Snoqualmie Study Area[a]

Parameter	Threshold	South Fork Snoqualmie Watershed					
		North-side	Summit North	Inter-national	Upper Alpental	Nacri-nomical	Other
Riparian Buffers in a Non-Natural Condition (% of total)	30	81.47	83.90	41.12	27.22	38.97	11.32
Stream Length with Management Concerns (% of total)	10	0.00	49.76	2.44	3.89	21.40	3.98
Road Density (miles/square mile)	3	4.88	7.02	0.50	0.68	1.70	2.34
Road Crossing Density (number/square mile)	6	0.00	26.62	4.76	7.16	12.05	11.93
Modified Channel Length (% of total)	8	0.00	88.43	1.96	0.00	25.17	5.49
Parameters Over Threshold		**2**	**5**	**1**	**1**	**4**	**1**
Fish Habitat							
Length of Fish Bearing Streams (miles)		0.42	0.38	0.00	0.00	0.00	1.42
Length of Presumed Fish Bearing Stream (miles)		0.00	0.00	0.00	0.00	0.00	1.60
Blocked by Human Barriers (miles)		0.00	0.14	0.00	0.00	0.00	0.00
Percent of Total Potential Fish Habitat		0.00	36.91	0.00	0.00	0.00	0.00
Human Caused Fish Barriers							
Fish Bearing Stream		0	1	0	0	0	0
Presumed Fish Bearing Stream		0	0	0	0	0	0

[a] The value stated for each drainage is in terms of the metric used to compare to the threshold. A complete breakdown of the DPC analysis can be found in Appendix I – Physical and Biological Resource Data Tables and includes the area of impact and analysis area for each DPC parameter.

Summit North

All five parameters exceed threshold in the Summit North drainage (see Table 3.4.2-2).

- Riparian buffers in a non-natural condition (83.9 percent)
- Stream length with management concerns (49.8 percent)
- Road density is over threshold (7.02 miles per square mile)
- Road crossing density (26.62 per square mile)
- Modified channel length (88.4 percent)

The Summit North area drains to an unnamed tributary of the S.F. Snoqualmie River. Resident trout have been observed in this stream between SR 906 and I-90. Although 0.38 mile of this stream is fish bearing,

the Riparian Buffer of the stream is highly modified in the vicinity of the I-90 off ramp and provides habitat of very limited quality. A large proportion of the Riparian Buffer and stream channels in this drainage are in a modified condition. The unnamed stream is too small to provide fish habitat in the Study Area and two culverts located near Exit 52 on I-90 are partial or complete barriers to passage. Roadway runoff from the I-90 off ramp and a gravel parking area at the Summit West ski area contribute fine sediment to this stream. Pfankuch ratings for lower bank cutting, streambed scour, and deposition also indicate a somewhat degraded channel condition in the drainage (Jones & Stokes 2001). The lack of trees in the Riparian Buffer adjacent to the I-90 off ramp has resulted in reduced channel shading and LWD recruitment.

Internationale

One parameter exceeds the threshold for concern in the International drainage (see Table 3.4.2-2).

- Riparian Buffers in a non-natural condition (41.12 percent)

A series of natural falls and cascades prevent fish access to this drainage, and the stream channels are generally too steep to provide fish habitat. Although there is no viable fish habitat in the International drainage, maintaining conditions in this large drainage is of importance to maintaining conditions downstream in the S.F. Snoqualmie River.

Upper Alpental

The upper Alpental drainage has one parameter that exceeds threshold for concern (see Table 3.4.2-2).

- Road crossing density (7.16 per square mile)

This entire drainage is too steep to support fish habitat.

Nacrinomical

Four parameters exceed the thresholds for concern in the Nacrinomical drainage (see Table 3.4.2-2).

- Riparian Buffers in a non-natural condition (38.97 percent)
- Stream length with management concerns (21.4 percent)
- Road crossing density (12 per square mile)
- Modified channel length (25.17 percent)

The Nacrinomical drainage includes several small, high gradient, non-fish bearing tributaries to the S.F. Snoqualmie River. The Nacrinomical drainage boundary ends at the bank of the S.F. Snoqualmie River. As a result there is no fish habitat in the Nacrinomical drainage, however watershed conditions are important as they drain to the S.F. Snoqualmie River (see Figures 3.3.1-4, Existing Riparian Conditions – Alpental, and 3.4.1-2, Existing Fisheries Conditions - Alpental).

The Nacrinomical drainage contains Alpental Parking Lots 4, 5, and 6. Alpental Lot 6 and the access road exhibit an accumulation of traction sand in the Riparian Reserve along the S.F. Snoqualmie River. This contributes fine sediment to the river and has been identified as a management concern by the USFS.

Other South Fork Snoqualmie

One parameter exceeds the threshold of concern in this drainage (see Table 3.4.2-2).

- Road crossing density (11.93 percent)

A total of 215 acres of the Study Area are situated within the Other S.F. Snoqualmie drainage. This is actually a grouping of smaller "sliver" drainages near the Study Area boundary, but primarily includes the valley bottom containing the mainstem of the S.F. Snoqualmie River.

This drainage includes the 1.42 miles of fish bearing stream, the S.F. Snoqualmie River. Although there are no human caused barriers on this stream, there are a number of natural falls that may prevent upstream migration within the stream. Resident trout have been confirmed up to a falls by the upstream most bridge, adjacent to Parking Lot 3, at Alpental. Upstream of this point the stream has good fish habitat, but fish observations have not been recorded. Fish presence is therefore presumed in this reach of the S.F. Snoqualmie River.

Additionally, one indicator of habitat quality, the number of deep pools, is below the USFWS 1998 guidance. However, this condition appears to be due to natural channel morphology rather than as a result of watershed degradation (Jones & Stokes 2001).

The proximity of Alpental road and Parking Lots 1, 2, and 3 to the S.F. Snoqualmie River contributes an unnaturally high quantity of fine sediment into the river. Snow clearing in winter results in deposition of traction sand and eroded native roadbed material into the stream channel. However, a large portion of this fine sediment is apparently transported through this portion of the stream as stream sediments do not show an excess of fine sediment deposited in the stream itself (Jones & Stokes 2001).

3.5 VEGETATION

This section describes the vegetation communities and the occurrences of special-status plant species in The Summit-at-Snoqualmie MDP Proposal Study Area. Biologists conducted field surveys, reviewed literature, interpreted color aerial photographs, and contacted state and federal resource agencies to accumulate information on vegetation resources. Resources consulted include the Upper South Fork Snoqualmie River and Coal Creek Watershed Condition Assessment (Jones & Stokes 2001), the Special-Status Plant Report for The Summit-at-Snoqualmie MDP (Jones & Stokes 2004), and other documents as referenced later in this section.

Additional information is presented for the watershed setting (i.e., the S.F. Snoqualmie Watershed and the U. Yakima Watershed) to place the Study Area in context with the surrounding conditions. In addition, database searches for occurrences of sensitive and other rare and uncommon plant species were conducted at a regional scale.

3.5.1 Summary of Existing Conditons

3.5.1.1 Introduction

Regional Setting

The Study Area lies within the subalpine forest region and is located at the break between the Northern and Southern Washington Cascades regions, each recognizing its own geologic, soil, and physiographic characteristics (Franklin and Dyrness 1988). The U. Yakima Watershed lies within the Southern Washington Cascade region and the S.F. Snoqualmie Watershed lies in the Northern Washington Cascade region. Potential vegetation zones and existing vegetation conditions characterize the vegetation of each region. Potential natural vegetation communities are those climax stage vegetation communities that could establish based on site conditions such as soil, elevation, and climate. Varied land ownership and land use activities in the area have created the mosaic of plant communities and developed areas that presently comprise the existing land cover in the Study Area.

Plant ecologists with the MBSNF and the OWNF have identified forest community plant associations that are based on sites with similar composition, structure, and site potential for different elevation zones (Henderson et al. 1992; Lillybridge et al. 1995). Based on this classification system, the western hemlock (*Tsuga heterophylla*), Pacific silver fir (*Abies amabilis*), and mountain hemlock (*Tsuga mertensiana*) are the common forested vegetation zones in the Study Area.

The Pacific silver fir zone is common from approximately 3,000 feet to 4,000 feet in elevation. The Pacific silver fir zone transitions to the mountain hemlock zone at the upper range of these elevations. The mountain hemlock forest zone generally occurs above 3,400 feet up to 5,400 feet, with a scattered occurrence above 4,600 feet in the Alpental area. The western hemlock zone is found in the lower elevations primarily below 2,800 feet. Most of the forests are mixed conifer forests dominated by one of

these tree species. Other nonforested vegetation communities that exist in the Study Area are described in Section 3.5.1.2 – Existing Vegetation Communities.

History

Several natural and management-related landscape disturbances have influenced the vegetation patterns within the upper reaches of both the U. Yakima Watershed and the S. F. Snoqualmie watershed. Natural disturbances include natural wildfire, mass wasting events (e.g., rockfall, debris avalanches, debris flows), windthrow (blowdown), snow avalanches, floods, insects, and diseases that affect forest trees. Most of these disturbances have had local effects on vegetation patterns throughout the Study Area. The effects of snow avalanches on vegetation patterns in the Study Area are limited primarily to Alpental.

Natural wildfire has significantly influenced vegetation patterns and forest stand age in both watersheds. Stand replacing fires burned much of the S.F. Snoqualmie Watershed in 1508, 1701, and 1774 (USFS 1995a). Fire return intervals in the U. Yakima Watershed range from 100 to 200 years at elevations ranging from 3,500 to 4,500 feet and 200 to 300 years at higher elevations (USFS 1997).

Land ownership in the Snoqualmie Pass area took on a checkerboard pattern when the Northern Pacific Railroad land grant was distributed in 1864 to federal, private, and other government holdings based on alternating sections within each township and range (USFS 1997). Management-related disturbances include the removal of vegetation during earlier timber harvest, railway and road construction, powerline construction, and development of recreational skiing facilities. Tree removal for ski trails began in the 1930's (Prater 1981). Tree removal in the area continued in the 1950's (USFS 1997). Currently, approximately 800 acres of forest within the Study Area has been removed primarily for recreational facilities. Modified shrub and herbaceous communities now exist in the maintained areas. Also, various nonnative plant species have been introduced to the Study Area since the Pass has been a primary travel corridor for human and livestock traffic since the mid-1800s.

Vegetation within the Mill Creek drainage portion (Section 21) of the Study Area has been allowed to reestablish after private timber harvest activities were completed and recreational operations ceased on the Backside Chair at Summit East. Operational activities have continued in the area for trail maintenance associated with cross-country skiing, back road and culvert maintenance, vegetation maintenance within the powerline corridor to maintain access to the Bonneville Power Administration transmission lines and towers, and backcountry recreational activities (e.g., mountain biking and hunting). This private land is currently managed for timber production.

3.5.1.2 Existing Vegetation Communities

Existing vegetation communities were mapped throughout the entire Study Area for this analysis. Existing vegetation cover was mapped based on dominance of forest, shrub, or herbaceous cover. Forest cover was further classified using the predominant species present and the estimated age class of the forest. Forest stands were classified as either mature or immature, with mature stands generally greater than 80 years

old, while immature stands are less than 80 years old. The existing conditions of the primary forest and nonforest vegetation communities within the Study Area are described below. See Table 3.5.1-1 for existing acreages of vegetation types found within the Study Area. The percent cover column in the table represents that portion of the Study Area covered by that vegetation type relative to the entire area within the Study Area. The distribution of various vegetation types and age class of these communities is displayed in Figures 3.5.1-1, Existing Vegetation Cover – The Summit, and 3.5.1-2, Existing Vegetation Cover – Alpental.

Table 3.5.1-1:
Summary of Existing Land Cover Types
Within The Summit-at-Snoqualmie Study Area

Vegetation and Land Cover Type	Acres	Percent Cover[a]
Mixed Conifer – Western hemlock		
Mature	47.71	1.6
Immature	96.18	3.3
Mixed Conifer – Pacific silver-fir		
Mature	780.80	26.9
Immature	234.69	8.1
Sapling	285.21	9.8
Mixed Conifer – Mountain hemlock		
Mature	224.61	7.8
Shrub		
Natural	108.04	3.7
Modified	342.02	11.8
Herbaceous		
Natural	14.77	0.5
Modified	434.15	15.0
Lakes/Open Water	1.34	0.1
Unvegetated Rock Outcrop/Talus	235.27	8.1
Developed Land	94.58	3.3
Totals (acres)	**2899.36**	**100**

[a] Percent of Total Cover Within the Study Area
Note: This table includes the Mill Creek portion of the Study Area.

Mixed conifer forests dominated by Pacific silver fir, mountain hemlock, or western hemlock are the most common cover types within the Study Area. Together these forests cover nearly 60 percent of the Study Area. Other coniferous species found in the mixed conifer forest include Douglas-fir (*Pseudotsuga menziesii*) and western red cedar (*Thuja plicata*). Few hardwood trees are present in the area. Red alder (*Alnus rubra*) and black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) are most frequently observed as smaller trees in disturbed areas and streamside locations along the S.F. Snoqualmie River.

Western Hemlock

Mature and immature mixed conifer forest dominated by western hemlock covers approximately 144 acres of the Study Area. This community occurs primarily on public lands (119.24 acres, see Table 3.5.2-1) in the Summit East area at elevations ranging from 2,500 to 3,000 feet. Mature trees, within the approximately 48 acres of mature stands, range in size from 20 to 30 inches diameter at breast height (dbh). Douglas fir, Pacific silver fir, and occasional mountain hemlock are also present in this community. Shrubs dominate the moderate to dense understory cover. Common shrubs include salmonberry (*Rubus spectabilis*), vine maple (*Acer circinatum*) and huckleberry (*Vaccinium* spp.). Herbaceous species found in this forest type include queen's cup (*Clintonia uniflora*), bunchberry (*Cornus canadensis*), and five-leaved bramble (*Rubus pedatus*). Approximately 96 acres of western hemlock forest is present as immature forest.

Pacific Silver Fir

Mixed conifer forest dominated by Pacific silver fir covers approximately 1,301 acres and is the most prevalent forest type found throughout the Study Area. This community generally occurs at elevations ranging from 2,800 feet to 4,100 feet and is almost evenly distributed on public (677.87 acres) and private (622.83 acres) lands (see Table 3.5.2-1). The Pacific silver fir forest includes both mature (780.80 acres) and immature stands (519.90 acres). The majority of canopy trees in the mature forest stands are in the 24 to 36-inch dbh range. Large mature trees reaching over 40 inches dbh also occur. Some remnant stands of forest dominated by mature Pacific silver fir remain on private land situated between Summit Central and Summit West.

Mountain hemlock and western hemlock also occur in the canopy and understory layers of these forests. The understory, dominated by shrub species, varies from moderate to dense cover. Common understory shrubs include big-leaf huckleberry (*Vaccinium membranaceum*), salmonberry, oval-leaf huckleberry (*V. ovalifolium*), and fool’s huckleberry (*Menziesia ferruginea*). Herbaceous vegetation within the forest understory includes deer fern (*Blechnum spicant*), queen's cup, twisted stalk (*Streptopus* sp.), bunchberry, and five-leaved bramble.

Some immature stands are dominated entirely by saplings (285.21 acres). These immature stands are located primarily in Section 21 within the Mill Creek drainage on private land.

Mountain Hemlock

Mixed conifer forest dominated by mountain hemlock generally occurs above 4,100 feet in the Alpental area and above 3,400 feet in the Summit Central and Summit East areas. Mountain hemlock occurs as mature forest on approximately 225 acres and exists primarily on public land (221.40 acres) within the Study Area. Large, mature trees between 24 and 30 inches dbh are found in this vegetation type. Some Pacific silver fir also occurs in the canopy and understory of this community. Understory shrubs and herbaceous cover are similar to those described for the Pacific silver fir forest.

Mountain hemlock also occurs in an open park-like setting in the Alpental area at elevations ranging from 4,700 to 5,200 feet. At these elevations, mountain hemlock has a scattered occurrence with approximately 10to 25 percent cover. Small herbaceous areas, scattered between rock outcrops and rock slabs, dominate the majority of this area. Grasses, sedges (*Carex* sp.), heather (i.e., *Phyllodoce empetriformis* and *Cassiope mertensiana*), and partridgefoot (*Luetkea pectinata*) are common at this higher elevation.

Shrub Communities

Natural shrub communities comprise approximately 108 acres (24 percent) of the approximately 450 acres of shrub communities within the Study Area. The majority of natural shrub communities exist on public lands (64.70 acres). Areas considered to be in a natural shrub cover include undisturbed riparian and wetland areas, avalanche chutes, and natural forest openings. The most common shrubs in these areas include Alaska huckleberry (*Vaccinium alaskaense*), big-leaf huckleberry, fool's huckleberry, salmonberry, vine maple, Sitka willow (*Salix sitchensis*), and Sitka alder (*Alnus sinuata*).

Shrubs are a common component of the vegetation found in areas modified by tree removal. These include areas currently dominated by shrubs from land management activities and development (e.g., timber harvests, roadside disturbance, powerline construction, and ski trail maintenance) as well as those areas cleared and managed as ski trails. This modified vegetation constitutes approximately 342 acres of the Study Area. The majority of modified shrub communities exist on public land (200.63 acres, see Table 3.5.2-1) compared to private land (141.39 acres). Common shrub species include big-leaf huckleberry, oval-leaf huckleberry, and seedlings of Pacific silver fir and mountain hemlock. Shrubs along stream banks and in wetlands commonly include salmonberry, Sitka willow, Sitka alder, stink currant (*Ribes bracteosum*), and subalpine spirea (*Spiraea densiflora*). For a more detailed discussion on wetlands, see Section 3.3.1.2 – Hydrography.

Herbaceous Communities

Natural open herbaceous areas are uncommon and cover approximately 15 acres (0.5 percent) within the Study Area. These areas are most frequently associated with emergent wetlands. Most of the herbaceous cover type is comprised of small wetland areas less than 1 acre that occur in openings in the forest canopy and in open meadows. Several large wet meadow or bog type wetlands occur in the lower elevations on private lands at Summit Central and on public lands at Summit East. Herbaceous vegetation such as sphagnum moss (*Sphagnum* sp.), grasses - e.g., blue-joint reedgrass (*Calamagrostis canadensis*), bentgrass (*Agrostis* sp.), sedges - e.g., showy sedge (*Carex spectabilis*), alpine sedge (*Carex. nigricans*), rushes - e.g., soft rush (*Juncus effusus*), dagger-leaf rush (*Juncus. ensifolius*), and forbs such as marsh marigold (*Caltha biflora*) commonly dominate these emergent wetlands.

Wetlands identified within Section 21 are primarily undisturbed palustrine emergent wetlands dominated by sphagnum moss, orchid (*Platanthera* sp.), marsh marigold, cotton-grass (*Eriophorum* sp.), small-

fruited bulrush (*Scirpus microcarpus*), and deer fern. For a more detailed discussion on wetlands, see Section 3.3.1.2 – Hydrography.

Approximately 434 acres of modified herbaceous cover exists on both public (205.50 acres) and private (228.65 acres) lands within the Study Area. Nearly twice as much modified herbaceous cover occurs on private land (224.07 acres) than on public land (125.33 acres) within The Summit area. Modified herbaceous cover also exists within a few wetlands and in the powerline corridor in Section 21. Herbaceous species commonly found on areas that have been modified, including areas maintained as ski trails, include grasses such as blue-joint reedgrass, bentgrass, orchardgrass (*Dactylis glomerata*), and forbs such as bracken fern (*Pteridium aquilinum*), queen's cup, pearly everlasting (*Anaphalis margaritacea*), and bunchberry. Ladyfern (*Athyrium filix-femina*) and reed canarygrass (*Phalaris arundinacea*) are commonly found in modified areas that are wetter.

Rock/Talus Slopes

Rock outcrops, talus slopes, and other high-elevation rock areas within the Study Area are sparsely vegetated. These areas total approximately 235 acres and are located in both subwatersheds. However, significantly more rock/talus slopes (213.28 acres) are observed in the Alpental area, generally above 4,500 feet. Of the 213 acres of rock/talus slopes, approximately 209 acres occurs on public land.

Developed Areas

Developed areas such as roads, parking lots, ski base area buildings, and other built facilities and impervious surfaces cover approximately 95 acres within the Study Area. Development has occurred on nearly three times as much private land (53.77 acres) as public land (17.06 acres) in The Summit base areas between the ski slopes and the I-90 corridor. Conversely, at Alpental, base area development is primarily on public land (18.89 acres) with minimal development on private land (4.87 acres).

3.5.1.3 Forest Stand Characteristics

As discussed in Section 3.5.1.1 – Introduction, forest stands in the Snoqualmie Pass area have been subjected to several natural (e.g., wildfire, avalanches, pathogens) and management-related landscape disturbances (e.g., timber harvest and recreational development). Stand replacing fires have not occurred in this area for over 200 years; however, tree removal related to land ownership and management activities has been significant since the turn of the century. As a result, forests currently within the Study Area are discontinuous and range from young immature forest to older, mature forest.

Mature Forest

There are approximately 1,053 acres (36 percent) of mature forest within the Study Area. Mature forest stands identified within the Study Area are those stands estimated to be greater than 80 years old, as determined from field sampling, and include mixed stands dominated by Pacific silver-fir, mountain hemlock, and western hemlock. Most of the mixed conifer forests in the Study Area are mature, with trees

generally greater than 100 years old and larger trees several hundred years old. As previously noted, large mature trees ranging from 24 to sometimes over 40 inches dbh are present in Pacific silver fir forest and trees with 24 to 30 dbh in mountain hemlock forest stands. Mature mixed conifer forest dominated by Pacific silver fir, covering nearly 781 acres, is the most prevalent forest type in the Study Area.

The MBSNF has mapped late-successional[36] forest within the S.F. Snoqualmie Watershed (USFS 1995b) and the OWNF and MBSNF have mapped late-successional forest in the SPAMA (USDA 1997). Portions of the mature forest communities located within the Study Area are within these mapped late-successional forest areas. Late-successional forests generally include trees greater than 120 years old. The majority of mature forest located in the Summit East area within Section 16 is representative of the late-successional forest type. These mixed conifer stands dominated by mature Pacific silver fir and mountain hemlock have a moderate canopy closure, a high incidence of large trees (including some snags and trees with broken tops), and large logs on the ground. Areas of blowdown (approximately 5 acres in size) occur near Hyak Lake and Forest Service Road 9070. Development in Section 16 has been minimal with a few ski trails, a powerline corridor, and a traverse trail (Trail 17A) constructed.

Field surveys were conducted to assess forest structure, canopy cover, and patchiness in the mature forest of Section 16 (Summit East). Data was collected from a total of 25 vegetation plots (see Figure 3.5.2-1, Vegetation Plot Locations). Canopy cover data was estimated using a field densitometer and includes the sum of the under-, mid-, and overstory canopy. Canopy cover ranges from 45 to 96 percent in these plots. The average canopy cover for these plots is 79 percent, with 88 percent (22 plots) having canopy cover greater than 70 percent (Jones & Stokes 1998, 2000; SE GROUP 2003). Based on a GIS analysis of digital aerial photography, the majority of the mature forest overstory is under 70 percent cover. Areas where overstory canopy cover is greater than 70 percent are scattered across Section 16.

Additional tree data in Section 16 was collected on 15 plots for the most frequent tree size greater than 4 inches in diameter. Young, immature trees in the understory are generally less than 8 inches dbh, while overstory trees are generally greater than 22 inches dbh. There are a few larger specimens in these vegetation plots with diameters greater than 40 inches, with one specimen reaching a dbh of 64 inches.

Immature Forest

Approximately 21 percent (616.08 acres) of the Study Area contains immature Pacific silver fir and immature western hemlock dominated forest. Trees approximately 6 to 15 inches dbh and approximately 40 to 80 years old are present. An immature mixed conifer forest dominated by western hemlock was

[36] Old-growth is a "forest stand ten-acres or greater usually 180 to 220 years old with moderate to high canopy closure; a multi-layered, multi-species canopy dominated by large overstory trees; high incidence of large trees, some with broken tops and other indications of old and decaying wood; numerous large snags; and heavy accumulations of wood, including large logs on the ground" (Thomas et al., FEMAT 1993). Late-successional forest is the stage of forest development that includes mature and old-growth forest. Mature forest by itself does not have the structural diversity and complexity of old-growth stands of the same forest type. Late successional forest is used in this document consistent with the late successional habitat mapped for the USFS AMA FEIS (1997) and to recognize the different mature forest types found in The Summit Study Area.

identified along the old railroad bed in the Summit East area. Immature Pacific silver fir forest was identified primarily on private lands in the Summit Central area above the maintained ski trails near the ridge crest and along portions of the SR906/I-90 corridor. Development of a shrub or herbaceous understory is limited in some immature forest stands where a dense canopy has formed. More open immature forest has understory shrubs commonly found in the mature forest.

Pacific silver fir saplings have established on approximately 285 acres within the Study Area. These saplings dominate areas that have been cleared but not maintained during the past 10to 25 years. The areas dominated by Pacific silver fir saplings are located primarily on private land in the Mill Creek drainage (Section 21) and also in tree islands between ski trails at Summit East.

3.5.1.4 Special-Status Plant Species

Special-status plant species, as described in this analysis, include:

- Vascular plants listed or proposed for listing as threatened or endangered under the federal ESA (50 CFR 17.12) and candidates for possible future listing as threatened or endangered (67 FR 40657, June 13, 2002),
- Vascular and non vascular plants listed on the USFS Regional Forester's sensitive species list (USFS 1999b, 2004a),
- Vascular plants considered endangered, threatened, or sensitive by the Washington Natural Heritage Program (WNHP 2003), and
- Other rare and uncommon species.

Surveys were conducted for special status plants (ferns and herbaceous flowering plants) and for nonvascular plants (lichens, liverworts, moss, and fungi), including species federally listed as threatened, endangered, or candidate. Surveys using USFS protocol were conducted on National Forest System Land where ground disturbance is proposed to occur. Targeted plant species, analysis methods, and results for special-status plant species surveys for the Study Area are presented in the Appendix C – Botanical Technical Report.

Proposed, Endangered, Threatened and Sensitive Plant Species, and Other Rare and Uncommon Species

No federal, state, or MBSNF listed endangered, threatened, or candidate vascular plant species were observed in the Study Area. One special-status vascular plant species, a population of swamp gentian (*Gentiana douglasiana*), was observed in the Summit West area of the SUP. This species in on the MBSNF (USFS, Region 6) sensitive plant species list and is considered a state sensitive species. Swamp gentian occurs in an open wet area dominated by herbaceous vegetation including few-flowered spikerush (*Eleocharis pauciflora*), woodrush sedge (*Carex luzulina*), wandering daisy (*Erigeron peregrinus*), marsh marigold, and Sphagnum moss. The area is surrounded by coniferous forest. The population of swamp

gentian is considered to be in the Mountain Hemlock/Devil's Club (*Oplopanax horridum*) - Alaska Huckleberry Association as described in the Forested Plant Associations of the MBSNF (Henderson et al. 1992).

In addition, one state sensitive moss species generally associated with late-successional forest, *Schistostega pennata*, was observed in 17 locations within the Study Area at Summit East (Section 16). To better understand the potential occurrence of *Schistostega pennata* in mature forests in and surrounding the Study Area, the MBSNF developed a potential habitat model for this species. The habitat model was developed using known locations of the species and associated modeled environmental variables to predict where on the landscape similar environmental conditions occur (Henderson and Lesher 2004). The model is a first approximation of potential habitat and has not been field verified. The most significant variables predicting potential habitat within the Study Area and within a 5-mile radius were precipitation, elevation, and known plant associations at documented sites. The model looks to potential natural vegetation, which is based on the site's potential ability to support a mature native forest community, not on existing conditions. High, moderate, or low habitat potential is based on how many of the model's environmental variables are present in a given area.

Results for *Schistostega pennata* indicate 87 percent (2,065.60 acres) of the potential habitat within the Study Area is considered high or moderate for the moss (see Table 3.5.1-2). The remaining 13 percent (300.23 acres) is predicted to be low potential habitat. The model predicts that there is high potential habitat at The Summit and low at Alpental. However, the model portrays more potential habitat than actually exists since it does not include any measure of microsite suitability. Microsite conditions (e.g., upturned root wads) for *Schistostega pennata* are not available in a GIS coverage (Henderson and Lesher 2004). Within the larger 5-mile radius, the model predicts 84 percent (60,266.54 acres) high or moderate potential habitat, with 16 percent (11,288.72 acres) low potential habitat. The model predicts more potential habitat to the west of the Study Area where precipitation is greater. For a more detailed discussion on potential habitat for this species, see Appendix C – Botanical Technical Report.

Table 3.5.1-2:
Potential Habitat for *Schistostega pennata*

Potential Habitat	5-Mile Radius (acres)	Study Area (acres)	Known Locations[a]
Low	11,288.72	300.23	0
Mod/High	60,266.54	2,065.60	17
Total	71,555.26	2,365.83	17

[a] Represents surveyed locations of Schistostega pennata within the Study Area
Note: This table includes the Mill Creek portion of the Study Area.

Hypogymnia duplicata, a rare and uncommon species, was observed throughout the late successional coniferous forest dominated by Pacific silver fir and mountain hemlock within Section 16 of Summit East

and at a location upslope of the existing Silver fir chairlift. *H. duplicata* was observed in forest stands at elevations ranging from 2,850 to 3,900 feet above mean sea level. *H. duplicata* was observed on the tree boles and bases of larger branches of mountain hemlock and Pacific silver fir in late successional forest of the Moist Mountain Hemlock/Alaska Huckleberry and Pacific Silver fir/Alaska Huckleberry plant associations. These forests are mesic to moist. The lichen was observed from 8 to 25 feet up the tree bole from ground level (resides above seasonal snow levels). Canopy cover in the overstory varies from 35 to 50 percent with some tree specimens having a 24 to 38-inch dbh. Windthrow has created gaps in the canopy cover. Common mid-story species include saplings of Pacific silver fir and mountain hemlock that comprise approximately 25 percent cover. Alaska huckleberry (*Vaccinium alaskensis*) and white rhododendron (*Rhododendron albiflorum*) frequently dominate the understory. *H. duplicata* was also observed on tree trunks at the edge of cleared ski trails.

A model using potential natural vegetation, precipitation, temperature, fog and cold air patterns was developed to predict potential habitat for *H. duplicata* within the range of habitat in Washington (Lesher 2005 pers. comm., see Appendix C – Botanical Technical Report). Data from this model was used to describe potential habitat with the Study Area, and within a larger 5-mile radius of the Study Area. This model covers approximately 1,613 acres of the Study Area. The remaining 1,287 acres of the Study Area is considered to contain 'no data.' The model predicts 36 percent (1,051.1 acres) of the potential habitat within the Study Area is considered high or moderate for *H. duplicata* (see Table 3.5.1-FEIS-1). Approximately 19 percent (549.9 acres) is predicted to be low potential habitat. Less than one percent (12 acres) of the Study Area is considered Not Likely habitat. In the context of the larger area evaluated (5-mile radius), the model predicts 21.5 percent (21,164 acres) high or moderate potential habitat and 18.6 percent (18,255 acres) low potential habitat.

Table 3.5.1-FEIS-1:
Potential Habitat for *Hypogymnia duplicata*

Potential Habitat	5-Mile Radius (acres)	Study Area (acres)
Not Likely	10,231	12.0
Low	18,255	549.9
Mod/High	21,164	1,051.1
No Data	48,569	1,287.8
Total	98,219	2,900.8

Note: This table includes the Mill Creek portion of the Study Area.

Field verification of this model determined the likelihood of occupancy within the mapped potential habitat. The field study showed that high potential habitat was occupied 68 percent of the time (36 of 53

plots), and moderate potential habitat was occupied 30 percent of the time (16 of 53 plots) (Lesher 2005 pers. comm.).

3.5.1.5 Noxious Weeds

Ten species of noxious weeds were recorded in the Study Area during floristic surveys and include diffuse knapweed (*Centaurea diffusa*), meadow knapweed (*C. jacea* x *nigra*), oxeye daisy (*Leucanthemum vulgare*), Canada thistle (*Cirsium arvense*), Scot's broom (*Cytisus scoparius*), orange hawkweed (*Hieracium auranitiacum*), St. Johnswort (*Hypericum perforatum*), common cat's ear (*Hypochaeris radicata*), reed canary grass, and common tansy (*Tanacetum vulgare*). These noxious plant species are identified by the Washington State Noxious Weed Control Board and recognized by the USFS.

3.5.1.6 Adaptive Management Area Standards and Guidelines

The MBSNF has mapped late-successional forest within the S.F. Snoqualmie Watershed (USFS 1995a) and the OWNF and MBSNF have mapped late-successional forest in the SPAMA (USDA 1997).[37] The Snoqualmie Pass AMA has been designated as a Connectivity Emphasis Area (see Section 1.2.3 - Applicable Land Allocations). Vegetative cover provides critical cover for wildlife species movement through the AMA area. As such, several applicable Standards and Guidelines from the Snoqualmie Pass AMA are considered in the analysis of vegetation resources. These Standards and Guidelines focus on the theme of late successional forest retention. A complete listing of the applicable Standards and Guidelines is contained in Section 1.2.4 – Particularly Applicable Goals, Standards and Guidelines. Discussion of these Standards and Guidelines can be found in Table 4.6.2-1 in Section 4.6 – Wildlife.

3.5.2 Upper Yakima River Watershed

The Study Area covers a total of approximately 1,885 acres within the U. Yakima Watershed, with 870 acres on public land and 1,015 acres within private holdings. Public lands are located on the OWNF. However, for ease of administration, the SUP is administered by the MBSNF. The lands are managed under the Okanogan-Wenatchee Forest Plan as Amended (USDA 1990b).

Mixed conifer forest dominated by Pacific silver fir is the most prominent land cover type in this portion of the Study Area. Immature stands of Pacific silver fir are significantly more prevalent in this portion of the Study Area, with sapling-age stands mapped solely in this portion. Mixed conifer forest stands dominated by western hemlock are also unique to this portion of the Study Area. Areas of talus and rock outcrops are very limited (less than 1 percent of the Study Area). Open water has been mapped in this

[37] Old-growth is a "forest stand ten-acres or greater usually 180 to 220 years old with moderate to high canopy closure; a multi-layered, multi-species canopy dominated by large overstory trees; high incidence of large trees, some with broken tops and other indications of old and decaying wood; numerous large snags; and heavy accumulations of wood, including large logs on the ground" (Thomas et al., FEMAT 1993). Late-successional forest is the stage of forest development that includes mature and old-growth forest. Mature forest by itself does not have the structural diversity and complexity of old-growth stands of the same forest type. Late successional forest is used in this document consistent with the late successional habitat mapped for the USFS AMA FEIS (1997) and to recognize the different mature forest types found in The Summit Study Area.

portion of the Study Area. Acreages for vegetation communities and other land cover types mapped in the Study Area are presented according to subwatershed and land ownership in Table 3.5.2-1.

Table 3.5.2-1:
Existing Land Cover Types Within The Summit-at-Snoqualmie Study Area

Land Cover Type[a]	Ownership	Upper Yakima (acres)	South Fork Snoqualmie (acres)	Study Area Totals (acres)
Mixed Conifer - Western hemlock				
Mature	**Public**	23.48	0.00	**23.48**
	Private	24.23	0.00	**24.23**
Immature	**Public**	95.76	0.00	**95.76**
	Private	0.42	0.00	**0.42**
Mixed Conifer - Pacific silver-fir				
Mature	**Public**	317.26	239.67	**556.93**
	Private	155.53	68.34	**223.87**
Immature	**Public**	93.35	10.62	**103.98**
	Private	117.97	12.73	**130.71**
Sapling	**Public**	16.96	0.00	**16.96**
	Private	268.25	0.00	**268.25**
Mixed Conifer - Mountain hemlock				
Mature	**Public**	53.76	167.64	**221.40**
	Private	0.00	3.21	**3.21**
Immature	**Public**	0.00	0.00	**0.00**
	Private	0.00	0.00	**0.00**
Shrub				
Natural	**Public**	2.09	62.61	**64.70**
	Private	12.46	30.88	**43.34**
Modified	**Public**	107.69	92.94	**200.63**
	Private	139.10	2.28	**141.39**
Herbaceous				
Natural	**Public**	6.17	1.05	**7.22**
	Private	7.17	0.38	**7.55**
Modified	**Public**	125.33	80.17	**205.50**
	Private	224.07	4.58	**228.65**

Table 3.5.2-1:
Existing Land Cover Types Within The Summit-at-Snoqualmie Study Area

Land Cover Type[a]	Ownership	Upper Yakima (acres)	South Fork Snoqualmie (acres)	Study Area Totals (acres)
Lakes/Open Water	**Public**	0.00	0.00	**0.00**
	Private	1.34	0.00	**1.34**
Unvegetated Rock Outcrop/Talus	**Public**	11.28	208.89	**220.18**
	Private	10.70	4.39	**15.09**
Developed Land	**Public**	17.06	18.89	**35.94**
	Private	53.77	4.87	**58.64**
Totals (acres)		**1885.21**	**1014.15**	**2899.36**

[a] Includes wetland and lake landcover types.
Note: This table includes the Mill Creek portion of the Study Area.

Private lands located in Section 21 (northwest, northeast, and southeast quarters) within the Mill Creek drainage lie adjacent to Summit East. Vegetation within this area has also been modified through land management activities (e.g., timber harvest, powerline construction, and recreational development). Immature and sapling Pacific silver fir dominate the regeneration found in the areas of clear-cut and the abandoned ski trails on Mt. Hyak. Common shrubs found in cleared areas include huckleberry, mountain ash (*Sorbus sitchensis*), and fool's huckleberry. Dominant forbs include pearly everlasting, fireweed (*Epilobium angustifolium*), and bracken fern.

3.5.3 South Fork Snoqualmie River Watershed

The Study Area also includes a total of approximately 1,014 acres within the S. F. Snoqualmie Watershed. Of this total, the majority (882.48 acres) is located on National Forest System lands managed by the MBSNF, with approximately 132 acres in private holdings. The Alpental ski area was developed in 1967 and ski resort facilities have remained in continued operation to the present day. The S.F. Snoqualmie Watershed Analysis identifies a mix of late-successional forest and nonforested areas for Alpental (USFS 1995a). Private lands within the Study Area at Alpental reside in the base area.

Due to its more rugged terrain, much of the upper portion of Alpental has been left in its natural state. Significant areas of talus and rock outcrops (213.28 acres) are interspersed with areas of scattered mountain hemlock. Mixed conifer forest dominated by mature Pacific silver fir constitutes the dominant forested land cover (308.01 acres). No lakes or areas of open water have been mapped in this area.

3.6 WILDLIFE

This section describes the wildlife in the Study Area as well as the adjoining Snoqualmie Pass Adaptive Management Area (SPAMA) and S.F. Snoqualmie Watershed and U. Yakima Watershed. The adjoining areas are described for the more regional setting, to place the Study Area in context with the surrounding conditions, and to adequately describe wide-ranging species such as elk, mountain goat, gray wolf, and grizzly bear. Information on wildlife was derived from background literature, color aerial photographs, field studies, and discussions with state and federal resource agencies including the USFS and USFWS.

Major sources of information used for this section included resource data from the MBSNF and OWNF GIS databases, the S.F. Snoqualmie Watershed Analysis (USFS 1995), the U. Yakima Watershed Analysis (USFS 1997), the SPAMA Plan EIS (USFS and USFWS 1997), and the WDFW priority habitats and species (PHS) database (WDFW 2002). Additional wildlife habitat information was derived from the review and interpretation of true color aerial photographs, and additional species occurrence information was derived from incidental observation data from the USFS MBSNF/Snoqualmie Ranger District and survey data collected from 1994 through 2002 by Jones & Stokes as a part of this study.

Several studies regarding wildlife in the vicinity of Snoqualmie Pass have been completed by other agencies and are included in this analysis by reference. These studies include;

- I-90 Snoqualmie Pass East DEIS (WSDOT 2005)
- I-90 Wildlife Linkage Habitat Assessment (Singleton and Lehmkuhl 2000)

Vegetation communities, described in detail in Section 3.5 - Vegetation, form the basis for the descriptions of wildlife habitat in this section.

3.6.1 Summary of Existing Conditions

3.6.1.1 Introduction

The following sections describe wildlife conditions in both the Study Area and the larger Analysis Area, as appropriate. The Study Area is defined as the area for which project specific GIS data has been developed and in which project components would occur. The Study Area is shown in Figure 3.0-1, Study Area. For low mobility species with small home ranges, the Study Area is the appropriate scale at which to analyze impacts. The Analysis Area is larger than the Study Area and is used to analyze impacts to wide ranging species or those with large home ranges. The Analysis Area is generally the area within approximately 5 miles of the Study Area.

The following sections focus on wildlife habitat associations, the likelihood specific wildlife species occur in the Study Area and/or Analysis Area, and specific habitat types that are used by the wildlife species. In addition, a discussion of habitat connectivity within the context of the Snoqualmie Pass area is

also presented. Many of the wildlife species that may occur in the Study Area, and habitat characteristics of those species, are based on important wildlife species identified in the MBSNF Forest Plan, as Amended (USDA 1990a; USDA and USDI 1994), the WNF Forest Plan, as Amended (USDA 1990b; USDA and USDI 1994), and species listed under the ESA. Federal regulatory policies related to wildlife species include compliance with regulations for federally listed species under the ESA and Standards and Guidelines identified in the Forest Plans referenced above. WDFW has established guidelines for state PHS and private lands within the Study Area are also subject to codes and policies of King County and Kittitas County.

3.6.1.2 General Wildlife Habitat Associations

The Study Area provides habitat for a variety of wildlife typically associated with mature Pacific silver fir, mountain hemlock, and herbaceous/shrub communities. The S.F. Snoqualmie Watershed Analysis and the U. Yakima Watershed Analysis each estimated that approximately 290 species of mammals, birds, amphibians, and reptiles potentially occur in each watershed (USFS 1995, 1997). While some of these species may be restricted to either the lower elevations of these watersheds, or the drier eastern portion of the U. Yakima Watershed, the majority of the species have the potential to occur in the Study Area. Common species include mule deer, elk, and black bear.

The Study Area contains a mosaic of wildlife habitats, dominated by mature Pacific silver fir and mountain hemlock forests and by modified herbaceous and shrub communities. Other habitat types include mature western hemlock forest, immature western hemlock and Pacific silver fir forest, natural shrub and herbaceous areas, and wetlands, ponds, and lakes. These habitat types are discussed in greater detail in Section 3.6.1.4 - Wildlife Habitats and Associated Species of this document and vegetation types are described in greater detail in Section 3.5 – Vegetation.

3.6.1.3 Species Included in Analysis

Wildlife species included in this analysis are those either known to occur or potentially occurring in the Study Area and which fall into one of the following categories:

- Species listed as endangered or threatened, and species proposed for listing, under the ESA;
- USFS sensitive species, which are species for which there are viability concerns as determined by the Regional Forester;
- Other rare and uncommon species;
- Species of concern identified by the USFWS, some of which are former Category 1 and Category 2 candidates (those species whose conservation standing is of concern to the USFWS, but for which status information is still needed);

USFS/MBSNF/OWNF Management Indicator species (MIS); the MBSNF Land and Resources Management Plan (USDA 1990a) and the WNF Forest Plan (USDA 1990b) identify Standards and

Guidelines to manage these species as representatives of a wide range of vertebrate species. A complete list of species included in this analysis, their status, primary habitat association, and probability of occurring in the Study Area, is found in Table 3.6.1-1. Table 3.6.1-FEIS 1 summarizes for which specific surveys have been completed as part of this NEPA process. Additional information regarding specific surveys can be found in Appendix D – Wildlife Resources Report and survey reports are on file with the MBSNF Snoqualmie Ranger District.

Table 3.6.1-1:
Species Potentially Occurring in the Study Area

Species Name	Status	Habitat Association	Probability of Occurrence
Primary Association with Forested Communities			
Northern spotted owl (*Strix occidentalis caurina*)	FT	Requires mature and old-growth forest, with multiple canopy layers and large amounts of dead and down woody material (FEMAT 1993).	Potential habitat available in areas of mature forest habitat within the Study Area and the Analysis Area. One spotted owl response to surveys conducted in 1994 and 1995; no spotted owls found during surveys conducted in 2001, 2002, and 2007 (barred owls found in vicinity of previous spotted owl response). Has been documented in the greater Snoqualmie Pass area (WDFW 2002; Sovern 2003 pers. comm.).
Marbled murrelet (*Brachyramphus marmoratus*)	FT	Mature and old-growth forest with trees having large-diameter branches for nesting (Hamer and Cummins 1991).	Potential habitat available in areas of mature forest habitat within the Study Area and the Analysis Area. No murrelets detected during surveys conducted in 1994, 1995, 2001, 2002, and 2007. Has been documented within the Analysis Area (WDFW 2002).
Pileated woodpecker (*Dryocopus pileatus*)	MIS	Mature and old-growth forest; second growth with abundant snag and down wood component (Rodrick and Milner 1991).	Known to occur in the Study Area (Jones & Stokes 1995a).
Primary cavity excavators	MIS	A variety of forested habitat types.	One species is known to occur in the Study Area. Potential habitat occurs in the Study Area for the remainder of these species and they may occur in the Study Area.
Olive-sided flycatcher (*Contopus borealis*)	FC	Northern and mountainous coniferous forests; perches on high dead branches (Stokes & Stokes 1995a) or dead tops of trees (Ehrlich et al. 1988).	Known to occur in the Study Area (Jones & Stokes 1995a).
Northern goshawk (*Accipiter gentilis*)	FC	Large stands of multi-layered old growth forest containing small openings (Johnsgard 1990).	Known to occur in the Study Area (WDFW 2002).
Great gray owl (*Strix nebulosa*)	FSS	Mature forest stands (80+ years) with greater than 60% canopy cover within 1,000 feet of a natural opening or meadows larger than 10 acres (USFS 1995b).	Potential habitat for this species exists within the Study Area. No great gray owls were detected during surveys conducted in 1999 and 2000.
FT = Federal Threatened, FE = Federal Endangered, FC = Federal (USFWS) Species of Concern, J2 = Identified as of Concern in Appendix J2 of the ROD, RU = Rare and Uncommon, FSS = Forest Service Sensitive, and MIS = Management Indicator Species			

Table 3.6.1-1:
Species Potentially Occurring in the Study Area

Species Name	Status	Habitat Association	Probability of Occurrence
Silver-haired bat (*Lasionycteris noctivagans*)	J2	Prefer older Douglas-fir/western hemlock forest to younger forests. Choose trees larger and taller than average, dead or damaged trees that contain refuge (Christy and West 1993). Forage primarily in clearcuts (Erickson and West 1996)	Potential habitat in the Study Area, may occur.
Hoary bat (*Lasiurus cinereus*)	J2	Roost almost exclusively in trees, preferring older conifer forests, and forage in open areas. Thought to be only a summer resident or spring and fall migrant of Washington. (Johnson and Cassidy 1997; Nagorsen and Brigham 1993)	Potential habitat in the Study Area, may occur.
Long-eared myotis (*Myotis evotis*)	FC	Forested habitat below the subalpine/parkland zone; roosts in trees, buildings, and caves and occurs in areas of low-density development (Johnson and Cassidy 1997).	Potential habitat in the Study Area, may occur.
Long-legged myotis (*Myotis volans*)	FC	A variety of habitats including arid range lands, and humid coastal and montane forests. Summer day roosts are in buildings, rock crevices, fissures in the ground, and tree bark. Maternity colonies occur in attics, fissures in the ground, and under tree bark. Caves and mines are used for night roosts and hibernacula (Nagorsen and Brigham 1993).	Potential habitat in the Study Area, may occur.
Yuma myotis (*Myotis yumanensis*)	FC	Forages primarily over open, still water. May prefer old growth to mature or young stands (Thomas and West 1991).	Potential habitat in the Study Area, may occur.
Pacific western (Townsend's) big-eared bat (*Corynorhinus townsendii*)	FSS	Utilize caves, old mines, and buildings for summer day roosts; nursery colonies, and hibernaculum; migrate short distances between summer and winter use areas (Nagorsen and Brigham 1993).	Potential habitat in the Study Area, may occur.
Fisher (*Martes pennanti*)	FC	Dense mature forest; second growth with adequate cover; require snags and down logs; low to mid elevation forest (Johnson and Cassidy 1997).	Potential habitat in the Study Area, may occur.
FT = Federal Threatened, FE = Federal Endangered, FC = Federal (USFWS) Species of Concern, J2 = Identified as of Concern in Appendix J2 of the ROD, RU = Rare and Uncommon, FSS = Forest Service Sensitive, and MIS = Management Indicator Species			

Table 3.6.1-1:
Species Potentially Occurring in the Study Area

Species Name	Status	Habitat Association	Probability of Occurrence
American marten[a] (*Martes americana*)	MIS	Prefer mature, mesic forests with complex physical structure near the ground (course woody debris, large talus, low hanging branches). Generally avoid cleared or open areas. (Buskirk and Ruggiero 1994)	Known to occur in the Study Area (MBSNF sighting database; WDFW 2002).
Primary Association with Riparian Communities			
Bald eagle (*Haliaeetus leucocephalus*)	FSS	Almost always found near large bodies of water where primary prey items of fish and waterfowl can be found (USFWS 1986).	May occur in the Analysis Area, not expected to regularly occur in the Study Area.
Harlequin duck (*Histrionicus histrionicus*)	FC	Summer habitat is fast flowing streams with nearby loafing sites; cobble to boulder substrate; vegetated banks. Usually found in areas of mature and old-growth forest cover (Lewis and Kraege 1999; Cassirer and Groves 1994 in Lewis and Kraege 1999).	Potential habitat in the Study Area, may occur.
Van Dyke's salamander (*Plethodon vandykei*)	RU	Usually among large, woody debris within the wetted edge of streams and seeps. Near the northernmost edge of known range. (Leonard et al. 1993).	Potential habitat occurs within the Study Area in forested riparian areas. No Van dyke's salamanders were found during surveys conducted from 1997 through 1999.
Primary Association with Aquatic Communities			
Cascades frog (*Rana cascadae*)	FC	Highly aquatic; closely associated with edges of seeps and other wetlands (Leonard et al. 1993).	Known to occur in the Study Area.
Red-legged frog *(Rana aurora)*	FC	Breeds in ponds or slow-moving water containing aquatic vegetation; adults highly terrestrial, occurring in forested areas or disturbed sites with a residual down wood component (Dvornich et al. 1997). Rarely found at elevations above 3,000 feet (Corkran and Thoms 1996).	May occur in the Analysis Area, not expected to regularly occur in the Study Area.
Tailed frog (*Ascaphus truei*)	FC	Turbulent mountain streams; has been found as high as 7,000 feet elevation (Leonard et al. 1993).	Known to occur in the Study Area (Jones & Stokes 1995a; WDFW 2002).
Western toad (*Bufo boreas*)	FC	Breed in lakes, ponds, and wetlands; adults utilize a variety of habitats including forest, brushy areas, and meadows (Corkran and Thoms 1996).	Known to occur in the Study Area (Jones & Stokes 1995a).

FT = Federal Threatened, FE = Federal Endangered, FC = Federal (USFWS) Species of Concern, J2 = Identified as of Concern in Appendix J2 of the ROD, RU = Rare and Uncommon, FSS = Forest Service Sensitive, and MIS = Management Indicator Species.

Table 3.6.1-1:
Species Potentially Occurring in the Study Area

Species Name	Status	Habitat Association	Probability of Occurrence
Primary Association with Cliff and Talus Habitats			
Peregrine falcon (*Falco peregrinus*)	FSS, FC	Cliffs for nesting; concentrations of waterfowl and/or flocking birds for foraging (Johnsgard 1990).	May occur in the Analysis Area, not expected to regularly occur in the Study Area.
Mountain goat (*Oreamnos americanus*)	MIS	Closely associated with steep, rocky cliffs, pinnacles, ledges, and talus slopes. Dense conifer stands, including mature and old-growth, may be important in providing winter forage and thermal cover (USDA 1990a; WDFW 1999a).	Known to occur in the Study Area (DeRosier 2003 pers. comm.) and in the Analysis Area (MBSNF sighting data; WDFW 2002).
Larch mountain salamander (*Plethodon larselli)*	RU	Steep, moist talus slopes, usually moss-covered and under a forest canopy (Leonard et al. 1993). Species has been found as far north as Cle Elum, WA.	May occur within forested habitats within the Study Area in areas of talus or coarse down woody debris habitat. No Larch Mountain salamanders were found during surveys conducted from 1997 through 1999. Known to occur in the Analysis Area (WDFW 2002).
Primary Association with Herbaceous and Shrub Communities			
Primary Association with General Communities			
Grizzly bear (*Ursus arctos horribilis*)	T	Vast areas of remote, undisturbed habitat; a variety of habitats including meadows, wet areas, open slopes with huckleberries (USFWS 1993)	Known to occur in the Analysis Area (WDFW 2002), not expected to regularly occur in the Study Area.
Gray wolf (*Canis lupus)*	E	Remote, undisturbed habitat; isolation from human disturbance for denning (Paradiso and Nowak 1982).	Known to occur in the Analysis Area (WDFW 2002), not expected to regularly occur in the Study Area.
Elk (*Cervus elaphus*)	MIS	Combination of forest and open habitats. Seclusion from human disturbance important for calving (Thomas and Toweill 1982)	Known to occur within the Study Area (MBSNF sighting data; observed during field work for this analysis).
Mule deer (*Odocoileus hemionus*)	MIS	Typically inhabit higher elevations in the summer and lower elevations in the winter. Benefit from interspersion of vegetative communities. Riparian zones are important for fawning. (USFS 1998a)	Known to occur in the Study Area (MBSNF sighting data; observed during field work for this analysis).
Wolverine (*Gulo gulo)*	FC, FSS	Utilizes a variety of habitats including tundra, taiga, boreal forest, high-elevation mixed conifer in alpine and sub-alpine zones. Distribution dependent on availability of large ungulates (Banci 1994; Johnson and Cassidy 1997).	Known to occur in the Analysis Area (WDFW 2002), not expected to regularly occur in the Study Area.
FT = Federal Threatened, FE = Federal Endangered, FC = Federal (USFWS) Species of Concern, J2 = Identified as of Concern in Appendix J2 of the ROD, RU= Rare and Uncommon, FSS = Forest Service Sensitive, and MIS = Management Indicator Species.			

[a] The MBSNF LRMP uses the common name of pine marten for this species.

Table 3.6.1-FEIS-1:
Summary of Wildlife Surveys within The Summit-at-Snoqualmie Study Area

Summit at Snoqualmie MDP Surveys			
Species	**Status**	**Survey Dates**	**Results**
Northern spotted owl	Threatened	1994, 1995, 2001, 2002, 2007	Not Detected
Marbled murrelet	Threatened	1994, 1995, 2001, 2002, 2007	Not Detected
Gray wolf	Endangered	1994-1995	No Confirmed Sightings
Great gray owl	Forest Service Sensitive	1999, 2000	Not Detected
Northern goshawk	Forest Service Sensitive	1994, 1995	Not Detected
Townsend's big-eared bat	Forest Service Sensitive	1994	Not Detected
Blue-grey taildropper	Rare and Uncommone	1998-2001	Not Detected
Warty jumping slug	Rare and Uncommone	1998-2001	Not Detected
Keeled jumping slug	Rare and Uncommone	1998-2001	Not Detected
Evening fieldslug	Rare and Uncommone	1998-2001	Not Detected
Pappillose tail-dropper	Rare and Uncommone	1998-2001	Not Detected
Larch mountain salamander	Forest Service Sensitive	1997-1999	Not Detected
Van Dyke's salamander	Forest Service Sensitive	1997-1999	Not Detected

Several species on the list of threatened or endangered species for the MBSNF and/or OWNF, or on the Regional Foresters Sensitive Species list, were not included in this analysis due to a lack of habitat in the Study Area. These species include Canada lynx, common loon, northwestern pond turtle, striped whipsnake, greater sandhill crane, upland sandpiper, and sage grouse. Of these species, Canada lynx and common loon may occur in the Analysis Area.

Habitat for Canada lynx was mapped on both Forests using guidelines provided in an August 22, 2000 memo from the Lynx Biology Team to the FS, BLM and FWS in the western United States. This memo recommended that lynx habitat be mapped using the following criteria:

- Areas below 4,000 feet elevation should generally be excluded.
- Primary vegetation habitat for lynx in the Cascades is mesic subalpine fir dominated by spruce, fir, Douglas-fir and lodgepole pine.
- Other cool, moist vegetation types should only be included in lynx habitat if they are intermingled and adjacent to primary habitat. The Pacific silver fir and mountain hemlock vegetation types are not lynx habitat.

The Study Area and most of the area immediately surrounding Snoqualmie Pass are below 4,000 feet except on the very tops of the mountains, lack sub-alpine fir and lodgepole pine forests, and consist mainly of Pacific silver fir and mountain hemlock forest. No lynx habitat was mapped in the Study Area

and lynx are not expected to regularly occur in this area. Lynx may travel through the Study Area, and habitat connectivity is addressed as a separate issue in this document.

Common loons may occur in association with large lakes in the Analysis Area, for example Keechelus Lake, however they are not expected to occur within the Study Area and activities within the Study Area are not expected to have any impact on common loons or their habitat outside of the Study Area.

3.6.1.4 Wildlife Habitats and Associated Species

For this analysis, species have been grouped by their primary habitat association which includes:

- forested habitats
- riparian habitats
- aquatic habitats
- cliff and talus
- herbaceous and shrub habitats
- general habitats

Unique habitats, as defined under the MBSNF Forest Plan, as Amended (USDA 1990a; USDA and USDI 1994) and the WNF Forest Plan, as Amended (USDA 1990b; USDA and USDI 1994), will be discussed under the appropriate primary habitat discussion.

Vegetation within the Study Area has been classified through review of existing GIS data, aerial photograph interpretation, and field level reconnaissance surveys. Table 3.6.1-2 presents the vegetation types and acreage of the types occurring in the Study Area. A more detailed description of the vegetation within the Study Area is located in Section 3.5 – Vegetation.

Table 3.6.1-2:
Existing Landcover Types within
The Summit-at-Snoqualmie Study Area

Vegetation Type	Acres within Study Area
Forested Habitats[a] (acres)	
Western hemlock, mature	47.71
Western hemlock, immature	96.18
Mountain hemlock, mature	224.61
Pacific silver fir, mature	780.80
Pacific silver fir, immature and sapling	519.90

Table 3.6.1-2:
Existing Landcover Types within
The Summit-at-Snoqualmie Study Area

Vegetation Type	Acres within Study Area
Riparian habitats[a] (acres)	
Western hemlock, mature	22.48
Western hemlock, immature	16.36
Mountain hemlock, mature	23.87
Mountain hemlock, immature	0.00
Pacific silver fir, mature	273.22
Pacific silver fir, immature and sapling	99.92
Shrub, natural	43.16
Shrub, modified	116.56
Herbaceous, natural	13.77
Herbaceous, modified	146.29
Rock/Talus	13.48
Developed	30.38
Aquatic habitats	
Ponds and Lakes	1.34
Wetlands	72.29
Streams[b] (miles)	29.47
Cliff and talus habitat	
Rock/Talus	235.26
Herbaceous and shrub habitats	
Shrub, natural	107.99
Shrub, modified	341.87
Herbaceous, natural	14.77
Herbaceous, modified	433.97

[a] Includes wetland and lake landcover types.
[b] Includes jurisdictional streams.
Note: This table includes the Mill Creek portion of the Study Area.

Of the approximately 2,900 acres Study Area, approximately 1,885 acres are located within the U. Yakima Watershed and 1,014 acres are located within the Upper S.F. Snoqualmie Watershed. Within each subwatershed, the land is further divided between public and private ownership, with approximately 870 acres and public land and 1,015 acres of privately owned land in the U. Yakima Watershed and

approximately 882 acres of public land and 132 acres of privately owned land in the S.F. Snoqualmie Watershed. The vegetation communities associated with public and private lands are described in greater detail in Section 3.5.2 - Upper Yakima River Watershed and displayed in Table 3.5.2-1 - Existing Land Cover Types Within The Summit-at-Snoqualmie Study Area.

The existing condition of lands within both the Study Area and the larger Analysis Area has been influenced by a variety of factors both natural and human caused. Naturally occurring events that influence habitat include wildfires, avalanches, and windthrow. Large stand replacing fires are known to have occurred in the vicinity (USFS 1995a; USFS 1997) and evidence of avalanche and windthrow is apparent in the Analysis Area. These types of events create diversity in the habitat on a landscape level.

Human caused factors that have influenced wildlife habitat in both the Study Area and the Analysis Area include construction of roads and trails, ski area development, commercial and residential development, timber harvest, and mining.

Within the Study Area ski area development has had the greatest impact on wildlife habitat with large areas cleared for ski trails, lift construction, buildings, parking lots, and access roads. Forest habitat has been removed and converted to a modified shrub or herbaceous condition that has been maintained in this condition. This conversion began in the 1930's with development of recreation and continues to the present. This is considered a permanent habitat change. Riparian and wetland habitat have also been altered by past development activities, including vegetation removal, filling and grading activities associated with ski trail development and through modification of vegetation type from ski trail development and maintenance. Timber harvest and road building has modified habitat within the Mill Creek portion of the Study Area (Section 21).

Construction of Interstate 90 and both residential and commercial development on lands adjacent to the Study Area has also resulted in a permanent loss of habitat and a barrier to movement through the area.

Within the Analysis Area land ownership and management allocation have largely influenced current habitat conditions. The area to the west and north of Alpental has been designated Wilderness and so contains habitat that is largely natural with the exception of the presence of hiking trails and the associated impacts of high human use of these trails. East and southeast of Alpental historic mining claims now contain residential developments, and Interstate 90 bisects the Analysis Area between Alpental and The Summit.

South of I-90 much of the Analysis Area was historically owned and managed in a checkerboard pattern. This checkerboard pattern in which alternate sections were federally or privately owned was the legacy of land grants to the Northern Pacific railroad and dates back to 1864 (USFS 1997). Since that time, the land formerly owned by the railroad has been sold to a variety of interests and many of these sections have

been intensively logged and or developed. Logging and development have also occurred on NFSL in the Analysis Area.

This checkerboard ownership led to a highly fragmented condition of mature forest and to concerns about habitat connectivity across the landscape, as described in the SPAMA (USFS and USFWS 1997). Within the Study Area the large patch of mature forest located in Section 16 (Summit East) that extends from Interstate 90 up hill to the Study Area boundary and beyond to the section boundary has been identified for the purposes of this analysis as an important area for habitat connectivity within the greater Snoqualmie Pass Area.

An effort has been made in recent years to reduce the amount of checkerboard land ownership in the Cascades. This pattern was greatly reduced in the Analysis Area by the recent land exchanges and purchases involving Plum Creek and the USFS.

Wildlife habitat in the Analysis Area is currently dominated by immature forest with fragmented patches of mature forest interspersed. The area within and directly adjacent to the Study Area is highly developed and includes the developed ski areas, commercial and residential development, and the Interstate and other secondary roads. Human activity occurs within this area on a year round basis and includes activities associated with residences, businesses, and recreation. Recreational use within the Study and Analysis Areas includes alpine skiing, tubing, Nordic skiing, and snowshoeing during winter and hiking and mountain biking during summer. The majority of alpine skiing occurs in the Study Area, however an extensive network of Nordic skiing trails occur outside of the Study Area, as shown in Figure 2.3.2-5, Nordic Trail Network. Many of these trails are actually logging roads and are also used as mountain bike trails in the summer. In addition to these trails, there is a single-track mountain bike trail that runs from the existing road 9070-110 to the east of Hyak Lake and down through the mature forest in Section 16 (Summit East) to the existing Summit Central-Summit East Crossover trail.

The presence of large numbers of people throughout the year reduces the habitat suitability for many wildlife species, since many species are sensitive to human activity and tend to avoid areas of high human use. In addition much of the developed ski area is lit for skiing at night on a regular basis through out the winter season, as shown in Table 2.3.2-3, and ski trail grooming activities occur at night throughout the ski season, potentially impacting use of the area by nocturnal species.

Habitat conditions for species included in this analysis and existing habitat connectivity are described in the following sections.

3.6.1.5 Forested Habitat

Forested community types include forested plant communities of all ages, from recently harvested regeneration stands to mature stands providing late-successional habitat (LSH). The majority of forested stands in the Study Area are mature Pacific silver fir and mountain hemlock forest. These forested stands

occur primarily on NFSL, with some also occurring on privately owned lands (see Table 3.5.2-1). A detailed description of forested habitat types is located in Section 3.5 - Vegetation.

Within forested habitats, snags and coarse woody debris (CWD) are important components of wildlife habitat. Many wildlife species depend on snags or downed logs for a portion of their life requirements. Snags are used by at least 100 vertebrate species in forests in western Washington and Oregon (Brown 1985), of which 53 use them as primary habitat for breeding, foraging or resting (USFS 1995a). Some species require snags in conjunction with early successional habitat, while others are generalist species that prefer mid- to late-successional habitats.

The MBSNF Forest Plan, as Amended (USDA 1990a; USDA and USDI 1994) and the WNF Forest Plan, as Amended (USDA 1990b; USDA and USDI 1994) emphasize protection and management of CWD to meet the needs of species and provide for ecosystem functions. The SPAMA (USFS and USFWS 1997) provides guidelines for the maintenance of CWD and snags.

In order to assess conditions in the Study Area, vegetation data, including data on snags and CWD, was collected in 16 one-tenth acre plots located in areas of LSH in the vicinity of Summit East, the existing snow-play area, and along Forest Service Road 9070-110. These areas were considered to be representative of the existing unmanaged forested habitat within the Study Area. All woody debris larger than 4 inches diameter and 2 feet long was tallied, as were all snags. Data collected on CWD included large and small end diameters, length and decay class, with decay class determined using definitions from Brown (1985). Data collected on snags included height, dbh, and decay class, again using decay classes from Brown (1985). The results of the field data collected and how it compares with SPAMA Management goals are presented in Table 3.6.1-3.

Table 3.6.1-3:
Snag and CWD Survey, Summit at Snoqualmie

Parameter	SPAMA Management Goal	Summit at Snoqualmie Field Surveys[a]
Linear feet per acre (average)	540 to 720	798
9-16” diameter	10%	60%
16-24” diameter	30%	24%
24-36” diameter	30%	13%
36-40” diameter	20%	0%
>40” diameter	10%	0%
Snags per acre	21-40	25

[a] 1/10 acre plots surveyed in areas of natural vegetation mature forest in the vicinity of Summit East (Section 16), and Summit West (between SR 906 and existing maintenance facility).

The SPAMA Plan has a goal for enough snags to maintain 100 percent of the maximum population level of cavity nesting birds and to provide snags of a variety of diameter size classes distributed across the landscape for a variety of animals including cavity nesting birds, and mammals that utilize snags such as

marten and several species of bats. Since precise estimates of how many snags are required for this goal are lacking, the SPAMA plan encourages a conservative strategy for retaining snags, with a recommendation of 21-40 snags per acre in the wet series forests of the Snoqualmie Pass area. The plan also strives for retention of 540 to 720 lineal feet of CWD in Pacific silver fir forest (USFS and USFWS 1997).

Although the sample size was small, the results of the field studies indicate that CWD length is within the range recommended by the SPAMA but that the larger diameter pieces are deficient. This may be due to harvest and incidental removal of large wood since most plots showed evidence of harvest activity in the form of cut stumps and sawed logs. The lack of large diameter downed wood limits the habitat value of the mature forests for species such as marten, fisher, weasels, and pileated woodpecker.

Snags were present in 14 of the 16 plots and a total of 40 snags were recorded. Any standing dead tree greater than 2 inches diameter was counted although small diameter snags have limited value for wildlife. Eight snags (20 percent) were in the 2 to 9-inch dbh size class. The majority of snags (27 snags, 68 percent) were in the 10 to 29-inch dbh size class and 5 snags (12 percent) were in the 30 to 40-inch dbh size class, with the largest snag measured being 45 inches dbh. The majority of snags (65 percent) were less than 25 feet tall. Decay class data was collected on 35 of the snags and of these 28 were (80 percent) were decay class 5 or greater, using the classes from Brown (1985).

Although the sample size was small, this data suggests:

- The number of snags per acre within the portion of the Study Area that contains LSH is at the low end of the AMA management goal range;
- The majority of snags are in the median size class; and
- The majority of snags are in the later stages of decay.

Live trees with broken tops or other wildlife value appeared to be present at useful densities in the mature mountain hemlock forest and in the patches of mature mixed conifer/western hemlock along SR 906 and the snow-play area. Blow-down is the largest source of large downed logs in the area.

Table 3.6.1-4 shows the species having a primary association with forested habitat and the forested habitat types with which they are primarily associated. Some species are grouped in order to reduce repetition.

Table 3.6.1-4:
Species Having a Primary Association with Forested Habitat and the Forest Types with which They are Associated in the Study Area

Species	Forested Habitat Types	Acres within the Study Area
Northern spotted owl Marbled murrelet Fisher	Mature western hemlock and pacific silver fir	**828.50**
Great gray owl Pileated woodpecker Primary cavity excavators Olive-sided flycatcher Northern goshawk Silver haired bat Hoary bat Long-eared myotis Long-legged myotis Yuma myotis Pacific western big-eared bat Marten Terrestrial mollusks Neotropical migratory birds (30 species, see Table 3.6.1-5)	Mature western hemlock, mature Pacific silver fir, and mature mountain hemlock	**1,053.11**
Neotropical migratory birds (11 species, see Table 3.6.1-5)	Immature mixed conifer- Pacific silver fir; Pacific silver fir-sapling; immature western hemlock.	**616.07**

Note: This table includes the Mill Creek portion of the Study Area.

Special status species included for analysis and a summary of information about habitat requirements and the potential for them to occur in the Study Area is contained in Table 3.6.1-1. A more detailed description of each species habitat needs and probability of occurrence in the Study Area is located in Appendix D - Wildlife Resources Report.

Habitat conditions in the Study Area and potential for occurrence of each of these species within the Study Area is described below.

Northern spotted owls, marbled murrelets, and fisher are three mature forest-dependent species that may occur in the Study Area and are associated with mature western hemlock and Pacific silver fir forest types (see Table 3.6.1-4). There are approximately 828 acres of potential habitat for these species in the Study Area, including 239 acres on public land in the S.F. Snoqualmie Watershed and 68 acres on private land in the S.F. Snoqualmie Watershed, 341 acres on public land in the U. Yakima Watershed and 180 acres on private land in the U. Yakima Watershed (see Figures 3.5.1-1, Existing Vegetation Cover – The Summit, and 3.5.1-2, Existing Vegetation Cover - Alpental, and Table 3.5.2-1). The amount of habitat available for the northern spotted owl may actually be less because these numbers include mature forest in the Pacific silver fir zone which has historically been considered potential nesting habitat for this species (USFS

1995a), however recent research suggests that spotted owls may not use true-fir dominated stands for nesting habitat (Herter and Hicks 2000).

Northern spotted owls are known to occur on both the east and west sides of the Cascades in the vicinity of the Snoqualmie Pass area. According to the SPAMA analysis, there are 33 known spotted owl activity centers and 143,021 acres of potential spotted owl habitat within the SPAMA (USFS and USFWS 1997). It is important to note that spotted owl habitat available in the Study Area is not representative of habitat within the SPAMA. The Study Area is located on the western edge of the SPAMA near the Cascade Crest and is a transition area between wetter western Cascade forest types and drier eastern Cascades forest types. Figure 1.1.1-FEIS-2, Existing NFSL Allocation depicts the AMA in relation to the Study Area.

As of 1994, there were 20 known spotted owl activity centers in the U. Yakima Watershed (USFS 1997) and 80,760 acres of habitat within the watershed. There are three known spotted owl activity centers in the S.F. Snoqualmie Watershed and 10,143 acres of potential habitat (USFS 1995a). As mentioned above, the actual amount of nesting and roosting habitat available may be lower based on the findings of Herter and Hicks (2000).

In the Washington Cascades Physiographic province, spotted owl home range territories are considered to encompass 1.8 miles of land around an activity center (USFWS 1990). Of the activity centers mentioned above, only one of the 1.8-mile-radius circles includes lands within The Summit-at-Snoqualmie. This territory is centered near Mt Catherine and extends into the Study Area to include a portion of the southwest corner of Section 16 (Summit East) near Summit East and most of Section 21 (Mill Creek), excluding primarily the northeast corner of this section.

Spotted owl surveys were conducted in potential spotted owl habitat within and adjacent to the Study Area in 1994 and 1995, 2001 and 2002, and again in 2007. One call response was obtained in the Mt. Catherine area in 1994, while no spotted owls were found during 2001, 2002, and 2007. This area is also monitored by the OWNF and by Raedeke Associates as part of a long-term demographic study. Surveys conducted by Raedeke Associates in 2003 resulted in a pair of nesting spotted owls being found, however no young were fledged (Sovern 2004 pers. comm.). The site center for this pair is approximately 1 mile away from the Study Area boundary.

The Summit-at-Snoqualmie is not within designated critical habitat for the northern spotted owl. The boundary of the nearest critical habitat unit (CHU), CHU-33, is located to the west and south of The Summit and at its nearest point is approximately 0.25 mile west of the Study Area boundary in Section 16 (Summit East) and is directly adjacent to Section 21 (Mill Creek).

The majority of the mature forest in the Study Area is in the Pacific silver fir zone. Based on the findings of Herter and Hicks (2000), this mature forest may not be utilized as nesting habitat or as roosting habitat, which generally exhibits the same characteristics as nesting habitat, but is expected to function as

potential foraging and dispersal habitat for the northern spotted owl. The Snoqualmie Pass area was identified in the SPAMA EIS (USFS and USFWS 1997) as an important area for habitat connectivity for spotted owls (see Section 3.6.2 - Habitat Connectivity) and the large, relatively contiguous patch of mature forest in Section 16 (Summit East) in the Study Area is considered an important component of the existing connectivity in the area.

Marbled murrelets are associated with mature western hemlock and Pacific silver forests and have the potential to occur in the Study Area. According to the SPAMA EIS, there are approximately 89,266 acres of marbled murrelet habitat within the SPAMA analysis area. There has been only one historic detection of marbled murrelet within the SPAMA, approximately 2miles east of the Cascade Crest (USFS and USFWS 1997). There have been no detections within the Study Area boundary.

Late successional forest containing large (>32-inch dbh) western hemlocks are considered suitable nesting habitat for marbled murrelets (Federal Register 1996, 60 FR 26256-26320). Potential nesting habitat within the Snoqualmie Pass area is between 40 and 50 miles inland from salt water. On the MBSNF, the majority (52 percent) of marbled murrelet detections to date have occurred within 20 to 29 miles inland from Puget Sound; 42 percent within 30 to 39 miles inland; four percent within 40 to 49; and less than 1 percent between 50 and 60 miles inland. While this suggests a preference for habitat closer to salt water, surveys were not evenly distributed, with more surveys conducted within the 40 miles or less zone (USFS and USFWS 1997). Hamer (1995) found that murrelet detections decreased with both increased distance from salt water and increased elevation, with a sharp decline in detections occurring above 3,500 feet elevation. While the Snoqualmie Pass area is greater than 40 miles from salt water, potential habitat in the area occurs at elevations less than 3,500 feet.

Protocol surveys were conducted for marbled murrelets in the potential habitat within and directly adjacent to the Study Area in 1994 and 1995, 2001 and 2002, and again in 2007. No marbled murrelets were detected during these surveys. The Summit-at-Snoqualmie is not within designated critical habitat for marbled murrelets. The boundary of the nearest CHU is CHU-10-c, is approximately 1 mile west of the Study Area boundary.

Fishers prefer dense mature forest, although the species inhabits second-growth forests that provide ample cover (Powell and Zielinski 1994; Johnson and Cassidy 1997). Records indicate that heavy snowfall at higher elevations may be detrimental to fisher (Johnson and Cassidy 1997).

Historically, fishers were present throughout Washington, although numbers were low relative to other western states. Currently, the fisher is exceedingly rare and in danger of extirpation (Lewis and Stinson 1998). Infrequent sightings and incidental captures in low to mid elevation forests and occasionally in silver fir dominated forests are the only reports that fishers still exist within the state (Lewis and Stinson 1998).

The S.F. Snoqualmie Watershed Analysis (USFS 1995a) concluded that habitat in the watershed was too fragmented to support fisher, but that the habitat in basins of the Middle and North Forks of the river was suitable and probably supported at least one pair of fishers. The width of I-90 and the road density (2.77 miles/square mile) in the Snoqualmie Pass area were considered an almost complete barrier to fisher dispersal (USFS 1995a).

The SPAMA FEIS (USFS and USFWS 1997) estimates a total of 127,000 acres of fisher habitat in the SPAMA. If fishers are present or re-introduced in Washington the Snoqualmie Pass area will be an important feature in the dispersal required for such a wide-ranging species.

No fishers were detected during intensive surveys for forest carnivores conducted in Washington in the 1980's and 1990's (Lewis and Stinson 1998). From 1969 to the present there have been only four incidental captures of fisher by trappers, and only four reliable sightings per year from 1980 to 1991. From this information the Washington State Status Report for the Fisher (Lewis and Stinson 1998) concluded that the fisher was either extirpated from the state or so rare that the population could not recover without re-introductions from other areas.

There are 42 other species of wildlife that may occur in the Study Area and are associated with mature western hemlock, Pacific silver fir, and mountain hemlock forest types (see Table 3.6.1-4). Thirty of these species are neotropical migratory birds, listed in Table 3.6.1-5. There are approximately 1,053 acres of potential habitat for these species in the Study Area; 406 acres on public land in the S.F. Snoqualmie Watershed, 72 acres on private land in the S.F. Snoqualmie Watershed, 394 acres on public land in the U. Yakima Watershed, and 180 acres on private land in the U. Yakima Watershed, with an additional approximate 1 acre of mature Pacific silver fir for which ownership is not defined in the GIS database (see Figures 3.5.1-1, Existing Vegetation Cover – The Summit, and 3.5.1-2, Existing Vegetation Cover - Alpental, and Table 3.5.2-1).

Great gray owls can be found in a variety of habitats but prefer dense conifer forest with interspersed open spaces (USFS 1995b). This species typically forage during the daylight in meadows or other openings. The main prey base is small mammals. Population numbers of owls fluctuate with changes in small mammal populations (Bull et al. 1990).

Potential great gray owl habitat within The Study Area and adjacent Analysis Area was defined from aerial photo interpretation and field verification. Based on review of the literature and characterization of the habitat at the Snoqualmie Pass Study Area/Analysis Area, potential nesting habitat occurs primarily in Section 16 (Summit East), with foraging habitat in the meadow east of Hyak Lake and in regenerating forest stands in the vicinity. Surveys for great gray owls were conducted in the potential habitat in the Study Area and the adjacent Analysis Area near Hyak Lake in 1999 and 2000 with none found.

Five species of woodpeckers may occur in the Study Area. The pileated woodpecker occurs throughout Washington and Oregon, and south to central California and east to Idaho and Montana (Winkler et al. 1995). This species is dependent upon large snags for nesting and large downed logs for foraging. Past timber harvests in the SPAMA and Snoqualmie Pass area, along with firewood collection, hazard tree removal and development of roads, ski trails and utility corridors have left the area deficient in both features (USFS and USFWS 1997). As previously mentioned, results of the random plot surveys of snags and CWD indicate a deficiency in large diameter snags and CWD, although areas of numerous large snags exist near Hyak Lake.

The hairy woodpecker, which specializes in conifer forests at all elevations, has been documented within the Study Area in Section 16 (Summit East). The Lewis' woodpecker is rare in Western Washington and occurs primarily in Ponderosa pine/shrub steppe transition in eastern Washington but may occur in the Study Area as a rare visitor (Larsen et al. 2004). The black-backed woodpecker, which utilizes high elevation open canopy forests on the east side of the Cascade crest, and the three-toed woodpecker, which utilizes high elevation, closed canopy conifer forests, is also rare but potentially present in the Snoqualmie Pass area (Smith et al. 1997).

Nest excavations and occasional sightings of pileated woodpeckers have been recorded in the mature forests of Summit East and in the larger trees and snags in the Snowplay area.

The olive-sided flycatcher is an aerial insectivore that breeds in upland forests and woodlands throughout most of the western U.S., and is common in most forested areas of Washington.

Olive sided flycatchers have been documented within the SPAMA (USFS and USFWS 1997), the U. Yakima Watershed (USFS 1997), and within the S.F. Snoqualmie Watershed (USFS 1995a) in the Olallie Creek drainage approximately 1 mile from the Study Area boundary (MBSNF sighting data). There are no records of olive-sided flycatcher in the PHS data for the Study Area (WDFW 2002) however this species was identified within the Study Area during field studies. This species is expected to occur throughout the Study Area.

The northern goshawk is adapted to hunting under the forest canopy in the Pacific Northwest (Johnsgard 1990). Within the SPAMA there is approximately 170,964 acres of potential habitat for northern goshawks, 30 sites with goshawk detections, and eight confirmed nests, all on the east side of the Cascade Crest, within the U. Yakima Watershed (USFS and USFWS 1997). No nests have been found in the S.F. Snoqualmie Watershed (USFS 1995a), and only one sighting has been recorded in this watershed (WDFW 2002).

Potential nesting habitat for goshawks occurs in the Study Area and this habitat was surveyed in 1994 with no goshawks detected. PHS data (WDFW 2002) indicates one goshawk nest in the general vicinity of Snoqualmie Pass, located southeast of the Study Area in the Rocky Run drainage in the U. Yakima

Watershed. PHS data show records of only one goshawk sighting within the S.F. Snoqualmie Watershed, approximately 1 mile from the SUP boundary (WDFW 2002).

Habitat within the Study Area is not representative of habitat in the SPAMA. The Study Area is located on the western edge of the SPAMA near the Cascade Crest and is a transition area between wetter western Cascade forest types and drier eastern Cascades forest types. Vegetation types, and therefore habitat quality, is not uniform across the SPAMA, with dominant tree species and forest type changing from west to east and, as indicated by the sighting information above, habitat conditions improving for goshawks in the eastern portion of the SPAMA.

The Snoqualmie Pass area is within the geographic range and habitat types used by the silver-haired bat, according to the analysis performed by the Washington Gap Analysis (Johnson and Cassidy 1997). Potential habitat for this species exists in the Study Area in areas of mature forest containing large damaged or dead trees. Open areas and lakes provide potential foraging habitat, are present at the higher elevations.

The Snoqualmie Pass area is also within the geographic range and habitat types used by the hoary bat, according to the analysis performed by the Washington Gap Analysis (Johnson and Cassidy 1997), with habitats utilized being similar to those described for the silver-haired bat above.

Three species of bats in the genus myotis that are associated with forested habitats and cliffs: the long-eared myotis, long-legged myotis, and the Yuma myotis. In Washington, the long-eared and the long-legged myotis are widespread throughout the state (Johnson and Cassidy 1997) while the Yuma myotis is more restricted (Ingles 1968).

Pacific western (Townsend's) big-eared bat has been documented on the MBSNF (USDA 1990a), with one winter hibernaculum about 20 miles south of the Pass area and hibernacula for males and juveniles elsewhere on the MBSNF and OWNF (USFS and USFWS 1997). Potential habitat for this species occurs within the Snoqualmie Pass area (USFS and USFWS 1997). Habitat surveys conducted by Jones & Stokes in 1994 within the Study Area at Alpental did not find any caves or detect this species (Jones & Stokes 1995b). The large amount of forest edge and the numerous lakes in the Analysis Area provide potential foraging habitat. These lakes include Frog Lake, Rockdale Lake, Surveyors Lake, Hyak Lake, Divide Lake, Lodge Lake, and Beaver Lake. Of these, only Beaver Lake is within the Study Area.

The primary habitat component for bats inhabiting forested landscapes is the presence of day and night roosts and maternity roosts. Potential roosting habitat in the Study Area for the six species of bats include:

- Buildings (all six species);
- Loose tree bark (silver haired bat, long-eared myotis, and long-legged myotis);
- Rock crevices (silver haired bat, long-eared myotis, and long-legged myotis).

- Caves and mines (Townsend's big-eared bat, silver-haired bat, hoary bat, long-eared myotis, and Yuma myotis);
- Bridges (Townsend's big-eared bat, long-legged myotis, and Yuma myotis);
- Snags (silver-haired bat, hoary bat, long-eared myotis, and long-legged myotis); and
- Conifer and hardwood foliage (hoary bat).

Of these features, snags and trees with loose bark occur throughout areas of mature forest habitat; buildings and bridges occur mostly in association with base area development, where high levels of human activity may preclude use of some buildings by bats; and caves, mines, and rock crevices occur primarily in the Alpental area.

The S.F. Snoqualmie Watershed and U. Yakima Watershed analyses estimate 3,703 acres of breeding habitat and 7,163 acres of foraging habitat available for Townsend's big-eared bat in the S.F. Snoqualmie Watershed (USFS 1995a, 1997), and 32,010 acres of potential foraging habitat in the U. Yakima Watershed (USFS 1997). None of the six bat species have been documented within the Study Area.

American marten generally prefer mature, mesic forests with complex physical structure near the ground (e.g., large woody debris, large talus or low hanging branches). Large woody debris is especially important to martens in winter because it provides thermal cover and creates small openings where they hunt small mammals.

Martens have been documented in the Study Area, in Section 16 (Summit East) and in the vicinity of Summit Central, Summit West, and Alpental (WDFW 2002). Recent winter tracking wildlife surveys have detected marten near Hyak Lake and lower elevations within the Hyak Creek corridor (Wilderness Awareness School 2007). Marten were detected at six of the camera stations near I-90 at the Snoqualmie Pass area during the I-90 Snoqualmie Pass Wildlife Habitat Linkage Assessment (Singleton and Lehmkuhl 2000). Marten have also been detected at remote camera stations within Section 16 (Watkins 2007 pers. comm..). Within the U. Yakima Watershed there is an estimated 44,278 acres of denning habitat and 3,925 acres of foraging habitat available for martens (USFS 1997) and within the S.F. Snoqualmie Watershed there is an estimated 9,353 acres of denning habitat and 1,567 acres of foraging habitat available for martens (USFS 1995a).

Several species of mollusks identified as USFS Rare and Uncommon species have grouped under 'terrestrial mollusks' for purposes of this analysis. Based on the understanding of the range and habitat requirements of terrestrial mollusks, it was determined that the Study Area may be within the suspected range of 5 Rare and Uncommon species, the blue-grey tail-dropper (*Prophysaon coeruleum*), evening fieldslug (*Deroceras hesperium*), the keeled jumping slug (*Hemphillia burringtoni*), the warty jumping slug (*H. glandulosa*), and the pappillose tail-dropper (*Prophysaon dubium*). These species generally prefer moist forest with canopy closures greater than 70 percent and downed woody material. Surveys for

these terrestrial mollusks (see Table 3.6.1-FEIS-1) were conducted within the Study Area and have not identified the presence of these species. Several non-listed mollusks were identified within the Study and are discussed further in Appendix D – Wildlife Resources Report.

There are 41 species of neotropical migratory birds that have a primary association with forested habitat; 30 species are associated with mature forest and 11 species are associated with younger forests. These species are listed in Table 3.6.1-5. There are 1,669.20 acres of forested habitat available in the Study Area (see Table 3.6.1-2). Many of these species also utilize other habitats; however they are primarily associated with forested habitats (see Table 3.6.1-5). Of these species, two are also special status species that are discussed separately in this document (northern goshawk and olive-sided flycatcher).

Table 3.6.1-5:
Neotropical Migratory Birds Potentially Occurring in the Snoqualmie Pass Area Having a Primary Association With Forested Habitat[a,b]

Species	Old-Growth	Clearcut	Young Forest	Broad Leaf Forest	Riparian	Meadow	Marshes	Subalpine	Cliff
Late-Successional Forest Associates (eastside and westside)									
Sharp-skinned hawk[c]	X		X		X				
Cooper's hawk[c]	X		X	X	X				
Northern goshawk[f]	X								
Red-tailed hawk[c]	X		X	X	X	X			X
Vaux's swift[c]	X				X				
Northern flicker[f]	X	X	X		X				
Olive-sided flycatcher[c]	X	X	X		X				
Western wood-pewee[c]	X		X	X					
Hammond's flycatcher[c]	X		X	X	X				
Golden-crowned kinglet[d]	X		X						
Hermit thrush[c]	X		X						
American robin[c]	X	X	X	X	X	X			
Cassin's vireo[c,d]	X		X	X	X				
Yellow-rumped warbler[c]	X		X						
Townsend's warbler[c]	X		X						
Western tanager[c]	X		X	X	X				
Chipping sparrow[c,d]	X		X						
Dark-eyed junco[f]	X	X	X	X					
Rufous hummingbird[c,d]	X	X	X	X	X	X			X
Red-breasted sapsucker[f]	X		X	X					
Pacific-slope flycatcher[c]	X	X		X	X	X			
Swainson's thrush[f]	X	X	X	X	X				
Wilson's warbler[c,d]	X		X	X	X				
Merlin[e]	X	X	X		X				

Table 3.6.1-5:
Neotropical Migratory Birds Potentially Occurring in the Snoqualmie Pass Area Having a Primary Association With Forested Habitat[a,b]

Species	Old-Growth	Clearcut	Young Forest	Broad Leaf Forest	Riparian	Meadow	Marshes	Subalpine	Cliff
Late-Successional Forest Associates (westside only)									
Band-tailed pigeon[f]	X		X						
Hermit warbler[f]	X	X	X						
Late-Successional Forest Associates (eastside only)									
Flammulated owl[f]	X								
Red-naped sapsucker[f]	X		X	X					
Williamson's sapsucker[f]	X		X	X					
Dusky flycatcher[f]	X		X	X				X	
Early to Mid-Successional Forest Associates									
Turkey vulture[c]		X							X
MacGillivray's warbler[c]		X			X				
Brown-headed cowbird[c]		X		X	X				
Willow flycatcher[c]		X			X				
Cedar waxwing[c]		X		X	X				
Warbling vireo[c]		X		X	X				
Fox sparrow[f]		X			X				
Orange-crowned warbler[c,d]		X		X	X				
Black-throated gray warbler[c]			X	X	X	X			
Spotted towhee[f]		X		X	X				
White-crowned sparrow[c]		X			X				

[a] From I-90 Land Exchange EIS (USFS 1998a)
[b] Table modified from USFS 1998a and Andelman and Stock 1994.
[c] Included in Sharp (1992) list of species found in MBSNF.
[d] Population trends declining based on data for species where population trends are known (Andelman and Stock 1994).
[e] Species habitat association in this table was modified from its original association for this analysis.
[f] Migratory Bird Treaty Act of 1918

The majority of the species (73 percent) in Table 3.6.1-5 are primarily associated with late-successional forest with the remainder (27 percent) are associated primarily with immature forest. Of the species associated with late-successional forest 24 (80 percent) occur on both the east and west slopes of the Cascades, while two (7 percent) occur on the west side only and four (13 percent) occur only on the east side of the Cascades. Since the Study Area is located on the Cascade Crest; is located in two watersheds, one that drains west and one that drains east; and habitat in the Study Area is transitional between east and west sides; all species in this table are considered to have the potential to occur in the Study Area and habitat available for them in the Study Area, as shown in Table 3.6.1-4, has not been divided into east and west.

3.6.1.6 Riparian Habitat

Riparian habitats occur adjacent to water bodies, the width of which is described in Section 3.7. Table 3.6.1-6 indicates the species having a primary association with riparian habitat.

Table 3.6.1-6:
Species Having a Primary Association With Riparian habitat and the Specific Riparian Habitat Types With Which They are Associated Within the Study Area

Species	Riparian Habitat Types	Acres
Bald eagle	Mature conifer forest adjacent to large bodies of water (within Riparian Reserve of Lake Keechelus).	0
Van dyke's salamander	Riparian areas of streams, seeps and wetlands within mature western hemlock, mature Pacific silver fir, and mature mountain hemlock.	319.57
Harlequin duck	Riparian areas of perennial streams within mature western hemlock, mature Pacific silver fir, and mature mountain hemlock.	68.82
Neotropical migratory birds (19 species - see Table 3.6.1-7)	Various - see Table 3.6.1-7	n/a

Note: This table includes the Mill Creek portion of the Study Area.

A detailed description of each species habitat needs and probability of occurrence in the Study Area is located in Appendix D - Wildlife Resources Report.

Bald eagles are associated with riparian habitat adjacent to large bodies of water such as Lake Keechelus southeast of the Study Area (USFWS 1986). The only known active bald eagle nest within the SPAMA is near Lake Cle Elum, approximately 14 miles east of Snoqualmie Pass and outside of the U. Yakima Watershed (USFS and USFWS 1997). Five potential nesting territories for bald eagles have been identified within the U. Yakima Watershed, two adjacent to Lake Keechelus and three adjacent to Lake Kachess (USFS 1997). Within the U. Yakima Watershed there are an estimated 22,093 acres of potential nesting habitat available and 44,366 acres of potential roosting habitat (USFS 1997).

Within the S.F. Snoqualmie Watershed, bald eagles are known to nest below Snoqualmie Falls, over 20 miles from the Snoqualmie Pass area (USFS 1995a). According to the S.F. Snoqualmie Watershed analysis there are, however, approximately 618 acres of winter roosting habitat and 375 acres of nesting habitat available for bald eagles in the watershed (USFS 1995a).

There are no known bald eagle nest sites or winter roost sites within The Study Area or Analysis Area (USFS 1995a, 1997; WDFW 2002).

Harlequin ducks are associated with riparian areas of perennial streams in mature forest. There are 68.82 acres of this habitat type available within the Study Area (see Table 3.6.1-6), which assumes the area within a 50-foot buffer on perennial streams provides habitat for this species. Harlequin ducks have been documented within the SPAMA, which contains an estimated 102 acres of potential nesting habitat, defined as low gradient (3-12 percent) streams within LSH (USFS and USFWS 1997). Within the U. Yakima Watershed, there are an estimated 76 miles of streams that contain habitat for harlequin ducks, which have been documented in the watershed (USFS 1997). There are an estimated 3,162 acres of potential nesting habitat in the S.F. Snoqualmie Watershed, and three confirmed sightings (USFS 1995a).

Potential harlequin duck habitat occurs along Hyak Creek and the S.F. Snoqualmie River in Alpental however none have been reported in the Study Area. Use of potential habitat in Alpental may be limited by human disturbance. The closest reported observation is from Gold Creek Pond, east of the Study Area (WDFW 2002).

Van Dyke's salamander is associated with riparian areas of streams and seeps containing mature forest habitat and large down wood (Jones 1999). There are approximately 319 acres of potential habitat for Van Dyke’s salamander in the Study Area (see Table 3.6.1-6); 96 acres on public land in the S.F. Snoqualmie Watershed, 12 acres on private land in the S.F. Snoqualmie Watershed, 150 acres on public land in the U. Yakima Watershed, and 61 acres on private land in the U. Yakima Watershed (see Figures 3.5.1-1, Existing Vegetation Cover – The Summit, and 3.5.1-2, Existing Vegetation Cover - Alpental, and Table 3.5.2-1).

Within the S.F. Snoqualmie Watershed there is an estimated 4,487 acres of potential habitat for this species (USFS 1995a). There are no estimates of habitat availability for the U. Yakima Watershed since this species is expected to occur on the west slope of the Cascades and so was not included in the U. Yakima Watershed Analysis.

Surveys for Van Dyke’s salamanders were conducted in the Study Area due to the proximity of the Study Area to the Cascade Crest and the fact that little is known about the distribution of this species. Surveys for Van Dyke's salamander were conducted simultaneously with surveys for Larch Mountain salamander within potential habitats on NFSL within the Study Area and where habitat disturbing activities are proposed under the alternatives. For this survey effort, all areas of mature forest were considered potential

habitat, regardless of the presence of streams or seeps. The largest amount of area surveyed was at Summit East, within Section 16 (Summit East), with smaller areas surveyed at Summit West and Alpental. Survey areas are described in Appendix D - Wildlife Resources Report. No Van Dyke's salamanders were located during protocol surveys and therefore the species has a status of “not detected” in the Study Area (Jones 1999).

Nineteen species of neotropical migratory birds have a primary association with riparian habitat (see Table 3.6.1-7). As shown in Table 3.6.1-7, these species utilize a variety of habitats; however they are primarily associated with riparian habitat.

Table 3.6.1-7:
Neotropical Migratory Birds Potentially Occurring in the Snoqualmie Pass Area Having a Primary Association With Riparian Habitat[a,b]

Species	Old-Growth	Clearcut	Young Forest	Broad leaf Forest	Riparian	Meadow	Marshes	Subalpine	Cliff
Riparian Associates									
Swainson's hawk[c]					X				
Mourning dove[c]		X			X	X			
American kestrel[c]				X	X	X		X	X
Long-eared owl[c]	X				X	X			X
Anna's hummingbird[e]					X				
Calliope hummingbird[c]		X	X		X	X		X	
Lewis' woodpecker	X				X				
Western kingbird[c]					X				
House wren[c]		X		X	X	X			
Red-eyed vireo[c]				X	X				
Nashville warbler[c]		X		X	X				
Yellow warbler[c,d]				X	X				
American redstart[c]				X	X				
Yellow-breasted chat[c]					X				
Black-headed grosbeak[c]				X	X				
Lazuli bunting[c]				X	X				
Brewer's blackbird[c]					X	X			
Northern oriole[c]				X	X				
American goldfinch[c]					X				

[a] From I-90 Land Exchange EIS (USFS 1998a)
[b] Table modified from USFS 1998a and Andelman and Stock 1994.
[c] Included in Sharp (1992) list of species found in MBSNF.
[d] Population trends declining based on data for species where population trends are known (Andelman and Stock 1994).
[e] Migratory Bird Treaty Act of 1918

These species use mature and immature western hemlock, mountain hemlock, and Pacific silver fir, natural and modified herbaceous, and cliffs. Table 3.6.1-2 depicts the amount of these habitat types available for these species in the Study Area.

3.6.1.7 Aquatic Habitats

Aquatic habitats within the Study Area include lakes, ponds, streams, and wetlands. Wetlands are important to approximately 130 species wildlife including beaver, muskrat, mink, herons, waterfowl and amphibians dependent for reproduction and foraging, and for use as movement corridors (Brown 1985). Wetlands within the Study Area are described in Section 3.3 – Watershed Resources of this EIS.

There are five special status species of amphibian primarily associated with aquatic communities (see Table 3.6.1-8). While these species require aquatic environments for part of their lifecycle, they also utilize other habitats; usually to a lesser degree (see Table 3.6.1-1).

Table 3.6.1-8:
Species Having a Primary Association with Aquatic Habitat and the Specific Aquatic Habitat Types with which They are Associated within the Study Area

Aquatic habitat types	Species	Acres/miles[a] of habitat type available
Lakes and wetlands	Cascades frog Red-legged frog Pacific tree frog Western toad	73.63
Streams	Tailed frog	49.86
All aquatic habitats	Neotropical migratory birds (17 species, see Table 3.6.1-9)	n/a

[a] Lake and wetland by size in acres, streams are reported by length in miles, therefore these numbers cannot be added to provide a total amount of aquatic habitat.
Note: This table includes the Mill Creek portion of the Study Area.

The Cascades frog is found in montane meadows, slow-moving streams, lakes, and ponds in the Olympic and Cascade Mountains of Washington and Oregon above 2,600 feet in elevation (Leonard et al. 1993).

The Cascades frog has been documented in the SPAMA (USFS and USFWS 1997), and the U. Yakima Watershed Analysis estimates that there are approximately 34,686 acres of potential breeding and foraging habitat for this species (USFS 1997). The Cascades frog has been documented in the S.F. Snoqualmie Watershed where there are 7,448 acres of potential habitat available (USFS 1995a). Cascades frog is widespread and abundant in the Study Area and was observed on several occasions while surveying for other species.

The red-legged frog is a common wetland and forest species occurring in marshes, bogs, ponds, springs, seeps, and slow moving streams in lower elevations west of the Cascade Mountains, but rarely occurs above 3,000 feet in elevation (Blaustein et al. 1995; WDFW 1999; Corkran and Thoms 1996).

The red-legged frog has not been detected in the U. Yakima Watershed. It has been found in the adjacent Cedar River Watershed. There are as estimated 478 acres of potential habitat for this species in the S.F. Snoqualmie Watershed (USFS 1995s). No red-legged frogs have been detected during surveys.

The tailed frog prefers cold, fast flowing, mountain streams on the west side of the Cascades. The adults generally stay in or near streams but may use nearby forests in wet weather. Watershed alterations such as road building and timber harvest have caused declines in some areas (Leonard et al. 1993).

There are approximately 12,150 acres of potential breeding and foraging habitat within the U. Yakima Watershed (USFS 1997), and this species has been documented throughout the S.F. Snoqualmie Watershed, the SPAMA, and the Study Area (USFS 1995; USFS and USFWS 1997; WDFW 2002).

The western toad is widely distributed over the United States. The adults can disperse through forests, and through grass and shrub habitats, but are most common near lakes, ponds, and wetlands. They require open water for breeding, which may occur as late as July at high elevations (Blaustein et al. 1995; Leonard et al. 1993).

The western toad has been documented as a permanent resident of the U. Yakima Watershed, the S.F. Snoqualmie Watershed, and the SPAMA (USFS 1997, 1995a; USFS and USFWS 1997), and would be expected occur in the Study Area although none have been detected.

There are 17 species of neotropical migratory birds with a primary association with aquatic habitat. As shown in Table 3.6.1-9, these species also utilize a variety of habitats.

Table 3.6.1-9:
Neotropical Migratory Birds Potentially Occurring in the Snoqualmie Pass Area Having a Primary Association With Aquatic Habitat

Species	Old-Growth	Clearcut	Young Forest	Broad leaf Forest	Riparian	Meadow	Marshes	Subalpine	Cliff
Marsh, Lake, and Pond Associates									
Osprey[a]					X		X		
Northern harrier[a]						X	X		
Killdeer[a]						X	X		
Black swift[a]					X		X		X
Belted kingfisher[a]					X	X			
Eastern kingbird[a]				X	X	X			
Purple martin							X		
Tree swallow[a]					X	X	X		
Violet-green swallow	X	X	X		X		X		
Northern rough-winged swallow[a]					X		X		
Bank swallow					X		X		
Cliff swallow[a]					X	X	X		X
Barn swallow[a]					X		X		
Marsh wren							X		
Common yellow-throat					X	X	X		
Red-winged blackbird					X		X		
Yellow-headed blackbird							X		

[a] Migratory Bird Treaty Act of 1918

3.6.1.8 Cliffs and Talus Slopes

Cliffs provide hiding and escape habitat for mountain goats and nesting habitat for raptors, cliff swallows, and swifts. According to Thomas (1979) approximately 90 species of wildlife are associated with cliff, rock outcrops and talus features. Cliff habitat is limited to small caves south of Beaver Lake at Summit West, with most of the cliff/talus habitat located at Alpental, at the peak of Denny Mountain and near the existing Edelweiss chairlift.

Peregrine falcon, mountain goats, and Larch Mountain salamander are primarily associated with cliff and/or talus communities (see Table 3.6.1-10). As mentioned in Table 3.6.1-1, these species also utilize other habitats, however they are primarily associated with cliff and/or talus communities.

Table 3.6.1-10:
Species Having a Primary Association with Cliff and/or Talus Habitat and the Specific Habitat Types with Which They Are Associated Within the Study Area

Species	Habitat Types	Acres
Peregrine falcon	Cliffs	235.26
Mountain goat	Cliffs/rock outcrops	235.26
Larch Mountain salamander	Talus	235.26
Neotropical migratory birds (2 species[a], see Table 3.6.1-11)	Cliffs	235.26

[a] One of these two species is peregrine falcon, which is discussed separately.
Note: This table includes the Mill Creek portion of the Study Area.

Within the Study Area there is approximately 235 acres of cliff, rock, or talus habitat available, with 11 acres on public land and 11 acres on private land in the U. Yakima Watershed, and 209 acres on public land and four acres on private land in the S.F. Snoqualmie Watershed, as shown in Figures 3.5.1-1, Existing Vegetation Cover – The Summit, and 3.5.1-2, Existing Vegetation Cover - Alpental, and Table 3.5.2-1.

The peregrine falcon is not expected to be resident but may occasionally occur within the Study Area. Nesting or otherwise critical habitat is generally lacking, however the Study Area is within the historic range of the species. Surveys conducted by the WDFW in 1987 evaluated the suitability of cliffs as peregrine falcon nesting habitat. All cliffs in the S.F. Snoqualmie River were rated as fair with the exception of Guye and Snoqualmie Peaks that were rated as good (USFS 1995a).

Peregrines have been documented as permanent residents of the S.F. Snoqualmie Watershed and although there are no known eyries in the U. Yakima Watershed, there are 5,107 acres of potential cliff habitat (USFS 1995a, 1997). There are 18,437 acres of potential nesting habitat within the SPAMA though there are no known eyries in the SPAMA (USFS and USFWS 1997). With the exception of Alpental, cliff habitat is generally lacking in the Study Area.

Mountain goats occur in rugged mountain terrain in the Snoqualmie Pass area (WDFW 2000). Goats are associated with such physiographic features as steep, rocky cliffs, pinnacles, ledges, and talus slopes. During the winter, mountain goats migrate to lower elevations and use dense conifer stands for thermal cover (USDA 1990a; WDFW 1999). There is a high degree of variation in mountain goat migration patterns and distances traveled; with some traveling several miles and others only short distances. Mountain goat winter range is characterized by steep rocky slopes in close proximity to dense conifer stands that provide cover on east and southwest facing slopes at low elevation, where there is relatively little snow accumulation (Rodrick and Milner 1991). In the north cascades, it is also a prey/carrion species for some carnivore species that forage in high elevation wilderness areas, such as the wolverine and grizzly bear.

There are 15,547 acres of cliff/bedrock habitat within the SPAMA, with approximately 7,976 acres of forage habitat within 0.25 miles of the cliff/bedrock habitat (USFS and USFWS, 1997). Mountain goats have been documented as permanent residents of the S.F. Snoqualmie and U. Yakima Watersheds.

The MBSNF sightings database contains several records of mountain goat sightings in the area between the southern boundary of the Study Area at Alpental and I-90, on the southern end of Denny Mountain. These sightings are clustered in the spring (April, May, and June) and fall (October) suggesting that this may be transitional habitat between summer and winter ranges. The presence of mountain goats during May and June also suggests that this area is likely used as kidding habitat, although all sightings that include young were recorded during fall.

Skiers have reported seeing mountain goats on the cliffs to the south of the Armstrong Express chairlift at Alpental during winter (DeRosier 2003 pers. comm.). Since the slopes of Denny Mountain, where both spring and fall sightings have been reported, fit the definition of winter habitat; and given sightings reported by skiers, this area may also be winter range, with summer range likely to occur higher up on Denny Mountain. These factors considered together provide sufficient evidence to conclude that mountain goats occur within the Study Area at Alpental. The MBSNF Forest Plan has mapped this area as mountain goat habitat, with the requirement that future recreational development maintain the integrity of that habitat (USDA 1990a).

The Larch Mountain salamander is a terrestrial salamander that occurs in steep, moist talus slopes. It is largely nocturnal, and when climatic conditions are appropriate, animals can be found on or near the surface hiding under wood or rock substrates (Crisafulli 1999). The Larch Mountain salamander has been documented within the U. Yakima Watershed and the SPAMA (USFS 1997; USFS and USFWS 1997). A GIS analysis of the U. Yakima Watershed identified approximately 474 acres of potential habitat available for this species (USFS 1997).

Protocol surveys for this species were conducted between 1997 and 2001 within potential habitats and where habitat-disturbing activities are proposed under the alternatives described in Chapter 2. Although

this species is thought to be primarily associated with talus habitat, for the purposes of the survey effort all mature forest was included as potential habitat. The reasons for this were that talus habitat often occurs in forested conditions and is not mapped separately and because Larch Mountain salamanders have been found in forested areas lacking talus habitat. Within the Study Area, there are no areas of talus habitat that are not associated with mature forest and where habitat-disturbing activities are proposed under the alternatives. Survey areas are described in Appendix D - Wildlife Resources Report. No Larch Mountain salamanders were located during surveys, and therefore have a status of "not detected" in the Study Area (Crisafulli 1999).

Two species of neotropical migratory birds, the peregrine falcon and golden eagle, have a primary association with cliff habitats (see Table 3.6.1-11).

Table 3.6.1-11:
Neotropical Migratory Birds Potentially Occurring in the Snoqualmie Pass Area Having a Primary Association With Cliff Habitat

Species	Old-growth	Clearcut	Young Forest	Broad leaf Forest	Riparian	Meadow	Marshes	Subalpine	Cliff
Golden eagle	X	X						X	X
Peregrine falcon							X		X

Peregrine falcon occurrence is described above. Golden eagles have not been documented in the Study Area but may occur. There is a record of a golden eagle sighting in the Analysis Area, in the vicinity of Snoqualmie Pass. This bird was observed in mid-September and may have been migrating (MBSNF sighting database).

3.6.1.9 Herbaceous and Shrub Habitat

Herbaceous and shrub communities in the Study Area include both naturally occurring meadows and shrub habitat and areas that have been modified from a forested condition and maintained in an herbaceous or shrub condition as ski terrain. Table 3.6.1-2 shows the amount of herbaceous and shrub habitat available in the Study Area by type. Table 3.6.1-12 shows the species associated with herbaceous and/or shrub habitat and the type with which they are associated.

Table 3.6.1-12:
Species Having a Primary Association with Herbaceous and/or Shrub Habitat and the Specific Types with Which They Are Associated Within the Study Area

Species	Habitat types	Acres
Neotropical migratory birds (7 species, see Table 3.6.1-13)	All herbaceous and shrub types	898.59

Note: This table includes the Mill Creek portion of the Study Area.

There are seven species of neotropical migratory birds having a primary association with herbaceous and/or shrub habitat (see Table 3.6.1-13). As shown in Table 3.6.1-13, the common nighthawk is also associated with both clearcut and riparian habitat. The primary association of this species is with herbaceous habitat. The amount of habitat available for these species in the Study Area is presented in Table 3.6.1-2.

Table 3.6.1-13:
Neotropical Migratory Birds Potentially Occurring in the Snoqualmie Pass Area Having a Primary Association With Grass/Forb Habitat

Species	Old-Growth	Clearcut	Young Forest	Broad leaf Forest	Riparian	Meadow	Marshes	Subalpine	Cliff
Meadow Associates									
Short-eared owl[a]						X			
Horned lark[b]						X			
American pipit[a]						X			
Vesper sparrow[a]						X			
Savannah sparrow[a]						X			
Western meadowlark						X			
Common nighthawk[a]		X			X				

[a] Included in Sharp (1992) list of species found in MBSNF.
[b] Migratory Bird Treaty Act of 1918.

3.6.1.10 General Habitats

The vegetation communities within The Summit-at-Snoqualmie area provide habitat for a wide variety of wildlife. There are 290 terrestrial vertebrate species with the potential to occur in or near the Snoqualmie Pass area, according to the U. Yakima Watershed Analysis (USFS 1997), the S.F. Snoqualmie Watershed Analysis (USFS 1995a), and the SPAMA EIS (USFS and USFWS 1997). Wide ranging, mobile species were evaluated for their potential to use the general Snoqualmie Pass area (Analysis Area) around the ski areas. Detailed information on the wildlife resources is provided in the Wildlife Technical Report (Appendix D).

Table 3.6.1-14 shows the special status species associated with more than one habitat or with habitat mosaics, as well as the habitats that they utilize, that may occur within the Study Area.

Table 3.6.1-14:
Species Having a Primary Association Habitat Mosaics and the Specific Types with Which They Are Associated in the Study Area

Species	Habitat Component	Acres
Grizzly bear	May use all vegetation types within the SUP	**n/a**
Gray wolf	May use all vegetation types within the SUP	**n/a**
Elk		
Foraging[a]	Pacific silver fir sapling, herbaceous (natural and modified), shrub (natural and modified), immature Pacific silver fir, immature western hemlock.	**1,514.41**
Cover	Mature mountain hemlock, mature Pacific silver fir, and mature western hemlock.	**1,052.67**
Deer		
Foraging[a]	Pacific silver fir sapling, herbaceous (natural and modified), shrub (natural and modified), immature Pacific silver fir, immature western hemlock.	**1,514.41**
Cover	Mature mountain hemlock, mature Pacific silver fir, and mature western hemlock.	**1,052.67**
Wolverine	May use all vegetation types within the SUP.	**n/a**

[a] Includes Wetland and Lake landcover types.
Note: This table includes the Mill Creek portion of the Study Area.

Special status species included for analysis, and a summary of information about habitat requirements and the potential for them to occur in the Study Area, are contained in Table 3.6.1-1. A more detailed description of each species habitat needs and probability of occurrence in the Study Area is located in Appendix D - Wildlife Technical Report. Existing habitat conditions and the potential for occurrence of these species is described in the following sections.

The grizzly bear is a large, wide-ranging animal that requires vast areas of remote, undisturbed habitat. It has a wide range of habitat tolerances and can exploit a wide variety of food resources. The North

Cascade Mountains is one of only five areas in the contiguous United States where the grizzly bear still remains and the mountainous area between I-90 and the Canadian border has been designated as a recovery zone for grizzly bear. Alpental lies within that North Cascades recovery zone. Within the recovery zone, Bear Management Units have been identified but management requirements have not yet been assigned in the area (USFS 1995a). The Alpental SUP has a land allocation of Administratively Withdrawn and Riparian Reserve under the NWFP and is designated as having a winter sports recreation emphasis. For this reason, core grizzly bear habitat is lacking within the Study Area at Alpental.

Within the SPAMA, there are an estimated 21,087 acres of key habitat types for grizzly bears. Use of much of this habitat is likely limited by road densities that exceed the 1 mile/square mile guideline recommended as a maximum for grizzly bear habitat (USFS and USFWS 1997). Between 1974 and 1991, there were nine grizzly bear sightings within the SPAMA, of which three are Level 1 or confirmed sightings and six are Level 2, or highly reliable sightings. There have also been other confirmed sightings in areas adjacent to the SPAMA (USFS and USFWS 1997). No confirmed sightings have occurred in the Study Area.

According to the S.F. Snoqualmie Watershed Analysis (USFS 1995a), there also have been no class 1 (confirmed) grizzly bear sightings on the Snoqualmie Ranger District. The watershed does contain an estimated 1,251 acres of spring foraging habitat and 8,467 acres of fall foraging habitat. Use of the watershed by grizzly bears is likely to be limited by high human use as described in the S.F. Snoqualmie Watershed Analysis (USFS 1995a). Within the U. Yakima Watershed there is an estimated 13,109 acres of grizzly bear habitat (USFS 1997).

The PHS data (WDFW 2002) shows two grizzly bear sightings in the general vicinity of the Study Area, one near Chikamin Lake approximately 6 miles northeast of the Study Area and another approximately 11 miles east of the Study Area. However no reliabilities are assigned to these sightings.

Grizzly bear use of the Study Area would be expected to be limited due to the amount of development in the area, the presence of the Interstate, and the high level of recreational use of the area year-round. Grizzly bears may occasionally utilize the Study Area, particularly Alpental, as part of a larger home range, however, and may rarely travel through the area.

The gray wolf is found in all habitats of the northern hemisphere except tropical forests and arid deserts (Nowak and Paradiso 1983). Dens tend to occur on southerly aspects of moderately steep slopes on well-drained soils. Rendezvous sites are typically composed of meadow or complex of meadows and adjacent stands of timber located near water. Three gray wolf family units have been confirmed in Washington; one in Okanogan, one in the Glacier Peak Wilderness, and one in the North Cascades National Park (USFWS 1987).

There have been no confirmed wolf sightings within the U. Yakima Watershed, however unconfirmed sightings are common. There is an estimated 5,204 acres of potential wolf denning and rendezvous habitat within the watershed, but road densities are 2.58 miles per square mile and so may limit wolf use of the area. Since roads are not uniformly distributed on the landscape, there are areas where road densities are below 1 mile per square mile. Areas within the U. Yakima Watershed with road densities below 1 mile per square mile are the Silver Creek, Gold Creek, and Box Canyon subwatersheds (USFS 1997).

Within the S.F. Snoqualmie Watershed, there is an estimated 1,631 acres of gray wolf denning and rendezvous habitat available. As described for the U. Yakima Watershed, high levels of human use are likely to limit wolf use of the area. There have been no confirmed wolf sightings within the S.F. Snoqualmie Watershed; however, there have been two sightings that, although unconfirmed, have a high reliability rating (USFS 1995a).

There have been no wolf sightings within the Study Area and given the high levels of human use in the area year-round and the proximity of I-90, it is unlikely that wolves would use the area for either denning or rendezvous sites. Within the Study Area, Alpental has the highest potential for use by wolves because it is more remote than the Summit south of I-90, however denning and rendezvous sites are usually located in broad flat valley bottoms (Mech et al. 1988) and Alpental contains predominantly steep slopes and cliff habitat. Howling surveys were conducted in the Snoqualmie Pass area in 1994, with no wolves detected.

Wolves may occasionally travel through the Study Area between areas of potential habitat but not expected to regularly utilize the Study Area for habitat.

Elk require forest for cover and open habitats for forage. Dispersal corridors between summer and winter ranges must provide these requirements. Elk also require freedom from human disturbance during the calving season that occurs primarily in early June. Winter range is considered to be the limiting factor in many elk populations (WDFW 2002). Winter range typically occurs below 3,000 feet elevation and tends to be concentrated around drainages and their associated riparian areas, but may occur below 2,200 feet during severe winters (USDA 1990a). On the MBSNF, late successional forest is considered important for thermal cover and maintenance forage (USDA 1990a).

In the Study Area, river corridors are used as dispersal corridors for elk (Cooper 1987). Grasses and sedges make up the bulk of elk diets, with forbs and browse utilized to a lesser extent (Boyd 1978; USFS 1998a). The WDFW PHS Database (2002) contains two records of regular, large concentrations of elk between 1 and 5 miles south of The Summit-at-Snoqualmie, but none within the Study Area. Many observations of elk have been made in and immediately surrounding the Study Area.

As shown in Table 3.6.1-14 elk habitat within the Study Area includes approximately 1,514 acres of foraging habitat (447 acres on public land and 769 on private land in the U. Yakima Watershed and 247 acres on public land and 51 acres on private land in the S.F. Snoqualmie Watershed) and approximately

1,053 acres of cover (394 acres on public land and 180 acres on private land in the U. Yakima Watershed and 406 acres on public land and 72 acres on private land in the S.F. Snoqualmie Watershed). The vegetation types that comprise foraging and cover habitat can be seen in Figures 3.5.1-1, Existing Vegetation Cover – The Summit, and 3.5.1--2, Existing Vegetation Cover - Alpental, and Table 3.5.2-1.

Within the Study Area and the Analysis Area, lands located in the U. Yakima Watershed are within the range of the Yakima elk herd and lands located within the S.F. Snoqualmie Watershed are within the range of the North Rainier elk herd (WDFW 2002). Since habitat is continuous across the Cascade Crest in the vicinity of The Summit, however, it is possible that individuals of both herds utilize the Study Area. Table 3.6.1-14 describes the vegetation types included as foraging and cover habitat for elk within the Study Area. Cleared ski trails at the Summit and Alpental would be expected to provide foraging habitat for elk, while remaining mature forest provides cover. The portion of the Study Area in the Mill Creek drainage is expected to be used as summer habitat, based on a high incidence of wetlands and associated plants of high forage value and dense shrubs that provide hiding cover. Outside of the Study Area but directly adjacent to it, the area around Hyak Lake contains potential elk calving habitat. Use of these areas may, however, be affected by the current level of human use, particularly mountain biking.

In Washington there are two different subspecies of mule deer, the Rocky mountain mule deer (*Odocoileus hemionus hemionus*) and the Columbia black-tailed deer (*O. h. columbianus*), with the Rocky Mountain mule deer generally occurring east of the Cascade Crest and the Columbia black-tailed deer generally occurring west of the Cascade Crest. Both subspecies are known to occur in the vicinity of the Cascade Crest and there is “region of integration” along the Crest for these subspecies (Rodrick and Milner 1991). Because habitat use is expected to be comparable for the two subspecies in the Study Area, they will be discussed under the heading mule deer for this analysis.

Mule deer are found in coniferous and hardwood forests with dense shrub or early successional stages containing small trees. They will also utilize meadows, grasslands, and wetland areas. They are considered an “edge” species, occurring where differing vegetation communities abut (USFS 1998a). They are intermediate between browsers and grazers, consuming grasses and forbs, as well as fruits, nuts, buds, shoots, and leaves of a wide variety of trees, shrubs, and vines, as well as mushrooms, and lichens (Wallmo 1978; WDFW 1999a). Mule deer benefit from the interspersion of vegetative communities (USFS 1998a). Riparian zones are important to mule deer for fawning (USFWS 1998a). Mule deer are considered common throughout the Study Area (Spencer 1999 pers. comm.). Within the Study Area there are approximately 1,514 acres of foraging habitat available for mule deer and 1,053 acres of cover habitat, as shown in Table 3.6.1-14. These habitats are the same as those identified for elk and the breakdown by subwatershed in the Study Area is as described for elk above.

Populations inhabiting higher elevations in summer migrate downslope to lower elevations when accumulations of snow make forage unavailable, while other populations move short distances to preferred food patches or do not migrate at all (Wallmo 1978).

Travel corridors between summer and winter range, freedom from human disturbance in fawning areas, and cover to escape harsh environmental conditions and predators are also important components of high-quality mule deer habitat. On the MBSNF, thermal cover, which is thought to be optimal in old-growth forest, is considered to be the most critical component of winter range habitat (USDA 1990a).

The wolverine is found in a wide variety of habitat types, from tundra and boreal forest in the northern part of the range, to high-elevation mixed conifer forest at the southern end of their range. Wolverines require large tracts of land that have not been developed, extensively modified, or accessed by humans, such as a large wilderness area, and their distribution is tied to availability of large ungulates that are taken primarily as carrion (Banci 1994). In forested areas, natal dens consist of holes dug under fallen trees, in decayed hollow logs or cavities in large trees, in old bear dens, abandoned beaver lodges, caves, in piles of woody debris, under exposed, snow-covered tree roots, and in rocks and boulders. Such sites may also be used as resting areas (Banci 1994).

The current distribution of wolverines in Washington is unknown. Between 1970 and 1990 there were 28 documented records of wolverines in the State and these were concentrated primarily in the north and central Cascades and the northeastern corner of the state (Banci 1994). Johnson and Cassidy (1997) cite 36 records in the State. These records are distributed throughout the mountainous areas of the State, however Johnson and Cassidy (1997) caution that this apparent wide distribution should not be construed to mean there is a large population of wolverines in the State, since wolverines are known to occur in low densities throughout their range and individuals are known to utilize large home ranges. The PHS database contains one sighting of tracks in 1999 between Keechelus and Kachess lakes (WDFW 2002). Wolverines may utilize habitat in the Pacific silver fir, mountain hemlock, subalpine and alpine zones in the Washington Cascades, however there is limited information on wolverine use of specific habitats for denning, resting, foraging, and dispersal in the southern portions of their range (Johnson and Cassidy 1997).

The significance of the Snoqualmie Pass area for wolverine movement is not known, however, human use of the area may limit the suitability of the area as wolverine travel habitat given their sensitivity to human presence (USFS and USFWS 1997). This will be discussed in greater detail in Section 3.6.2 – Habitat Connectivity.

3.6.2 Habitat Connectivity

Habitat connectivity and fragmentation refer to the size, quality, and spatial arrangement of patches of a species' habitat across the landscape, particularly the number and arrangement of these patches as they relate to the dispersal of organisms. Fragmentation and connectivity of LSH is one of the focus points in the MBSNF Forest Plan, as Amended (USDA 1990a; USDA and USDI 1994), the WNF Forest Plan, as Amended (USDA 1990b; USDA and USDI 1994) and the SPAMA EIS (USFS and USFWS 1997).

The Snoqualmie Pass area has unique importance because it is the narrowest point of federally owned middle and high elevation habitat between the North and South Cascades, and the lowest elevation corridor between western and eastern Washington. The Snoqualmie Pass area provides a corridor between the following areas:

- The Alpine Lakes Wilderness to the immediate north of Alpental
- The Late-Successional Reserve (LSR) in the Teanaway River watershed to the east
- The LSR in the Cedar River and Snoqualmie River watersheds to the west
- The White River watershed LSR, the Norse Peaks Wilderness and Mount Rainier National Park to the south

Because of this, the suitability of the area for movement and dispersal of wildlife is critical to sustaining populations of rare or sensitive species with naturally low densities and large ranges, such as the wolverine, grizzly bear, fisher, spotted owl and wolf. A common feature of these species, except for the spotted owl, is that their primary remaining range is in Canada and the only likely path for their movement into the southern Washington or Oregon Cascades is through the Snoqualmie Pass area. The Puget Sound region to the west has become too urbanized for these species, and the region east of the pass contains drier forest types that quickly descend to a shrub/steppe habitat unsuitable for these forest-dwelling species (USFS and USFWS 1997).

A comprehensive analysis of habitat connectivity and fragmentation was conducted as a part of the SPAMA EIS (USFS and USFWS 1997) focusing on LSH and associated wildlife. The I-90 Land Exchange EIS (USFS 1998a) continued this analysis and the I-90 Wildlife Linkage Habitat Assessment (Singleton and Lehmkuhl 2000) combined further modeling studies with field studies of wildlife travel patterns in the I-90 area of Snoqualmie Pass. All three modeling analyses were based upon landscape level GIS modeling. Separate ratings were calculated for four to six different species or groups representing different levels of mobility and habitat specificity.

The connectivity analysis performed for the SPAMA EIS used the spotted owl to represent species linked to LSH but not sensitive to road density, and the fisher for species also dependent upon LSH but sensitive to roads and barriers. The wolverine and the Cascades red fox were chosen as mobile species linked to high elevation, with the wolverine also sensitive to road densities. Low mobility late-successional dependent species such as small mammals, mollusks and amphibians were considered as a group. At the SPAMA scale, the modeling concluded that the Snoqualmie Pass area has moderate dispersal potential for all modeled species or species groups despite the presence of significant road density. At a site-specific scale, much of the portion of the Summit-at-Snoqualmie Study Area that was modeled in the SPAMA has a low potential for dispersal for all modeled species or species groups, particularly areas of existing modified vegetation, although the LSH in Section 16 (Summit East) has a high potential for all modeled

species or species groups. The Cabin Creek/Lake Keechelus area to the east was less suitable dispersal habitat for all modeled species or species groups because of the lack of LSH (USFS and USFWS 1997).

The I-90 Snoqualmie Pass Wildlife Habitat Linkage Assessment (Singleton and Lehmkuhl 2000) used a least-cost grid path model to estimate movement corridors across the I-90 area. It was determined from the model that the Snoqualmie Pass area was "most permeable for high mobility dispersal habitat generalists and least permeable for low mobility late successional riparian associates" (Singleton and Lehmkuhl 2000). High and moderate mobility species face significant barriers near the Study Area and would encounter the best opportunity for habitat connectivity between Kachess and Cle Elum Lakes and across I-90 south of Kachess Lake. Connectivity for low mobility riparian or LSH associated species, such as salamanders, mollusks shrews and voles, was good or moderate along I-90 at the ski areas.

The I-90 Wildlife study also included several phases that evaluated actual wildlife movement and use in the I-90 corridor, from milepost 52 just west of the ski areas to milepost 81 on the outskirts of Cle Elum. The evaluation was based on:

- Analysis of deer and elk road kills on I-90 from 1990 to 1998,
- Automated camera stations, mostly within 1 mile of the highway,
- Snow tracking surveys along both sides of the highway, and
- Monitoring of highway crossing structures such as bridges and culverts using traps, cameras and track plates.

The analysis for the report did not include consideration of the land west of the Denny Creek drainage.

The overall conclusion of the report, after consideration of both the modeling studies and the results of the studies of actual animal movements near the freeway, was that seven areas along I-90 have existing or potential connectivity value for wildlife. Four of these areas occur east of The Summit. The three areas near The Summit are shown on Figure 3.6.1-1, Areas of Existing or Potential Habitat Connectivity and are discussed below.

- **Airplane curve, from Milepost 51 to 51.5**. This narrow zone has nearby late successional forest and the elevated roadbed of the westbound lanes of I-90 to provide wildlife passage. The eastbound lanes, however, are cut into a steep hill supported by retaining walls, which likely block direct animal passage to the habitat 'behind' (west of) The Summit ski areas. There is only one large culvert under the highway under the eastbound lanes in this area, but there are 19 small culverts. These small culverts were found to be used by numerous small mammals such as mice, chipmunks, Douglas squirrel and striped skunk.
- **The corner of Sections 10 and 16 (Summit East)**. These sections of Township 22N, Range 11E meet near milepost 54 of the highway. They are both located on NFSL and retain considerable

LSH. Section 16 (Summit East), which is discussed further in the section on LSH habitat, makes up the majority of Summit East and is mostly covered by mature forest, despite the presence of several ski runs, roads and the cleared right-of-way for electrical transmission lines. Section 10 is largely undeveloped. The shape of the forested habitat in these sections may serve to funnel wildlife movement into the area of milepost 54, where two marten were detected using the large box culverts that carry Coal Creek under the highway. Bear, coyote and bobcat were also detected in the area of this corridor. The surface crossing potential at this point would appear to be poor however, because the highway is six to eight lanes wide with a six-foot high jersey barrier between the east and west bound lanes. The Snoqualmie Pass Advisory Council plan foresees considerable development in this area, especially in the adjacent Section 15 where a golf course, residential development, and community facilities are envisioned.

- **Gold Creek Valley and Underpasses**. The I-90 wildlife report considers the Gold Creek valley, and the north end and west shore of Keechelus Lake to be the prime wildlife movement corridor in the Snoqualmie Pass area. A high density of deer and elk road kill, and bobcat, coyote and other carnivores were observed in this zone. Gold Creek crosses under I-90 and a parallel secondary access road through three bridges, which may provide passage for larger animals when the lake water level is low. In seasons of high runoff in the creek or high water in the lake the design of these bridges leaves little opportunity for wildlife passage. Enhancement of the passageway potential of these bridges is one goal of the proposed rebuilding of I-90 between the Hyak interchange at milepost 55 and the south end of Keechelus Lake. This project has become necessary because of continued avalanche and structural problems on the highway and the inefficiency of this section in handling the traffic load (WSDOT 2004). The Gold Creek valley on the north side of the highway is mostly forested but is currently being developed into low-density residential use. A substantial natural vegetation reserve along the creek is planned to preserve the wildlife value of the valley (Snoqualmie Pass Advisory Council).

There has been no formal analysis of habitat connectivity to the west of the Denny Creek area or a survey of culverts. In reviewing GIS/vegetation data for the area 5 miles to the west of Snoqualmie Pass and along Interstate 90, the data shows large areas of mature forest on both sides of the Interstate from Denny Creek to the Asahel Curtis picnic area, with closed immature and hardwood stands occurring on the north side of the interstate from this area down to Talapus Creek and areas of second growth forest containing large residual trees, open mature forest, and LSH occurring south of the Interstate in this area. Based on vegetation type, it appears that there would be habitat connectivity across this area.

In the area near The Summit, however, movement of animals other than birds would likely be limited by steep topography in the area between Snoqualmie Pass and Rockdale Creek. Topography to the north of the interstate suggests a natural path of travel following the Denny Creek drainage. Animals utilizing this area could travel under the elevated westbound lanes of I-90, and travel along the S.F. Snoqualmie River to cross I-90 in the area between Rockdale Creek and the Asahel Curtis picnic area. The greatest barrier to

movement through any of the areas discussed is crossing the interstate. As part of an ongoing analysis on modifications to I-90 to the southeast of the Study Area, the Washington Department of Transportation is working with the Forest Service to identify crossing structures that could be constructed in the future (Garvey-Darda 2003 pers. comm.) however this is not certain to occur.

Within the Study Area, LSH habitat within Section 16 (Summit East) has been identified as an important area of habitat connectivity for both wide-ranging and low mobility wildlife species. This area extends from SR 906 up to the ridgetop above Hyak Lake and provides nearly continuous forest cover, with only the existing cross over trail between Summit Central and Summit East bisecting it from north to south and a transmission line corridor bisecting it from east to west. Within this area, three different surveys have been conducted to assess canopy cover and forest stand characteristics.

The first survey conducted by Jones & Stokes (1998), collected data on canopy cover from ten plots. Jones & Stokes conducted the second survey in 2000 and data was collected from 12 plots in the mature forest in Section 16 (Summit East). Data collected included canopy cover, tree species, dbh of trees, number, size and condition of both snags and pieces of CWD, and understory cover. Tree age was also determined for representative trees in some plots. SE Group conducted the third survey in 2003 and data for canopy cover, tree species, and dbh was collected from three plots located within the mature forest in Section 16 (Summit East). Data from these three surveys was combined and used to describe canopy cover within the mature forest in Section 16 (Summit East), where canopy cover was found to range from 45 to 96 percent in the plots with an average canopy cover of 79 percent and 88 percent of the plots (22 plots) having canopy cover greater than 70 percent (Jones & Stokes 1998, 2000; SE GROUP 2003). On 15 of the plots, tree dbh data was also collected, with Jones & Stokes (2000) collecting data only for trees greater than four inches dbh and SE GROUP (2003) collecting dbh for all trees in the plot. These data sets combined, and including only trees greater than four inches dbh for consistency, show that understory trees are generally less than 8 inches dbh, while overstory trees are generally greater than 22 inches dbh. Some plots also contain large specimen trees with diameters greater than 40 inches dbh and one reaching a dbh of 64 inches (Jones & Stokes 2000; SE GROUP 2003).

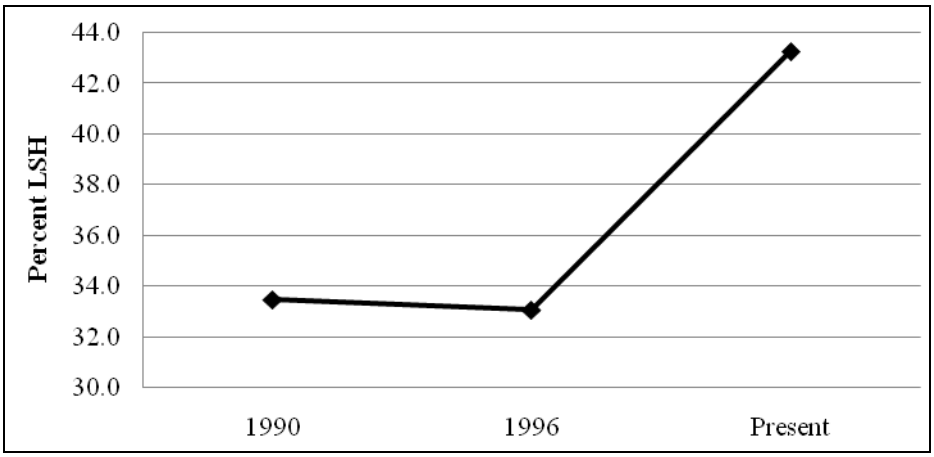
Canopy cover information from the three data sets were then incorporated into a GIS database and used to model over-story canopy cover within Section 16 (Summit East). The result of this modeling effort showed that most of the mature forest in Section 16 (Summit East) currently has a canopy cover below 70 percent with areas greater than 70 percent occurring immature western hemlock down-slope of the existing trail 71, on either side of the transmission line right-of-way where it is coexistent with existing Trail 49, and in scattered patches south of this area.

The spatial landscape of the Study Area, defined as the SUP boundary, does not provide an appropriate spatial scale at which to evaluate connectivity between habitats. USFS datasets describing forest stands is readily available from the MBSNF and OWNF from 1990, 1996, and 2006 for the area within a 5-mile

radius of Snoqualmie Pass. This area covers approximately 98,000 acres between the north and south Cascade zones, within the area identified by SPAMA as a CEA.

Utilizing this data the following illustration indicates that the trend in mature forest has been increasing within the Snoqualmie Pass vicinity. In 1990, mature forest represented approximately 33.5 percent (32,872 acres) of the area. By 2006, the percentage of mature forest had increased to approximately 43.3 percent (42,487 acres), an increase of 9,615 acres. The increase in mature forest can be attributed to decreased timber harvesting, natural maturation of immature forest, and land trades, though the relative contribution of each of the factors is unknown.

Illustration 3.6.2-FEIS-1:
Percentage of Late-Successional Habitat in the Snoqualmie Pass Vicinity



3.6.3 Adaptive Management Area Standards and Guidelines

The MBSNF has mapped late-successional[38] forest within the S.F. Snoqualmie Watershed (MBSNF 1995a) and the OWNF and MBSNF have mapped late-successional forest in the SPAMA (USDA 1997). The SPAMA Plan identified a Connectivity Emphasis Area at the Summit (see Section 1.2.3.4 - Snoqualmie Pass Adaptive Management Area). Vegetative cover provides critical cover for wildlife species movement through the AMA area. As such, several applicable Standards and Guidelines from the Snoqualmie Pass AMA are considered in the analysis of vegetation resources. These Standards and Guidelines focus on the theme of late successional forest retention. A complete listing of the applicable Standards and Guidelines is contained in Section 1.2.4 – Particularly Applicable Goals, Standards and Guidelines. These Standards and Guidelines are also discussed in Section 4.6 – Wildlife in Table 4.6.2-1.

[38] Old-growth is a "forest stand ten-acres or greater usually 180 to 220 years old with moderate to high canopy closure; a multi-layered, multi-species canopy dominated by large overstory trees; high incidence of large trees, some with broken tops and other indications of old and decaying wood; numerous large snags; and heavy accumulations of wood, including large logs on the ground" (Thomas et. al., FEMAT 1993). Late-successional forest is the stage of forest development that includes mature and old-growth forest. Mature forest by itself does not have the structural diversity and complexity of old-growth stands of the same forest type. Late successional forest is used in this document consistent with the LSH mapped for the USFS AMA FEIS (1997) and to recognize the different mature forest types found in The Summit Study Area.

3.7 AQUATIC CONSERVATION STRATEGY

3.7.1 Introduction

The Aquatic Conservation Strategy (ACS) was developed to improve and maintain the ecological health of watersheds and aquatic ecosystems contained within them on federal public lands. The four primary components of the ACS are designed to operate together to maintain and restore the productivity and resiliency of riparian and aquatic ecosystems:

1. **Riparian Reserves:** As stated in the 1994 ROD, "Riparian Reserves are lands along streams, wetlands, and lakes, and unstable and potentially unstable areas where special Standards and Guidelines direct land use." Riparian Reserves were mapped in the Project Area and described in Section 3.3 – Watershed Resources.

2. **Key Watersheds:** As stated in the 1994 ROD, "Key Watersheds are a system of large refugia comprising watersheds that are crucial to at-risk fish species and stocks and provide high quality water. A Tier 1 Key Watershed contributes directly to conservation of at-risk anadromous salmonids, bull trout, and resident fish species, and they have a high restoration potential. A Tier 2 Key Watershed may not contain at-risk fish stocks, but are important sources of high quality water." No watersheds within the Study Area have been identified as key watersheds.

3. **Watershed Analysis:** As stated in the 1994 ROD, "The Northwest Forest Plan Standards and Guidelines contain procedures for conducting watershed analysis that evaluates geomorphic and ecologic processes operating in specific watersheds." The S.F. Snoqualmie Watershed Analysis (USFS 1995a) and the Yakima Watershed Analysis (USFS 1997) were used as information resources during the preparation of the Summit-at-Snoqualmie MDP Proposal FEIS.

4. **Watershed Restoration:** As stated in the 1994 ROD, "A comprehensive, long-term program of watershed restoration to restore watershed health and aquatic ecosystems, including the habitats supporting fish and other aquatic and riparian-dependent organisms."

The four components of the ACS employ several tactics to approach the goal of maintaining the natural disturbance regime. Land use activities should be limited or excluded in those parts of the watershed prone to instability. The distribution of land use activities, such as timber harvest or roads, must minimize increases in peak streamflows. Headwater riparian areas need to be protected, so that when debris slides and flows occur they contain LWD and boulders necessary for creating habitat farther downstream. Riparian areas along larger channels need protection to limit bank erosion, ensure an adequate and continuous supply of LWD to channels, and provide shade and microclimate protection. As specified in the 1994 ROD:

> "To protect the remaining high quality habitats, no new roads will be constructed in inventoried roadless areas in Key Watersheds. Watershed analysis must be conducted in all non-Key Watersheds that contain roadless areas before any management activities can occur within those roadless areas. Existing system and non-system road mileage should be reduced outside roadless areas in Key Watersheds, and if funding is insufficient to implement reductions, there should be no net increase in the amount of roads in Key Watersheds" (1994 ROD at B-19).

Any species-specific strategy aimed at defining explicit standards for habitat elements would be insufficient for protecting even the targeted species. Therefore, the ACS must strive to maintain and improve ecosystem health at watershed and landscape scales to protect habitat for fish and other riparian-dependent species and resources and restore currently degraded habitats. This approach seeks to prevent further degradation and restore habitat over broad landscapes as opposed to individual projects or small watersheds. Because it is based on natural disturbance processes, it may take decades, possibly more than a century, to accomplish all of its objectives. Some improvements in aquatic ecosystems, however, can be expected in 10 to 20 years.

3.7.2 Aquatic Conservation Strategy Objectives

As stated in the Northwest Forest Plan Standards and Guidelines (B-11), Forest Service and BLM-administered lands within the range of the northern spotted owl will be managed to:

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, addition, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

3.8 AIR QUALITY

3.8.1 Air Quality Standards and Regulations

National Ambient Air Quality Standards

In accordance with the Clean Air Act and its amendments, National Ambient Air Quality Standards (NAAQS) have been established by the USEPA for criteria pollutants including lead (Pb), ozone (O_3), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and particulates with aerodynamic diameters of less than ten microns (PM_{10}) and less than 2.5 microns ($PM_{2.5}$). Air quality standards are shown in Table 3.2.8-1.

Some pollutants are subject to both primary and secondary standards. Primary standards are designed to protect human health with a margin of safety. Secondary standards are established to protect the public welfare from any known or anticipated adverse effects associated with these pollutants such as soiling, corrosion, or damage to vegetation.

Three agencies have jurisdiction over air quality within the Study Area: the USEPA, the WDOE, and the Puget Sound Clean Air Agency. These agencies establish regulations that govern both the concentrations of pollutants in the outdoor air and contaminant emissions from air pollution sources. Unless the state or local jurisdiction has adopted more stringent standards, the USEPA standards apply.

The WDOE and Puget Sound Clean Air Agency maintain a network of air quality monitoring stations throughout the Puget Sound area. In general, these stations are located where there may be air quality problems. As such, they are usually located in or near urban areas or close to specific large air pollution sources. Other stations are located in remote areas to provide an indication of regional air pollution levels. No state-operated air quality monitoring stations are located within The Summit-at-Snoqualmie's Study Area. The site nearest to The Summit-at-Snoqualmie is site 0017, which is located in North Bend. This site is operated by the WDOE to collect data on ozone, $PM_{2.5}$, winds and temperature. This site runs continuously but only collects ozone data during the official Washington state ozone monitoring season of May through October.

Data collected during the period of January 1, 2002 through December 31, 2004 at the North Bend station were analyzed to provide a baseline condition for air quality in the area surrounding The Summit-at-Snoqualmie. The Air Quality Index (AQI) Summary Report shows that of the 1,041 days for which data were collected, 991 days had an AQI value of less than or equal to 50, which is considered Good air quality. There were 48 days with an AQI values between 51 and 100, which is considered Moderate and 2 in which AQI values were over 100, which is considered Unhealthy for Sensitive Groups. Of the 50 days in which the AQI was over 50, the pollutant of concern was ozone on 27 days. Particulate matter (PM2.5) was the pollutant of concern the other 23 days. Ozone determined the AQI on both days in which it was over 100. Based on the data collected at the North Bend station, the AQI follows a seasonal pattern where

ozone is the main pollutant in the summer months, and $PM_{2.5}$ is dominant in winter months. Overall, air quality at The Summit-at-Snoqualmie is considered good.

Based on monitoring information collected over a period of years, the state and federal agencies also designate regions as being attainment or non-attainment areas for particular pollutants. Attainment status is an indication that air quality in an area complies with the federal health-based ambient air quality standards shown in Table 3.2.8-1.The Study Area is recognized as an attainment area for all criteria pollutants. Standards in parenthesis were approved by the USEPA on September 21, 2006, and became effective on December 18, 2006.

Table 3.8-1:
Ambient Air Quality Standards

Pollutant	National		Washington State
	Primary (2006 Revision)	Secondary (2006 Revision)	
Total Suspended Particulates			
Annual Geometric Mean[a]	no standard	no standard	60 μg/m^3
24-hour Average	no standard	no standard	150 μg/m^3
Lead (Pb)			
Quarterly Average	1.5 μg/m^3	1.5 μg/m^3	no standard
Particulates			
PM_{10}			
Annual Arithmetic Mean	50 μg/m^3 (no standard)	50 μg/m^3 (no standard)	50 μg/m^3
24-hour Average	150 μg/m^3	150 μg/m^3	150 μg/m^3
$PM_{2.5}$			
Annual Arithmetic Mean	15 μg/m^3	15 μg/m^3	15 μg/m^3
24-hour Average	65 μg/m^3 (35 μg/m^3)	65 μg/m^3 (35 μg/m^3)	65 μg/m^3
Sulfur Dioxide (SO_2)			
Annual Average	0.03 ppm	no standard	0.02 ppm
24-hour Average	0.14 ppm	no standard	0.10 ppm
3-hour Average	no standard	0.50 ppm	no standard
1-hour Average	no standard	no standard	0.40 ppm[a]
Carbon Monoxide (CO)			
8-hour Average	9 ppm	9 ppm	9 ppm
1-hour Average	35 ppm	35 ppm	35 ppm
Ozone (O_3)			
1-hour Average[b]	0.12 ppm	0.12 ppm	0.12 ppm
8-hour Average	0.08 ppm	0.08 ppm	no standard
Nitrogen Dioxide (NO_2)			
Annual Average	0.053 ppm	0.053 ppm	0.05 ppm

Source: WSDOE 1999. Source for PM_{10} Annual Arithmetic Mean and $PM_{2.5}$ 24-hour average: USEPA 2006.
Notes: Primary standards are listed in this table as they appear in the federal regulations; ambient concentrations are rounded using the next higher decimal place to determine whether a standard has been exceeded. The data in this report are shown with these unrounded numbers.
[a] Annual standards that are never to be exceeded, short-term standards not to be exceeded more than once per year unless noted.
[b] Not to be exceeded on more than 1.0 days per calendar year as determined under the conditions indicated in Chapter 173-475 WAC.
ppm = parts per million; μg/m3 = micrograms per cubic meter.

On September 21, 2006, the USEPA approved new NAAQS for particulate matter (PM_{10} and $PM_{2.5}$). Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, the USEPA revoked the 50 µg/m^3 annual PM_{10} standard (USEPA 2006). The 24-hour $PM_{2.5}$ standard was changed from 65 to 35 µg/m^3 because of the effects of small particle pollution on public health and welfare (40 CFR Parts 53 and 58). The new standards came into effect on December 18, 2006. Table 3.8-1, above, reflects the revisions to the NAAQS approved by the USEPA in 40 CFR Parts 53 and 58.

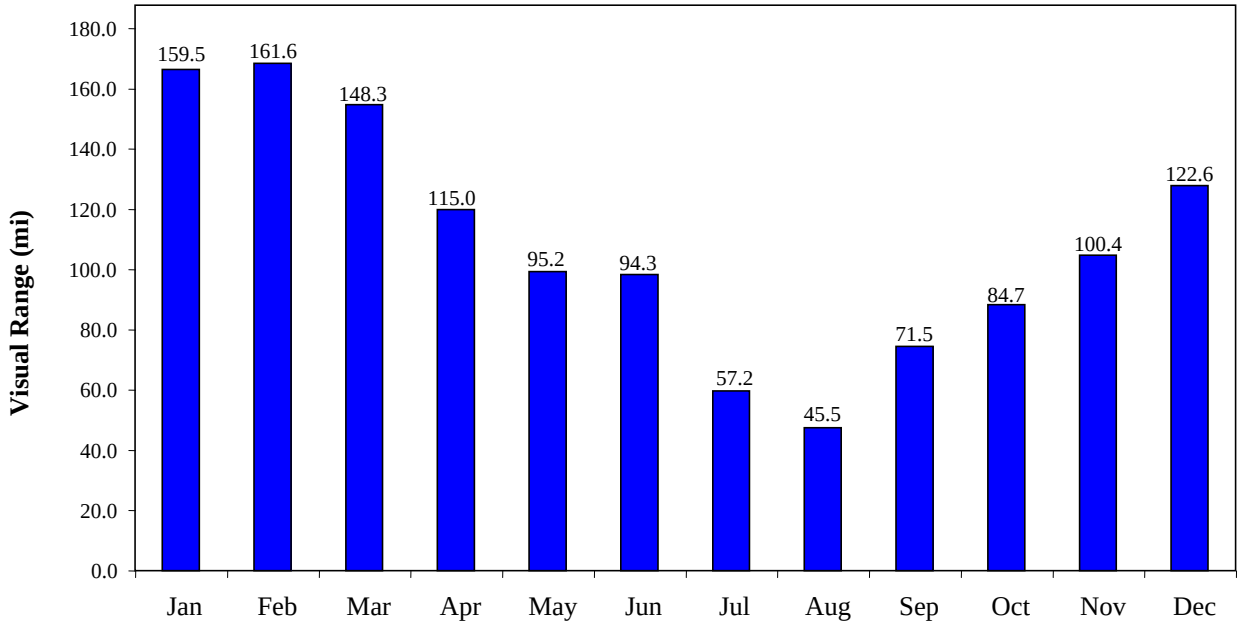
On June 15, 2005, the USEPA revoked the one-hour ozone standard for all areas except 14 eight-hour ozone nonattainment Early Action Compact areas (USEPA 2005). No counties in Washington State are included on the list of areas. However, Washington State regulations continue to require compliance with the annual PM_{10} and one-hour ozone standards, as shown in Table 3.8-1, above (WAC Chapter 173-470, Chapter 173-200).

Visibility

Visibility is an important air quality value in the western United States, particularly for scenic and recreational areas. The Clean Air Act requires that the USEPA establish regulations in order to prevent visibility impacts within Class I areas (e.g., Alpine Lakes Wilderness) resulting from human sources of air pollution (e.g., The Summit-at-Snoqualmie).The agency has established regulations that provide guidelines to states for including visibility protection in State Implementation Plans.

Since 1993, the Forest Service has been operating an IMPROVE (Interagency Monitoring of Protected Visual Environments) monitor at The Summit-at-Snoqualmie. This site is part of a national network of air quality monitoring sites targeted at monitoring visibility in Class I areas. The monitors operate every third day for 24 hours throughout the year. Information collected from the monitor between 1999 and 2003 indicates that visibility at Snoqualmie Pass is typically better during the winter months than the summer months due to the decreased amount of particulates in the air (see Illustration 3.8.1-1 - Average Annual Visibility at Snoqualmie Pass).Unstable air masses typically found in the winter likely contribute to increased mixing in the atmosphere thereby reducing the particle concentration in a single air mass (Peterson 2004).

Illustration 3.8.1-1:
Average Annual Visibility at Snoqualmie Pass
Based on IMPROVE Monitoring Station Measurements, 1999-2003



The major contributors to visibility impairment at Snoqualmie Pass are shown for the most recent available data from the IMPROVE network (see Illustrations 3.8.1-2 and 3.8.1-3).Typically, on the worst 20 percent of visually impaired days at Snoqualmie Pass there is more sulfate, nitrate, and organic carbon suspended in the air. On the least visually impaired days these compounds are at lower concentrations, suggesting that sulfate, nitrate, and organic carbon are key sources of air pollution affecting visibility in the Snoqualmie Pass area.

Illustration 3.8.1-2:
Comparison of the Major Contributors of Visibility Impairment for the Best 20 Percent and Worst 20 Percent Days for 2002

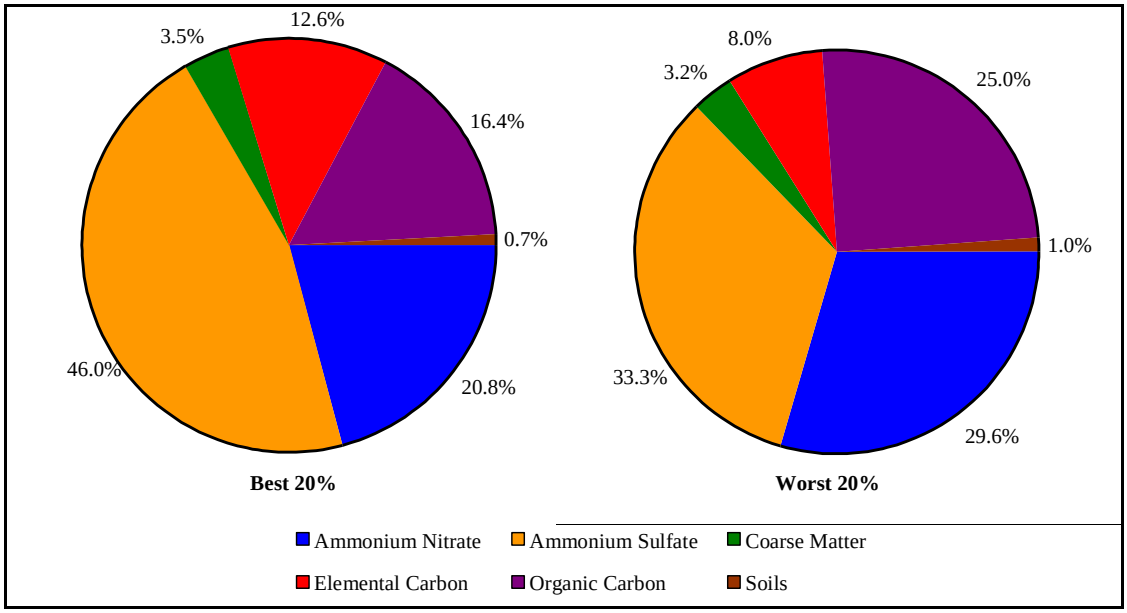
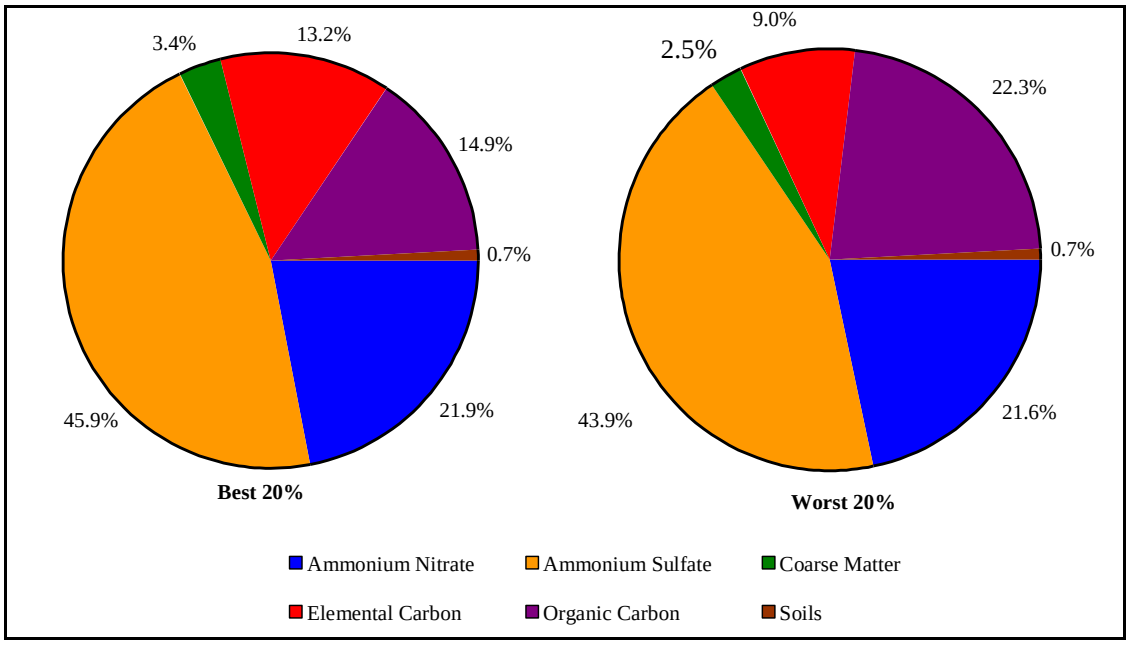


Illustration 3.8.1-3:
Comparison of the Major Contributors of Visibility Impairment for the Best 20 Percent and Worst 20 Percent Days for 2001



3.8.2 Existing Air Quality and Source of Background Pollutants

Primary sources of air pollutants within the Study Area include wood-burning stoves and fireplaces, vehicle exhaust emissions (e.g., guest and maintenance vehicles), and paved and unpaved road emissions (e.g., fugitive dust).

Emissions Inventory

Four existing and historic conditions have been identified and inventoried in the Study Area that have the potential to periodically degrade air quality below pristine levels. These conditions include: 1) dust from highway, road and parking lot maintenance particularly during the late winter and spring months; 2) emissions from parked and transient car and truck traffic, an emergency diesel generator and snow-grooming vehicles; 3) emissions from wood burning fireplaces; and 4) kitchen stack emissions from the restaurant and day lodge. There are negligible fireplace smoke emissions from the Ski Area, as propane gas is used for heating and fireplace use. The "Worst Case Scenario" outputs of these sources are shown in Table 3.8.2-1.

Assumptions made for the "Worst Case Scenario" in Table 3.8.2-1 include:

- There is one wood-burning fireplace in operation.
- There is parking space for 5,600 vehicles; worst case scenario would have one-half of all vehicles leave in one hour, which is 2,800 vehicles.
- There is one existing diesel generator in operation.
- On average, The Summit-at-Snoqualmie runs 10 groomers each day.
- There are seven existing kitchens in operation, including two propane burning fireplaces.

Table 3.8.2-1:
"Worst Case Scenario" Peak 1-Hour Pollutant Emission Levels (lbs/hr)
from Existing Sources in The Summit-at-Snoqualmie Study Area

Pollutant	Sources	Emissions (lbs/unit)	No. Units	Total Output (lbs/hr)
PM_{10}	Fireplaces	0.17/hr	1	0.17
	Highway Dust	0.012/VMT	2,800	33.60
	Vehicles	0.016/hr	2,800	44.80
	Generator	0.23	1	0.23
	Groomers	0.23	10	2.30
	Kitchens	0.07	7	0.49
	Total			**81.59**

Table 3.8.2-1:
"Worst Case Scenario" Peak 1-Hour Pollutant Emission Levels (lbs/hr)
from Existing Sources in The Summit-at-Snoqualmie Study Area

Pollutant	Sources	Emissions (lbs/unit)	No. Units	Total Output (lbs/hr)
$PM_{2.5}$[b]	Fireplaces	0.088/hr	1	0.09
	Highway Dust	0.006/VMT	2,800	16.80
	Vehicles	0.008/hr	2,800	22.40
	Generator	0.11	1	0.11
	Groomers	0.11	10	1.10
	Kitchen	0.03	7	0.21
	Total			**40.71**
CO	Fireplaces	1.27/hr	1	1.27
	Vehicles	6.32/hr	2,800	17,696.00
	Generator	4.87/hr	1	4.87
	Groomers	4.87/hr	10	48.70
	Kitchens	0.51/hr	7	3.57
	Total			**17,754.41**
NO_x	Fireplaces	0.01	1	0.01
	Vehicles	0.2	2,800	560.00
	Generator	3.95	1	3.95
	Groomers	3.95	10	39.50
	Kitchens	0.07	7	0.49
	Total			**603.95**
SO_x	Fireplaces	0.002	1	0.00
	Vehicles	0.009	2,800	25.20
	Generator	0.454	1	0.45
	Groomers	0.454	10	4.54
	Kitchens	0.001	7	0.01
	Total			**30.20**

[a] Emission Factor Source – USDA 1995b
[b] $PM_{2.5}$ emissions estimated at 0.5 PM_{10}

Cars and Buses

Vehicle exhaust is a potential source of pollutants, particularly carbon monoxide, hydrocarbons, and fine particulates, at and around The Summit-at-Snoqualmie. Interstate 90 (I-90), which is a major east/west travel corridor throughout the state, runs through the Study Area between Alpental and The Summit. Average daily traffic along I-90 is approximately 27,000 vehicles. Interchange 52 experiences the highest traffic levels of the three exits servicing The Summit-at-Snoqualmie, with an average daily traffic of approximately 2,300 vehicles. Section 3.12 – Transportation more clearly identifies issues associated with traffic along I-90 and SR 906.

The Summit-at-Snoqualmie provides approximately 47 acres of parking, accommodating approximately 5,600 vehicles. Friday evenings throughout the season, approximately 65 buses travel to The Summit. These diesel engine buses carry participants in the ski school program from King County. A portion of the

lot at Summit Central is dedicated for bus parking. Other buses travel to and from the resort primarily on the weekends.

The Summit operates four 15-passenger shuttles that provide access to all four base areas. Three of these vehicles are diesel, and one runs on gasoline. On weekdays, only one shuttle operates from 8:00 AM until 10:00 PM. Typically, on Friday, Saturday, and Sunday the resort operates three shuttles; however, as demand warrants, sometimes all four shuttles are in operation from 8:00 AM until 10:00 PM. The shuttles start at Alpental and work their way east; guests usually have to wait less than 15 minutes between shuttles.

Groomers and Other Maintenance Vehicles

The Summit has a fleet of 17 machine groomers to help ensure a high quality ski trail surface, especially during the early and late stages of the season when climate and snow conditions are less than optimal. The snow groomers are diesel-powered; and approximately two-thirds comply with the status of "green" as defined by the 1996 USEPA Air Trends Report.

Of the 17 groomers, 14 are based at Summit West and accommodate all the grooming needs at The Summit. A three-person crew operates in 10-hour shifts five days a week. The 10-hour night shift utilizes 5 to 14 groomers, depending on the day of the week. Typically, five groomers operate Monday through Thursday nights, and 14 groomers operate on Friday and Saturday nights.

The three remaining groomers are located at Alpental. Alpental is groomed every night except Sunday with two groomers on 10-hour night shifts.

Auxiliary Power Units

Each chairlift at The Summit has an auxiliary power unit. These auxiliary power units are used in the event of a lift breakdown and for lift evacuation only. The majority of the lifts at The Summit operate on gasoline fueled auxiliary power units; two lifts utilize diesel auxiliary power units. Additionally, two lifts, The Central Express and the Armstrong Express at Alpental, have a second diesel auxiliary power unit that allows the lift to run at 100 percent capacity in the event of a power failure. On average, total hours of operation for all auxiliary power units combined do not exceed ten hours per season.

Fireplaces, Wood-Burning Devices, and Restaurant Grills

Air pollution (i.e., carbon monoxide and particulates) from fireplaces, wood-burning stoves and restaurant grills can be an air quality concern, especially during the autumn and winter seasons when air inversions are most likely. The Summit has two large fireplaces located in the Slide-In Lodge at Summit West and the Old Milwaukee Lodge at Summit East. Both lodges utilize the fireplaces for ambience only; they do not act as heat sources. The Slide-In fireplace generally burns in the evenings on Wednesday through Saturday. Over the course of a season, it burns between one and two cords of wood. Old Milwaukee operates its fireplace only on Friday and Saturday nights; it utilizes less than one cord of wood per season.

The Summit-at-Snoqualmie currently operates several restaurant grills at The Summit and Alpental. These sources are considered minor sources of emissions at The Summit.

3.9 HERITAGE RESOURCES

The Summit-at-Snoqualmie is located at the lowest cross-Cascades pass in the state of Washington, an area that has been used by peoples of the region for thousands of years. Snoqualmie Pass was an important travel corridor for Euroamerican settlers arriving in the Northwest as well as for the movement of goods between western Washington and points east. One of the earliest wagon roads and a transcontinental railroad crossed the Cascades via Snoqualmie Pass. The pass also became a destination for mining, logging, and skiing. During the early historic period, Snoqualmie and Upper Yakama (Kittitas) people camped and obtained resources at the pass in addition to traveling over it on established trails between Puget Sound and the Columbia Plateau. Prehistoric sites and isolated artifacts found in this part of the Cascades represent perhaps 12,000 years of human occupation (Hollenbeck and Carter 1986). Heritage resources from any of these or other uses of Snoqualmie Pass could be present within the project area.

The area of potential effects for the heritage resource study includes all land within the ski area, totaling approximately 1,864 acres of NFSL; 1,500 acres of private land held by Ski Lifts, Inc.; and about 400 acres of private land held by the Plum Creek Timber Company.

3.9.1 Heritage Resource Protection

Preservation and management of heritage resources is mandated by a variety of regulations, which are discussed in more detail in *Heritage Resources Investigations for the Snoqualmie Pass Ski Area, King and Kittitas Counties, Washington, Final Technical Report* (Nelson 2008). Regulations protecting heritage resources include: NEPA; the Antiquities Act of 1906; the National Historic Preservation Act (NHPA) of 1969, as amended, which established the National Register of Historic Places (NRHP); the Archaeological and Historic Preservation Act of 1974; the Archaeological Resources Protection Act of 1979; the American Indian Religious Freedom Act of 1978; the Native American Graves Protection and Repatriation Act of 1990; Uniform Regulations for the Protection of Archaeological Resources (36 CFR Part 296); and Final Rule for Protection of Historic Properties (36 CFR Part 800). In addition, federal agencies administer programs consistent with Executive Order 11593 (Protection of the Cultural Environment), Executive Order 13007 (Indian Sacred Sites), and Executive Order 13287 (Preserve America).

3.9.2 Existing Conditions

This section summarizes information on heritage resources contained in *Heritage Resources Investigations for the Snoqualmie Pass Ski Area, King and Kittitas Counties, Washington, Final Technical Report* (Nelson 2008) and *Archaeological Investigation of Proposed Forest Service Acquisition Parcel, Summit at Snoqualmie Ski Areas, Washington, Technical Report Addendum* (Nelson 2005), provided in the project file. The report includes a review of background information on prehistory, ethnohistory, history, and previous archaeological investigations in the project vicinity, emphasizing the potential for the

occurrence of heritage resources in the project area. Expectations for additional historic properties within the area of potential effects are developed from this information along with information on past and present environmental settings. Site distributions are related to the kinds and distribution of resources needed by human inhabitants as well as the suitability of particular landforms for occupation. Environmental conditions also have consequences for the archaeological record in terms of site visibility and preservation. Past and present environments of the project vicinity are discussed in Sections 3.1 – Climate and Snow through 3.6 – Wildlife.

Prehistory

The oldest known evidence of human occupation in the region consists of a small number of sites on both sides of the Cascades dating to 11,500 to 11,000 years ago, shortly after glacial retreat (Carlson 1990; Gustafson et al. 1979; Mehringer 1989; Meltzer and Dunnell 1987). Occasional use of the southern Washington Cascades also may date to this time, as suggested by a Clovis-like fluted point found at Lake Cle Elum, 10 miles east of Snoqualmie Pass (Hollenbeck and Carter 1986). Sites thought to be between about 10,000 and 5,000 years old have been identified in both the Puget Sound and Columbia Plateau regions. Few sites of this type are known from the Cascades, although projectile points similar to those in lower elevation areas have been found around lakes Keechelus and Kachess near Snoqualmie Pass (Hollenbeck and Carter 1986).

Increased occupation of upland and montane areas dates to ca. 4,500/4,000 years ago and may be associated with higher regional population size and establishment of a logistical land use system (e.g., Burtchard 1998; Schalk 1988). Sites from the past 2,000 to 3,000 years in the Cascades are found in a wide variety of upland settings and show a general continuity in distribution and contents on both sides of the Cascades, which may reflect close intergroup connections via trade, travel, and kinship (Hollenbeck and Carter 1986). Euroamerican contact brought about many changes to native cultures, including population loss and displacement, and the adoption of non-native goods such as horses, metal, and guns (Boyd 1999; Campbell 1989).

Ethnohistory and Ethnography

The Cascade Crest forms an ethnographic territorial boundary between the Snoqualmie people on the west and the Upper Yakama or Kittitas people on the east. The Snoqualmie occupied the Snoqualmie River watershed from its confluence with the Skykomish River at present-day Monroe to its headwaters at Snoqualmie Pass. The Kittitas occupied the Yakima River valley above Selah and the Kittitas valley.

The Snoqualmie spent winters in permanent villages along the Snoqualmie and Tolt rivers between Snoqualmie Falls and Monroe, and at Sallal Prairie near present-day North Bend (Smith 1941; Waterman ca. 1920). In early spring, the Snoqualmie split up into smaller groups and traveled to seasonal camps and locations to obtain and process a variety of resources as they became available. They traveled into the mountains, including the Snoqualmie Pass area, during the summer, where they collected huckleberries,

beargrass, and other plants, and hunted deer, elk, bear, mountain goats, and smaller game (Coleman 1932; Haeberlin and Gunther 1930; Turner 1976).

The early historic period native occupants of the Yakima Watershed included two main groups: the Upper Yakama or Kittitas in the Yakima Watershed above present-day Selah, and the Lower Yakama or Yakama proper from Selah to the Columbia River. For purposes of the following discussion, the terms Kittitas and Lower Yakama are used when referring to peoples from the areas specified above, and the term Yakama to people of the entire watershed. Both the Kittitas and Lower Yakama were made up of several bands living in different parts of the Yakima Watershed. One of the Kittitas bands was the Pshwanwapam. During the nineteenth century, they were joined by members of the Taidnapam band who were driven from the upper Cowlitz River into the upper Kittitas valley (Ruby and Brown 1992). Before moving into the Cowlitz watershed, the Taidnapam had lived along the Tieton River, which flows into the Yakima River just downriver of Selah.

Yakama winter villages were located mostly on the Yakima and Columbia rivers. Fishing was the most important subsistence activity, followed by root and berry gathering and supplemented by hunting. The Kittitas traveled to higher elevation resource areas during the summers, including Lake Keechelus, where they obtained sockeye salmon, and Snoqualmie Pass, where they collected huckleberries along with the Snoqualmie. After they obtained horses in the eighteenth century, the Yakama also traveled east to hunt bison on the Great Plains (Anastasio 1972).

Strong ties were formed across the mountains as people from both sides of the Cascades exchanged goods, socialized, and intermarried (Gibbs 1855; Hollenbeck and Carter 1986; Schuster 1990). The Snoqualmie and Yakama traveled across the mountains along an extensive trail system over Snoqualmie and Yakima passes. The Snoqualmie Pass trail, which was used mostly by foot travelers, followed the South Fork Snoqualmie River to the pass, where it crossed to the north side of Coal Creek and continued east along the east shore of Lake Keechelus and the Yakima River through the Kittitas Valley. This trail connected with a horse trail over Yakima Pass via the Cedar River valley.

In 1855 the Treaty with the Yakama was signed by the United States and the Consolidated Tribes and Bands of the Yakama Indian Nation, comprised of the Kittitas and Lower Yakama and 12 other Columbia River bands. The Treaty established the Yakama Reservation and ceded all other lands to the United States.

The Snoqualmie were signatories to the Point Elliott Treaty of 1855 and were assigned to the Tulalip Reservation along with the Snohomish, Stillaguamish, and Skykomish. Many refused to relocate to Puget Sound, however, and continued to live upriver in their traditional territory. The Snoqualmie Tribe was recognized by the federal government as an independent sovereign in 1999.

History

Non-Indian use of the Snoqualmie Pass area dates to 1853, when territorial governor Isaac I. Stevens authorized a military expedition to survey railroad routes through the Cascades. In 1854 Abiel Tinkham crossed Yakima Pass and observed Snoqualmie Pass, which he recommended as a suitable railroad route. In 1865, a group of Seattle citizens raised funds to build a wagon road over Snoqualmie Pass. The road, which generally followed the Indian trail, was completed in 1867 (Bagley 1929; Lyman 1919; Oliphant 1947). The road was upgraded and rerouted numerous times, becoming the Sunset Highway in 1913, Highway 10 in the late 1920s, and Interstate 90 in the 1970s (Prater 1981). In the early days, a number of automobile campgrounds and inns were established at Snoqualmie Pass and other places between North Bend and Ellensburg. Most of the inns closed after the highway was paved in the 1930s and were later destroyed by highway expansion.

Railroad construction from eastern Washington to Puget Sound began somewhat later than road construction. The first railroad to cross the Cascades was the Northern Pacific, which completed its line over Stampede Pass in 1887. It was followed in 1893 by the Great Northern, and in 1909 by the Chicago, Milwaukee, and St. Paul Railroad (later the Chicago, Milwaukee, St. Paul and Pacific, known as the Milwaukee Road), which linked Ellensburg and Seattle over Snoqualmie Pass. The original Snoqualmie Pass segment was constructed as a temporary “High Line” from 2 miles east of Hyak (Summit East) to Laconia, at the summit of Snoqualmie Pass (Summit West) (Derleth 1948; Holstine et al. 1991). Section houses, order stations, substations, and flag stops were established at Lake Keechelus, Hyak, Laconia, Rockdale, and Bandera in the project vicinity. Mile-long snowsheds were built near Rockdale and Lake Keechelus in 1909-1910, and in 1915 the temporary High Line between Hyak and Rockdale was bypassed by the Snoqualmie Tunnel. The line was also electrified that year, largely eliminating the need for maintenance stops and greatly increasing load capacity on slopes. Operating costs on the electric line were high, however, and railroad freight shipping was supplanted by long-haul trucking. The Milwaukee Road ceased operations in 1980. Order stations and other buildings were razed and the tracks removed or sold for use by other railroads (DePuydt 1990; Holstine et al. 1991; Luttrell et al. 1999).

Mining in the Snoqualmie Pass area began after Arthur Denny was shown iron ore deposits on Denny Mountain by a Snoqualmie Indian guide in 1859. The Denny Iron Mining Co. was formed in 1882 with nine claims on Denny Mountain in the Summit Mining District (Evans 1990; Hollenbeck 1987). The venture was not profitable, however, and the mines were closed in 1907 (Hodges 1897). Substantial, but short-lived, mining operations were also located at Rockdale, Guye Peak, and Lake Keechelus. The Guye Iron Mines flume later became part of a never-completed system designed to provide water to Yakima from Snow Lake. Many others staked small claims in the Upper Snoqualmie Valley and at the pass, and mined iron, gold, silver, zinc, copper, and coal. A small rush followed the 1898 discovery of gold at Gold Creek, and the Flanagan Mining Company built a tramway from Gold and Coal Creeks across the Snoqualmie Pass Road. Eventually, the industry died out in the area because of the relatively small amounts of good quality minerals and ores.

Logging in the upper Kittitas Valley began in the 1880s, with timber supplied to the Northern Pacific for use in construction of the line over Stampede Pass. Logging in the Snoqualmie Valley peaked between 1905 and 1910; by 1908, mills employed hundreds of men living around North Bend and in logging camps between there and Snoqualmie Pass (Evans 1990; Hollenbeck 1987). Timber along the Sunset Highway around Rockdale and Snoqualmie Pass was logged in 1919-1920 (Boswell et al. 1990; Lyman 1919; West Coast Lumberman 1944). Private land around Snoqualmie Pass was logged mostly in the 1930s and 1940s, while sections managed by the Forest Service were logged mostly after 1940 (Hollenbeck 1987).

Early Forest Service administration of the Cascades was related primarily to grazing and fire control, with timber harvesting and recreation becoming more important later (Carter 1994; Steen 1977). Early trails on the Forests were built and maintained largely for fire control purposes. Trail construction accelerated in the 1920s and 1930s, spurred by increased recreational demand. A plan to link segments of trail into what later became the Pacific Crest National Scenic Trail (PCNST) was proposed in 1932. The Washington section was known as the Cascade Crest Trail. It was surveyed in 1935 and the Civilian Conservation Corps and relay teams from the YMCA began construction of several segments shortly thereafter. A segment near Mt. Rainier was described as a “combination of cheap way trails and old Indian trails” (Fenby 1931). Work on the trail was suspended during World War II and its aftermath, and existing sections fell into disrepair. Construction and repair resumed during the 1960s and 1970s when the trail was designated a National Scenic Trail and renamed the PCNST. In the Snoqualmie Pass area, the original alignment was generally followed with the exception of a segment from the mid-ski slope at Summit West to the toe of the slope on the north side of Interstate 90, according to historic maps (USFS 1937, 1945; USGS 1961).

During the 1930s, the Civilian Conservation Corps also built a number of facilities in the National Forests, including ranger stations, campgrounds, and other recreational facilities. The Snoqualmie Pass Guard Station was constructed by the Civilian Conservation Corps in 1939 (Throop 1979).

Snoqualmie Pass was an early focus of recreational activities for people from Seattle due to its proximity and easy access by train. The Mountaineers built the earliest lodge in the Snoqualmie Pass area in 1914 just south of Lodge Lake above the current Summit West ski area, with a number of trails to nearby lakes and peaks (The Mountaineer 1915; Prater 1981). The original Mountaineers’ Lodge burned down in 1944 and was rebuilt between Summit West and Summit Central in 1948. The rebuilt lodge burned down in May of 2006.

In 1936, the Milwaukee Road Railroad began clearing timber for a ski area at Hyak Station just east of the present Summit East ski area. The Snoqualmie Ski Bowl opened the following year with a lodge and electric ski lifts and lights for night skiing (Washington Sportsman 1937). The area was closed during World War II so that the Milwaukee Road could focus its resources on the war effort, and reopened after the war as the Milwaukee Ski Bowl. The lodge burned down in 1949 and the area closed in 1950 when

the Milwaukee Road withdrew from ski area management. In the late 1950s, the Hyak Ski Corporation purchased the ski resort and rebuilt and expanded the facilities. The ski area reopened as Hyak in 1959.

The first organized use of the future Snoqualmie Summit (Summit West) ski area was in 1929, when a ski jumping competition was held at Beaver Lake hill. In 1933 the Seattle Parks Department had 40 acres of timber removed and trails and a warming hut built on land it owned there (Moffett 1978). The first rope tow was installed in 1937. Additional structures were built at Summit West over the years, including the Thunderbird, Alpenhaus, and Ski-Inn lodges, a chapel, maintenance buildings, and chair lifts. The warming hut was torn down in 1960 and replaced by the Alpenhaus Lodge, which opened in 1962 (Moffett and DeBruler 1995).

Ski Acres (now Summit Central), built on private land purchased from the Northern Pacific, opened in the winter of 1948-1949, a year before the Milwaukee Ski Bowl closed. In 1967, Alpental opened on Denny Mountain across the highway from the other Snoqualmie Pass ski areas.

Previously Recorded Heritage Resources

A number of cultural resource investigations have been conducted in or within approximately 1 mile of The Summit-at-Snoqualmie ski areas since 1978, most of them small-scale reconnaissance surveys conducted by the Forest Service (Nelson 2008:Table 2). Several of the Forest Service investigations covered limited portions of the current project area. The Snoqualmie Pass portion of the PCNST was surveyed, although the historic Cascade Crest Trail was not specifically identified in this area (Reid and Zweifel 1987). The Snoqualmie Pass RR Tunnel and the Snoqualmie Pass Guard Station have been evaluated for the NRHP; both were determined Not Eligible.

Nine prehistoric sites have been recorded within approximately 1 mile of the project area (Hicks and Bishop 1993). These and other nearby prehistoric sites consist of lithic scatters, some of which also contain fire-modified rock, and appear to be short-term resource locations or camps.

Thirteen previously recorded historic sites are located within approximately 1 mile of the project area (Nelson 2008: Table 3). They are associated with small-scale mining, the construction and early use of the road and railroad, and Forest Service administration and recreation. Buildings constructed for the railroad and early automobile travel were later removed in the course of road and ski area construction and dismantling of the Milwaukee Road line. Four of the previously recorded historic sites have been recommended eligible, nominated to, or determined eligible for the National Register of Historic Places: the Snoqualmie Pass Wagon Road, South Fork Snoqualmie River Bridge, Denny Creek Recreation Residence Tract and the Snoqualmie East Recreation Residence Tract. The South Fork Snoqualmie River Bridge was determined eligible to the NRHP in 2002. It was removed following HABS/HAER documentation (Historical American Building Survey/Historic American Engineering Record). The Denny Creek and the Snoqualmie East Recreation Residence Tracts were determined eligible as Historic Districts (Gassaway 2006). A portion of the Snoqualmie Pass Wagon Road was placed on the Washington

Heritage Register in 1990. Historic resources of the Milwaukee Road (the Chicago Milwaukee St. Paul and Pacific Railroad) were described in 1992 as a basis for evaluating related properties for listing in the National Register. At that time, the Milwaukee roadbed was specifically excluded as a property potentially eligible for the NRHP within the developed context. The Snoqualmie Pass Guard Station was determined ineligible to the NRHP in 1982 due to the addition of a façade, but could be reconsidered for eligibility if the façade were to be removed and a majority of its historic characteristics remained.

Field Survey Results

Field surveys of the area of potential effects were conducted in 1994 and 1999. At the time of those surveys, a portion of the MDP area was not included in the area of potential effects. These areas, on upper Mill Creek at Summit East and the Alpental base area, were surveyed in October, 2004 and an addendum to the technical report prepared (Nelson 2008). The complete findings of the 1994 and 1999 surveys are documented in *Heritage Resources Investigations for the Snoqualmie Pass Ski Area, King and Kittitas Counties, Washington, Technical Report* (Nelson 2008a). The results of those surveys and the 2004 survey were prepared as a separate report (Nelson 2005) and were revised for and incorporated into the final technical report as Appendix C. Prior to the fieldwork, the area of potential effects was divided into areas of low, medium, or high probability for heritage resources. Probability determinations were derived using the MBSNF heritage resource inventory strategy (Hearne and Hollenbeck 1996). Following Forest inventory strategy guidelines, all high probability areas were surveyed on foot with transects spaced 20 meters apart, or less, while lower proportions of medium (40 percent) and low (10 percent) probability areas were surveyed. Shovel probes were excavated on high probability landforms where surface visibility was poor or artifacts could be more deeply buried.

Two sites and two isolated artifacts were documented during the field surveys (see Table 3.9.2-1). The newly recorded heritage resources included remains of a railroad logging operation, a lithic scatter, and two lithic isolates. A third lithic isolate (biface) was discovered during a fisheries survey for the MDP (Wones 2003). A previously unrecorded segment of the Milwaukee Road was also documented during the archaeological survey, and three previously recorded sites, the Snoqualmie RR Tunnel, Snoqualmie Pass Guard Station, and Cascade Crest Trail, were revisited.

Table 3.9.2-1:
Heritage Resources Recorded or Revisited
in The Summit-at-Snoqualmie Ski Areas Project Area

Forest Service Number	Name/Description	NRHP Eligibility and Criteria
06-05-05-00064	Lithic scatter	Eligible, Criterion D
06-05-05-00113	Lithic isolate	Not eligible
06-05-05-00087	Logging railroad operation	Potentially eligible, Criteria A and D
06-05-05-00089	Lithic isolate	Not eligible
06-05-05-00114	Lithic isolate (biface)	Not eligible
06-05-05-00051	Snoqualmie Tunnel, Milwaukee Road	Determined ineligible as individual property, 1990
06-05-05-00063	Snoqualmie Pass Guard Station	Determined not eligible due to addition (1982); could be re-evaluated if addition removed.
06-05-07-00088	Cascade Crest Trail	Recommended eligible, Criterion A
06-05-05-00091	Milwaukee Road High Line railroad	Not eligible as individual property (1992)

06-05-05-00064, Lithic Scatter. This site consists of cryptocrystalline flakes and a biface fragment found in four shovel probes (one excavated in 1994, three in 2004). One of the probes excavated in 1994 contained seven small cryptocrystalline silica flakes, one excavated in 2004 contained about 17 cryptocrystalline flakes and three obsidian flakes. No cultural material was found in the other 64 shovel probes placed in this area during the 1994, 1999, and 2004 surveys, including those excavated at smaller intervals around the positive probes. The site is potentially eligible to the NRHP as one of a small number of known lithic scatters located in montane saddles and along cross-Cascades travel corridors. The high artifact density in two of the probes suggests that lithic technological studies could be undertaken, and the obsidian could be sourced to provide information on long-distance trade networks.

06-05-05-00113, Lithic Isolate. A possible metasediment flake was found at Summit West in 1994. Although surface exposure was good in this area, no other cultural material was found. No shovel probes were excavated in this vicinity due to good surface visibility and previous disturbance. This artifact is not considered eligible to the NRHP because it is an isolated occurrence.

06-05-05-00087, Logging Railroad Operation. This site consists of a historic debris scatter. This site is potentially eligible to the NRHP for its ability to yield information about historic logging activities in the area. If development or construction could disturb this vicinity, material collection and subsurface testing will be conducted to complete a NRHP evaluation.

06-05-05-00089, Lithic Isolate. This is a metasediment biface tip found in a shovel probe in 1999. A fire-modified rock and charcoal-infused sediments were also present in this probe stratigraphically above the biface. No additional cultural material was found in other probes excavated nearby. Based on current information, the isolate is not considered eligible to the NRHP. Because there will be no subsurface disturbance to this area under any of the MDP alternatives, further testing is not necessary at this time.

However, this artifact was found on a high probability landform, and if future development or construction could disturb this vicinity, archaeological testing should be undertaken to determine the nature and extent of heritage resources there and whether the cultural material could be eligible to the NRHP.

06-05-05-00114, Lithic Isolate (Biface). This cryptocrystalline biface was found in a stream bed during a fisheries survey for the MDP. The vicinity of the find was examined during field survey of selected areas of the MDP area of potential effects in October of 2004. No additional cultural material was observed. The area appears unlikely to have been used as a camp site, and the point was likely lost during hunting. As an isolated occurrence, 06-05-05-00114 is not eligible to the NRHP.

06-05-05-00051, Snoqualmie Railroal Tunnel. This site remains essentially as originally recorded and the site inventory form was not updated. The tunnel is approximately 2.3 miles long, with its east portal at the base of the Summit East ski area. It has been converted for use as part of the Iron Horse Trail. The Snoqualmie Tunnel was found ineligible to the National Register as an individual property in 1990.

06-05-05-00063, Snoqualmie Pass Guard Station. This site remains essentially as originally recorded and the site inventory form was not updated. The guard station, built by the Civilian Conservation Corps in 1939, was not included in a thematic nomination of Forest Administration Civilian Conservation Corps structures due to a one-story addition to the front of the structure dating to the 1960s (Scott 1982). If the addition was to be removed, however, and the structure retains a majority of its historic characteristics, it could be reconsidered for eligibility to the NRHP.

06-05-07-00088, Cascade Crest Trail. The Cascade Crest Trail, on which construction began in 1935, and which was later expanded and re-named the PCNST, has not been recorded fully, nor has it been evaluated for the NRHP. The trail is recommended eligible to the NRHP as a discontinuous linear resource under criterion A, which includes properties “that are associated with events that have made a significant contribution to the broad patterns of our history” (36 CFR 60.4). The trail is associated with both Forest Administration (1904-1950) history and recreation. The concept and construction of the Cascade Crest Trail has had a long and substantial administrative history with several National Forests in Washington, Oregon, and California as well as being an important recreational feature for many years. A trail along the crest in this area does not appear on the 1903 30-minute USGS map, but is shown on Snoqualmie National Forest maps dating to the late 1930s and 1940s Where practical, the Cascade Crest Trail was constructed using existing American Indian, miners’, and fire control trails. Although the trail was renovated and rebuilt during the 1960s and 1970s as the PCNST, the segment in the Snoqualmie Pass ski areas vicinity is in or near its historic position except on the lower slope of Summit West, according to Forest Service and USGS maps. No unequivocal evidence of the Cascade Crest Trail such as trail markers or old blazes was observed in the area of potential effects. However, based on maps and field observations, the PCNST trail tread appears to be in approximately the same position as the Cascade Crest Trail outside the developed (cleared and graded) ski area slopes and parking lots.

06-05-05-00091, Milwaukee Road High Line Railroad Roadbed. A segment of the roadbed constructed in 1909 and operated until 1915, when the Snoqualmie Tunnel was completed, was recorded. The segment is approximately 400 meters (1,300 feet) long; the rails and ties have been removed, but the grade remains largely intact there except for erosion adjacent to Hyak Creek and the un-named creek near the south end of the identified grade. Indentations left by the ties can still be seen over much of the grade in this area. The grade has been destroyed or significantly disturbed to the north of the recorded segment, where it crosses the developed ski slopes of Summit Central and Summit North. Historic resources of the Milwaukee Road (the Chicago Milwaukee St. Paul and Pacific Railroad) were described in 1992 as a basis for evaluating related properties for listing in the National Register. At that time, the Milwaukee roadbed was specifically excluded as a property potentially eligible for the NRHP within the developed context.

3.9.3 Traditional Cultural Heritage Resources

The NRHP recognizes that historic properties possess many kinds of significance, including cultural significance. Traditional Cultural Heritage Resources that are eligible for or listed on the NRHP are one kind of historic property, also called Traditional Cultural Properties. Their significance derives from their role in the community's historically rooted beliefs, customs, and practices (Parker and King 1990).

Information on Traditional Cultural Heritage Resources in the area of potential effects was sought through literature review (Blukis Onat and Hollenbeck 1981; Nelson 2008) and correspondence with potentially interested American Indian Tribes and Indian cultural groups. The Snoqualmie Tribe, Tulalip Tribes, and Yakama Indian Nation were contacted in 1994, when the original survey took place (NWAA 1994), informed of survey results, and asked to contact NWAA regarding Traditional Cultural Heritage Resources, questions, or concerns. No specific information was provided by any of those tribes at that time. In 1999, the Lummi, Muckleshoot, Nooksack, Sauk-Suiattle, Samish, Snoqualmie, Stillaguamish, Suquamish, Swinomish, Tulalip, and Upper Skagit Tribes, Yakama Nation, and the Duwamish and Snohomish Tribal cultural groups were sent letters by the Forest Service inviting them to participate in the scoping process for the current MDP and soliciting historic and cultural property concerns (Harkenrider 1999). The Yakama Nation and Tulalip Tribes were sent letters notifying them of the issuance of an ARPA permit for this project, inviting them to participate in government-to-government consultation regarding the project and to voice any concerns they wished to have considered prior to a decision about the MDP. The Tulalip Tribes, the Yakama Nation and the Snoqualmie Tribe were also sent project update mailers. Subsequent to the publication of the Draft EIS in December, 2005, a comment letter was received from the Snoqualmie Tribe requesting dialogue with the USFS prior to preparation of the FEIS (see FEIS Volume 5, Section 3.0 – Response to Comments) as a result the Forest Supervisor initiated government-to-government consultation with the Snoqualmie Tribe via a letter dated March 30, 2006, and another on December 21, 2007. On January 31, 2008 Forest Supervisor Rob Iwamoto met with representatives of the Snoqualmie tribe to provide a project update and answer questions. A follow-up letter was sent on February 7, 2008.

Letters were sent to the Snoqualmie Tribe, the Yakama Indian Nation and the Tulalip Tribes requesting comments on the final heritage resources report (Nelson 2008). Copies of the report were sent to the respective Tribal Cultural/THPO departments. The Snoqualmie Tribe responded, and met with the Forest Heritage Specialist on June 24, 2008 to discuss the findings and recommendations. On July 2, 2008, the Snoqualmie Tribe sent a letter to the SHPO concurring with the USFS findings of eligibility and mitigation requirements.

Ethnohistoric, ethnographic, and historic documents confirm that the Snoqualmie Pass area was used by Snoqualmie and Yakama peoples for travel between their territories as well as by members of the Tulalip Tribes to obtain huckleberries and other resources such as mountain goats and fish (Blukis Onat and Hollenbeck 1981; see *Ethnohistory and Ethnography* section). The Forest Service has identified no Traditional Cultural Properties within the area of potential effects for this undertaking.

3.9.4 Reserved Treaty Rights

Treaty rights include rights specifically reserved in treaties signed by American Indian groups with the federal government as well as other rights not taken away by treaty. They include the right to “fish at usual and accustomed grounds and stations” together with “privilege of hunting and gathering roots and berries on open and unclaimed lands”. Although the term “open and unclaimed lands” has not been clearly defined, federal courts have ruled that certain federal public lands, such as National Forests, not set aside for uses incompatible with these uses can be considered open and unclaimed (Northwest Indian Fisheries Commission 2001).

The Tulalip Tribes and Yakama Indian Nation retain rights to obtain traditional resources in the Snoqualmie Pass vicinity, which is within the traditional use area of each of these peoples (U.S. v. Washington, 1974). The Snoqualmie Tribe was recognized through the Department of the Interior’s acknowledgment process in 1999, but does not have the same off-reservation treaty rights as tribes that are party to U.S. v Washington. Their off-reservation rights to fish, hunt, and gather traditional resources are undetermined at this time.

The USFS requested information from the Tulalip Tribes and Yakama Indian Nation about their exercise of reserved rights in the project area as part of government-to-government consultations for the Proposed MDP. To date, neither has responded. Consultation with Indian Tribes continues, as appropriate, throughout the processes prescribed by NHPA, NEPA and National Forest policy (FSM 1563). No current tribal exercise of reserved treaty rights has been specifically identified on NFSL in the Study Area.

3.10 SOCIAL AND ECONOMIC RESOURCES

3.10.1 Analysis Area

The Summit-at-Snoqualmie's operations are not sizeable enough to have a discernable effect on the economies of either King or Kittitas counties as a whole. Therefore, this socioeconomics analysis focuses on communities along Interstate 90, immediately east and west of Snoqualmie Pass. The communities of North Bend, in King County, and Snoqualmie Pass, Cle Elum, and Easton in Kittitas County have been identified for potential social and economic impacts by current and future management decisions at The Summit-at-Snoqualmie.[39] These communities will be referred to as "impact communities" throughout this analysis. Also, the term "regional' is used throughout this analysis of socioeconomic resources to define the geographic area that is served by The Summit-at-Snoqualmie – it generally refers to areas that are within a reasonable (approximately two hours) driving distance of the ski area.

3.10.2 Introduction

The Summit-at-Snoqualmie is accessible via Interstate 90, which provides easy access (approximately one hour's driving time) to the ski area from Washington State's largest population center, the greater Seattle area (including Seattle proper, Bellevue, Federal Way, Kent, Kirkland, Redmond, Renton, and Shoreline). All of the aforementioned cities are located in King County.

The Summit-at-Snoqualmie's annual visitation numbers have fluctuated considerably over the past 18 seasons, primarily a result of weather and snow conditions. Between 1989/90 and 2006/07, The Summit-at-Snoqualmie accounted for an average of 28.2 percent of the State's annual skier visits (PNSAA 2007).

Historically, the majority of visits to The Summit-at-Snoqualmie have been attributed to day visits (88 percent).[40] The Summit-at-Snoqualmie's central location between the Seattle (west on I-90) and Ellensburg (east on I-90) markets, as well as ease of I-90 access, makes it an easy choice for day skiers. Snoqualmie competes with Crystal Mountain, White Pass, and Stevens Pass within the local/day skier market.[41] Stevens Pass is The Summit-at-Snoqualmie's main competitor, attracting the majority of its skiers from Seattle, Bellevue, and areas north, but also benefiting from its proximity to Leavenworth and Wenatchee.

Day skier visits at The Summit-at-Snoqualmie declined between 1998/99 and 2001/02 – from 7 percent to 3 percent (RRC Associates 2002). Between 1997/98 and 2001/02, the proportion of skier visits from Washington remained remarkably stable (hovering around 94 percent). Skier visits outside the local market are generated by visitors to the south metropolitan area; people that take a day to ski while visiting family, friends, or on a business trip. The next tier of geographic markets includes Oregon (1.1 percent)

[39] The community of Cle Elum is represented by two separate U.S. Census units: Cle Elum city and South Cle Elum town.
[40] Day skiers are loosely defined as those driving two hours to reach the ski area – including people from the Seattle area and Ellensburg
[41] However, Crystal Mountain is more of a regional destination resort due to its overnight accommodations.

and California (0.7 percent). Less than half a percent originate from New York, Texas, Arizona, Florida, and Wisconsin. International visitors accounts for 1 percent, with the U.K. being the primary international market (0.4 percent). Within Washington, the greatest percentage of skiers visiting The Summit-at-Snoqualmie comes from King County (74 percent), followed by Pierce (8 percent), Snohomish (4 percent), Kittitas (2 percent) and Kitsap (2 percent) (RRC Associates 2002).

3.10.3 Counties

King County

Covering 2,128 square miles (3.2 percent of Washington State) King County is bordered by Puget Sound to the west and the Cascade Crest to the east. The northern border, shared with Snohomish County, is a political designation, rather than a natural delineation.

King County grew and prospered during the late nineteenth and early twentieth centuries with the expansion of the shipping and lumber industries. It boomed again during and after World War II as an aircraft production and shipbuilding center. Today the County is the Pacific Northwest's major manufacturing and shipping center (King County undated).

King County is the largest metropolitan county in the State of Washington in terms of population, number of cities and employment. With an estimated population of 1,826,732 in 2006, it is the fourteenth most populous county in the United States and represents approximately 29 percent of Washington's population. Notable businesses and employers in the County include Boeing and Microsoft. Seattle, with approximately 582,454 residents, is the most populous city in Washington and is the King County seat. (U.S. Census Bureau 2007).

Kittitas County

Kittitas County is located east of the Cascade Mountains on the Okanogan-Wenatchee National Forest, in the geographical center of the state. Ellensburg, home of Central Washington University, is the County seat. The southern area of the County contains part of the U.S. Military's Yakima Training Range. In 1905, a U.S. Reclamation Service project opening up 72,000 acres for agricultural development was of major importance to the County's economic development. Today, Kittitas County is an important food processing, mixed agriculture and stock-raising center. Mining and timber also add diversity to its economy, however many communities in Kittitas County have transitioned away from extraction industries and into travel and tourism.

Kittitas County spans from the forested Cascade Mountains to the upper Yakima River Valley plains and the Columbia River and covers 2,297 square miles. Compared to King County's urban setting, Kittitas County is considered rural.

Agriculture, at present, consists largely of the production of grass hay, cereal grain, and livestock. The early agriculture of Kittitas County was centered on the raising of livestock. Irrigated pastures and

extensive rangeland provide the basis for a thriving livestock industry. Kittitas County has the fourth largest beef cow inventory in Washington State.

Kittitas County is the largest producer of grass hay, primarily timothy, in Washington as well as oats for grain. The County's logging and lumber industries were established in the early 1870s, fueled primarily by two factors: in-migration of settlers who needed lumber to build homes and railroads that needed wooden ties to expand their spurs. Most of the logging was concentrated in the western end of the County. Sawmills sprang up wherever access to timber existed. By the turn of the century, major logging companies such as the Cascade Company had overtaken many smaller independent groups of loggers. Railroads replaced both horse team/skids and the downriver log drives. After World War II, the logging railroads were themselves decommissioned as pneumatic tires made logging trucks and logging road construction more practical.

In the early 1880s, coal and mineral activities got underway in the Cle Elum River Valley and the surrounding mountains. At the turn of the century, several large coal concerns were mining in excess of a million tons of coal annually. Mining subsided in the face of competition from oil in the 1930s. Even before the discovery of coal, prospectors flocked to the region searching for precious metals and ores. Efforts centered around gold, but silver, copper, lead, iron, chromium, mercury, manganese, molybdenum, nickel, and antimony were also present. Mining activity continued at an accelerated pace until peaking during the 1930s (Cochran undated).

3.10.4 Impact Communities

Table 3.10.3-1 provides a comparison of relevant socio-economic data for each of the impact communities.

With the exception of North Bend, these smaller communities tend to be focused, relative to the size of their populations, on travel and tourism, having recently transitioned away from resource extraction-based economies (primarily timber). Their location along Interstate 90 and their proximity to recreation destinations in the Cascade Mountains make them convenient stops for travelers. In addition, communities such as these tend to have little employment in manufacturing or other industries that characterize more densely populated areas in the state.

Development pressures have increased significantly along the I-90 corridor in east King County, with the communities of Issaquah and North Bend growing rapidly throughout the 1990s due to their proximity to Seattle. Development pressures have thus begun to unfold in rural Kittitas County as a result of spillover demand from Seattle. Increasing numbers of people are commuting from Kittitas County to King County and this is likely to expand considerably in the future. The increasing ability of the workforce to telecommute, especially within the high tech sectors prevalent in the Seattle-Tacoma region, will further enable the resident labor force to find high quality living environments somewhat remote from their workplaces.

However, the capacities of communities in eastern King County, such as North Bend, to absorb the anticipated growth over the decade will be limited. Snoqualmie Pass and communities further east represent the next logical tier to accept development pressures from the greater Seattle-Tacoma metropolitan area along the I-90 corridor.

Table 3.10.3-1:
Socio-Economic Data for Impact Communities

Location	Miles from the Study Area	Median Family Income (dollars)	Per Capita Income (dollars)	Population	Total Housing Units	Occupied Housing Units	Vacant Housing Units	Seasonal Housing Units[a]	Rental Vacancy Rate	Median Rent/Month (dollars)
King County										
North Bend	27	$69,402	$28,229	4,746	1,889	1,841	48	3	3.3%	$1,001
Kittitas County										
Snoqualmie Pass CDP[b]	N/A	$89,532	$54,316	201	330	88	242	225	13.3%	$575
Easton CDP[b]	19	$37,917	$19,773	383	228	151	77	45	7.7%	$643
South Cle Elum	31.7	N/A	$22,375	457	210	188	22	12	2.4%	$350
Cle Elum	31.5	$39,000	$16,620	1,755	956	792	164	34	6.2%	$434

Source: US Census Bureau, Census 2000a.
[a] Seasonal Housing Units are not occupied on a year-round basis.
[b] The U.S. Census defines a CDP as a "a statistical entity, defined for each decennial census according to Census Bureau guidelines, comprising a densely settled concentration of population that is not within an incorporated place, but is locally identified by a name."

North Bend

North Bend is located on the South Fork of the Snoqualmie River about half way between Seattle and Snoqualmie Pass along Interstate 90. Its close proximity to Snoqualmie Pass and the Cascade Mountains makes it a convenient stop for travelers wanting food, lodging or last minute items en-route to the mountains. With its convenient location on the I-90 corridor, North Bend is increasingly becoming a bedroom community for Seattle. The town has a rural character, and is the chief agricultural area for King County's upper Snoqualmie Valley.

As indicated in Table 3.10.3-1, North Bend's population in 2000 was 4,746, with a median resident age of 34.5 years, and a median house value of $273,400. Approximately 90 percent of the population is white (non-Hispanic) (City-data 2004).

Snoqualmie Pass CDP[42]

The Snoqualmie Pass community is a diverse group of part-time and full-time residents. The Summit-at-Snoqualmie is governed by both Kittitas and King Counties. Alpental is solely within King County, while Summit Central and Summit East are entirely in Kittitas County. Summit West is in both King and Kittitas Counties.

As an unincorporated area at the edges of two counties, the Snoqualmie Pass community is rather distant from the seat of their local government. Obviously, Snoqualmie Pass is the most likely of the impact communities to be affected by the existing and proposed management activities at The Summit-at-Snoqualmie. Snoqualmie Pass is a small community of year-round and rental single-family homes and condominiums, and is predominantly a winter recreation destination, with lower summer and shoulder season utilization.

While U.S. Census data provided in Table 3.10.3-1 indicates that Snoqualmie Pass has an estimated year-round population of 201 and approximately 330 housing units, the Snoqualmie Pass area is substantially larger, and is composed of the following areas: Alpental, Denny Creek, Summit West, Yellowstone, Gold Creek and Hyak. [43] [44]

Total housing units in the Snoqualmie Pass area were 600 as of 1999. Of the total 600 housing units, 99 are primary residences. Approximately one-quarter of the single family residences are year-round, while only 5 percent of the condominiums and townhouses are year-round residences. Hyak is the most established of the Snoqualmie Pass areas, with primary residences making up 48 percent of the single family housing units and 18 percent of the condominium/townhouse units. Approximately three quarters

[42] Snoqualmie Pass is identified as a Census Designated Place (CDP) - a statistical entity defined for each decennial census according to Census Bureau guidelines, comprising a densely settled concentration of population that is not within an incorporated place, but is locally identified by a name.
[43] The Snoqualmie Pass area is part of both King County to the west of the summit and Kittitas County to the east.
[44] Over one half of the year-round population of the Snoqualmie Pass area is in Hyak.

of the primary residences in the Snoqualmie Pass area are single family homes, while only 45 percent of second homes are single family units (SNOPAC 1999).

Approximately 30,000 total square feet of commercial space are present in the Snoqualmie Pass area. Most of the existing commercial space is concentrated in the Summit West area. According to the U.S. Census Bureau, there are 12 businesses in the Snoqualmie Pass area, composed of restaurants, a supermarket, convenience stores, specialty retail, a gas station, and lodging. Taking into account that the ski area employs approximately 1,500 full-time and seasonal employees, it is estimated that the Snoqualmie Pass area currently has approximately 1,565, mostly seasonal employees (SNOPAC 1999).[45]

Real estate sales in the range of $45,000 to $50,000 per lot have occurred in Alpental, the Inn at the Summit, and Hyak. Lower priced lots have sold in portions of Hyak and Conifer Estates. Prices for new homes are typically in the $150,000 to $200,000 range. Many of the recent/current home purchases are intended for use as primary residences. Larger condominium projects, such as those at Hyak, are considered quite affordable – as low as $30,000. In 1999, the highest priced condominiums ($100,000) were in Alpental (SNOPAC 1999).

Cle Elum and South Cle Elum

Cle Elum is situated approximately 25 miles northwest of Ellensburg. Two of the town's largest employers are manufacturing companies, and a portion of its residents work for the Forest Service or The Summit-at-Snoqualmie. Its small town atmosphere and central location draw many visitors each year for hiking and cross-country skiing, antique and specialty shops and fine dining.

The logging and lumber industries were established in the early 1870s; in the 1880s coal was discovered. Coal continued to support these communities through 1963; the last mine closed in that same year leaving the timber industry to support the community. The economy of Cle Elum has managed to keep pace with changes in railroading, coal mining, and saw milling. Cle Elum now depends primarily on logging and recreation.

As indicated in Table 3.10.3-1, Cle Elum has a population of 1,755 in 2000. The town is 1.5 square miles in area. Median resident age is 40.5 years, and the median house value is $103,000. Approximately 93 percent of Cle Elum is white (non-Hispanic).

South Cle Elum (population 457) is the smallest town in Kittitas County. The town played a key role in the history of the Pacific Northwest Railroad. From 1908 to 1980 the main line of the Chicago, Milwaukee, St. Paul and Pacific Railroad connected this community to the rest of the country (Cle Elum/Roslyn Chamber of Commerce undated).

[45] This assumption is based on 1999 data, and takes into account that the number of people employed by The Summit has increased from 1,150 to almost 1,500. It is assumed that employment at other private enterprises throughout the Snoqualmie Pass area has not increased.

Easton CDP

The Easton CDP is located on I-90 approximately 19 miles east of The Summit-at-Snoqualmie. Land area of the Easton CDP is approximately 1.7 square miles. The median resident age is 35.3 years, and the median house value is $119,200. Approximately 89 percent of the CDP is considered White.

3.10.5 Population

More recent demographic data has been included in the FEIS, as available, for King and Kittitas Counties. In 2006, King County had a household population of 1,826,732: approximately 912,649 females and approximately 914,083 males. The median age was 38.0 years (U.S. Census Bureau 2007). Twenty-two percent of the population was under 18 years and 11 percent was 65 years and older. The County's population grew by 18.7 percent between 1980 and 1990, and by 15.2 percent between 1990 and 2000 (King County Budget Office 2003).

In comparison to the overall state population, Kittitas County's population has grown slowly. Kittitas County had a population of approximately 37,189 in 2006, which ranks it 25th out of 39 counties in the state (U.S. Census Bureau 2007). Population of the County rose 25 percent between 1990 and 2000, as more people have moved east of the Cascade Crest (Kittitas County 2007).

Table 3.10.5-1 provides population projections for King and Kittitas Counties through 2025.

Table 3.10.5-1:
Population Projections for King and Kittitas Counties

	2005	2010	2015	2020	2025
King	1,787,000	1,861,000	1,940,000	2,019,000	2,092,000
Kittitas	34,300	36,700	39,500	41,800	44,000

Source: Washington Office of Financial Management/Forecasting 2002.

Population changes between 1990 and 2000 for Kittitas County impact communities are provided in Table 3.10.5-2.

Table 3.10.5-2:
Year 2000 Kittitas and King County Population

	2006 Population[c]	2000 Population	Percent Change from 1990-2000	Percent Change from 2000-2006
Kittitas County				
Total Population	37,189	33,362	20%	10
Unincorporated	-	13,614	32%	-
Incorporated	-	19,748	12%	-
Cle Elum	1,797	1,755	¯4%	2
South Cle Elum	538	457	9%	15
Snoqualmie Pass	-	201	-	-
Easton	-	383	-	-
King County				
Total Population	1,826,732	1,737,034	15%	5
North Bend	4,621	4,746	84%	-3

Source of percent change from 1990-2000: Kittitas County, 2002; and US Census Bureau, 2000; US Census 1990 and City-data 2000. Source of 2006 data: U.S. Census Bureau 2007.
[c] Population demographics are estimates based on symptomatic data including birth records, death records, tax returns and immigration.

3.10.6 Housing

The Summit-at-Snoqualmie

Local and regional population and housing stocks are key considerations in ski resort operations. The population represents the number of potential local users of a resort as well as the number of people available to work at the resort. The housing stock has an impact on affordability and availability of housing for all citizens in the community, including resort and non-resort employees.

The Alpental facility currently does not house employees, nor is there a need to do so in the future. Slopeside employee housing at Summit Central is traditionally reserved for supervisory level employees. Summit Central's Equipment Rental Building houses 12 units (i.e., bunk rooms) of short-term housing. Each of this building's units is single occupancy rated, thus the building has a total capacity of 12 employees. In addition to these 12 units, the North Shore Lodge has one, five-person apartment and the Day Lodge at Summit East has one, two-person apartment. Each of these units can be rented for the snow season. Employee housing is reserved for supervisory employees and for emergency situations caused by weather related, interstate closures.

With a resort-wide housing capacity of 19 employees, most employees look to the nearby communities of North Bend and Cle Elum for housing opportunities. Issaquah, Roslyn, and Ellensburg also provide some housing opportunities. Table 3.10.6-1 provides a breakdown of the counties in which The Summit-at-Snoqualmie's employees reside. As is indicated in the table, the majority (61 percent) of Ski Lifts, Inc. employees reside in King County.

Table 3.10.6-1:
The Summit At Snoqualmie Employee County of Residence 2002/03

County of Residence	Number of Ski Lifts, Inc. Employees	Percent of Ski Lifts, Inc. Employees
King	911	61%
Kittitas	455	31%
Pierce	87	6%
Snohomish	38	2%
Total	**1,491**	**100%**

Source: Ski Lifts, Inc.

King County

In 2000, King County had a total of 742,237 housing units, 4.2 percent of which were vacant (U.S. Census Bureau 2000).

Kittitas County

Per the 2000 Census, housing units in Kittitas County totaled 16,475. Renter occupied households in Kittitas County totaled 41.7 percent (compared to 35.4 percent for the state); the County has a 6.8 percent renter vacancy rate (US Census Bureau 2000b).

3.10.7 Employment

The Summit-at-Snoqualmie

Compared to the 2002/03 operating season, in which Ski Lifts, Inc. employed 1,491 people, 2003/04 employment numbers increased to 1,539. Type of employment is broken down as follows: 56 full-time year-round; approximately 444 full-time seasonal; and approximately 1,039 part-time seasonal.

During the 2002/03 operating season, The Summit-at-Snoqualmie employed 911 people (60 percent of total employment) that resided in King County, constituting less than one-tenth of one percent of King County's civilian workforce of 999,600 (2002/03). Similarly, the 455 Summit at Snoqualmie employees (30 percent of total Ski Lifts, Inc. employees) that resided in Kittitas County during the 2002/03 operating season constituted approximately 3 percent of Kittitas County's civilian workforce of 14,920 (Washington State Employment Security Department 2002). The remaining 10 percent of The Summit-at-Snoqualmie's employees resided in Pierce and Snohomish Counties.

With approximately 1,500 people employed over the past two operating seasons (3 percent full-time year-round and 97 percent full and part-time seasonal), Ski Lifts, Inc. is *not* considered to be a major employer on a regional level or in King County, and only a modestly important employer for Kittitas County.

King County

In 2006, King County had a civilian workforce of 1,044,340 and an unemployment rate of 4.2 percent, (approximately 43,700 unemployed individuals). In 2001, the Seattle-Bellevue-Everett PMSA (which

includes King, Snohomish and Island Counties) had a civilian workforce of 1,363,000 people, with an unemployment rate of 5.2 percent (Washington State Employment Security Department 2002, 2007).[46] More recent data for the Seattle-Bellevue-Everett PMSA was unavailable as of publication of this FEIS, however historical data appears to mirror King County.

Kittitas County

In 2006, Kittitas County had a civilian labor force of 20,020 and an unemployment rate of 5.0 percent (approximately 1000 unemployed individuals) (Washington State Employment Security Department 2007).

3.10.8 Income

King County

In 2002, the average annual wage in King County was $47,900. Median household income rose from $53,157 in 1999 to $62,700 in 2005 (The Economic Development Council of Seattle and King County 2007). In 2004, the median income of households in King County was $55,969. In 2004, 10.0 percent of the population of King County was in poverty. In 2003, 8.4 percent of related children under 18 were below the federal poverty level (The Economic Development Council of Seattle and King County 2007).[47]

Kittitas County

Median household income in Kittitas County in 2004 was $35,891. As of the 2000 US Census, Kittitas County had the sixth lowest median household income in Washington State. The proportion of persons living below the federal poverty level is approximately 14.4 percent (US Census Bureau 2007).

3.10.8.1 Taxable Retail Sales

Table 3.10.8-1 shows recent taxable retail sales for the impact communities and municipalities for calendar years 1998 through 2005. Overall, taxable retail sales in these communities have fluctuated in recent years. Washington State has a state-wide sales tax rate of 6.5 percent; however, the combined sales tax rate varies by county and municipality statewide, currently ranging from 7.0 percent to 8.9 percent. Regarding the impact communities, North Bend imposes a local sales tax of 1.9 percent in addition to the state sales tax (8.4 percent total), while all cities in Kittitas County impose 1.2 percent local sales taxes in addition to the state sales tax rate (7.7 percent total).

[46] Primary Metropolitan Statistical Area
[47] This is based on the 1999 Federal Poverty Level of $8,240 for one person below the age of 65 and $16,700 for a family of four.

Table 3.10.8-1:
1998 – 2002 Taxable Retail Sales for Impact Communities[a]

	1998 (dollars)	1999 (dollars)	2000 (dollars)	2001 (dollars)	2002 (dollars)	2005 (dollars)
King County						
North Bend	131,163,758	142,007,532	146,287,870	142,378,818	139,772,459	166,841,015
Kittitas County						
Cle Elum	37,398,681	40,302,084	42,931,048	45,649,241	49,393,900	65,582,765
South Cle Elum	741,452	919,668	1,178,557	1,104,186	928,927	1,115,114
Unincorporated Kittitas County	74,617,611	75,189,993	91,521,934	72,057,212	84,245,730	147,846,904

Source: Washington State Department of Revenue, 2004, 2007
[a] Corresponding information on the Easton CDP was unavailable.

3.10.8.2 Ski Area Permit Rental Charge Fees

The United States Government collects fees from ski areas operating on NFSL based on the Ski Area Permit Rental Charge; the calculations are pursuant to Section 3 of the National Forest Ski Area Permit Act of 1986.[48]

Ski Area Permit Rental Charge fees are calculated by adding the permittee's gross revenues from lift ticket/year-round ski area use pass sales plus revenue from ski school operations and multiplying such total by the slope transport feet percentage on NFSL.

From 1998 to 2004, the U.S. Government has collected approximately $1.9 million in fees from The Summit-at-Snoqualmie. This is illustrated in Table 3.10.5-3.

Table 3.10.8-2
Ski Area Permit Rental Charge Fees Paid to the Forest Service 1997 – 2004

Year	Ski Area Permit Rental Charge Fees Paid (dollars)
1997	$220,000
1998	$197,000
1999	$255,000
2000	$219,000
2001	$229,000
2002	$300,000
2003	$203,000
2004	$277,000

Source: Ski Lifts, Inc.

[48] 16 USC 497c

3.10.9 Marketplace Competition

The Summit-at-Snoqualmie competes most directly with Crystal Mountain, White Pass, and Stevens Pass within the local/day skier market. Its proximity to the Seattle and Ellensburg markets, as well as ease of I-90 access helps make The Summit-at-Snoqualmie an easy choice for day skiers originating from the Seattle metropolitan area. Table 3.10.9-1 indicates total skier visits for Washington State between the 1999/00 and 2006/07 seasons and provides percent of annual visits captured by each of these four ski areas. As evidenced, The Summit-at-Snoqualmie has consistently captured the majority of state skier visits for this time period.

Table 3.10.9-1:
Marketplace Competition in Washington State (Visitation in Thousands)

Ski Resort	1999/ 00	2000/ 01	2001/ 02	2002/ 03	2003/ 04	2004/ 05	2005/ 06	2006/ 07	Total 1997/1998-2006/2007	Percent of WA Skier Visits 1997-2007
The Summit-at-Snoqualmie	506.0	507.8	611.6	328.7	475.0	55.2	618.5	618.4	4633.8	27.2
Crystal	332.3	230.5	391.6	255.4	348.9	123.2	371.8	306.8	2990.4	17.6
Stevens	485.5	426.1	498.4	378.9	450.2	133.8	452.5	377.6	3986.7	23.4
White Pass	130.2	114.4	142.6	123.3	131.2	19.1	132.7	127.3	1130.0	6.6
Total WA State Visits	1922.1	1710.0	2151.5	1434.8	1859.5	491.5	2137.9	1950.8	17012.7	-

Source: PNSAA, 2007

3.10.10 Visitor Spending

Compared to destination resorts, expenditures made by skiers at day use areas are likely to be lower due the proximity to home for day skiers. Located approximately one hour's driving time from the Seattle metropolitan area, The Summit-at-Snoqualmie serves a day use market. With day use areas such as The Summit-at-Snoqualmie, visitors tend to purchase fuel closer to home and spend more of their food dollars there before driving to Snoqualmie Pass; however, it is assumed that North Bend (west of Snoqualmie Pass) and Cle Elum (east of Snoqualmie Pass) represent popular stops along the way for gas and incidentals. Therefore, skier spending in the impact communities as part of overall economic spending throughout the year at North Bend or Cle Elum is assumed to be inconsequential in light of the overall size of the two counties' economies.

3.10.11 Public Services

Public services for The Summit-at-Snoqualmie, including fire and emergency medical, are provided via a local volunteer fire department located in Snoqualmie Pass. The nearest police stations are located in

North Bend, approximately 27 miles west, and in Cle Elum, 32 miles east. The nearest hospital, Snoqualmie Valley Hospital, is also located in North Bend.

3.10.12 Environmental Justice

In 1994, President Clinton issued Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" to ensure such populations are not subject to disproportionately high levels of environmental risk.[49][50] Executive Order 12898 provides that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." Executive Order 12898 makes it clear that its provisions apply fully to programs involving Native Americans.

In response to Executive Order 12898, the impact communities and two county census tracts (King County - 327.02 and Kittitas County – 9751) were analyzed to determine if selection of any of the alternatives has potential to disproportionately affect minority and/or low-income populations.[51] Determinations are presented in Chapter 4. Percent minority populations and Latino/Hispanic origin of the impact communities are compared to the state of Washington in Table 3.10.12-1.

Table 3.10.12-1:
2000 Minority and Hispanic or Latino Population
in Washington State and the Vicinity of The Summit-at-Snoqualmie

	Percent Minority Population[a]	Percentage of Population of Hispanic or Latino Origin[b]	Total Population
Washington	18.2%	7.5%	5,894,121
King County Census Tract 327.02 and Kittitas County Census Tract 9751 (combined)	6.8%	2.1%	11,704
North Bend	8%	3.8%	4,746
Snoqualmie Pass CDP	7%	0.5%	201
Easton CDP	8.1%	9.1%	383
Cle Elum City	4.8%	3.4%	1,755

Source: U.S. Census Bureau 2000
[a] "Minority" includes those indicating Black or African American alone, American Indian or Alaska Native alone, Asian alone, Hawaiian or Pacific Islander alone, some other race alone, and those indicating two or more races.
[b] According to the U. S. Office of Management and Budget directive 15, the term Hispanic does not refer to a race, but an Origin. Therefore, persons of Hispanic Origin may be of any race. The Hispanic Origin statistics contained in this table represent the percentage of the total population that are of Hispanic Origin, regardless of race.

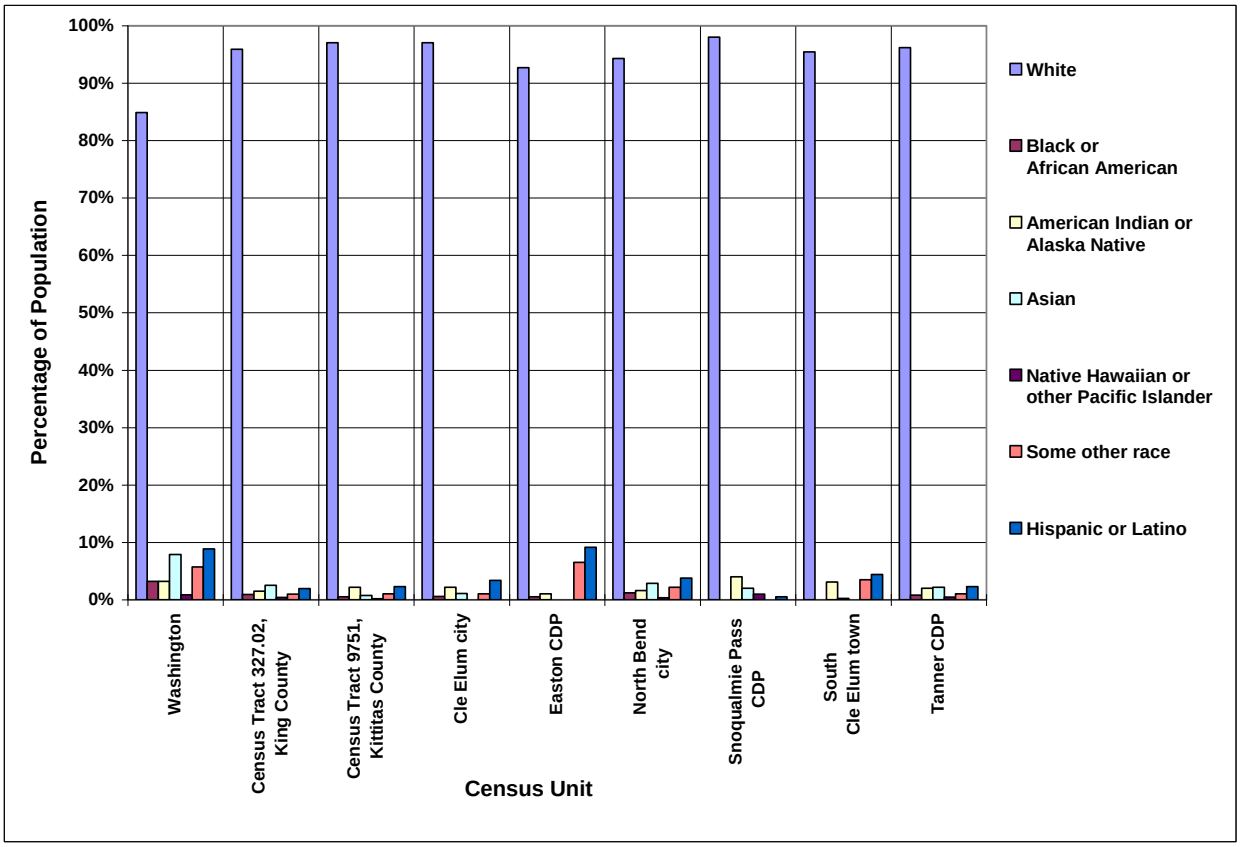
[49] 59 Federal Register 7629, 1994
[50] *Disproportionately* is a generic term used to define the adverse effects of environmental actions that burden minority and/or low income populations at a higher rate than the general public.
[51] King County Census Tract 327.02 includes the Tanner CDP, the Kittitas County Census Tract 9751 includes the Snoqualmie Pass CDP, Cle Elum City and South Cle Elum Town.

As shown in Table 3.10.12-1, racial minorities represent a larger percentage of the population of Washington State (18.2 percent) than any of the impact communities or census tracts within the Study Area. As shown in Illustration 3.10.12-2, all of the impact communities have smaller percentages of minorities and those of Hispanic/Latino origin when compared to the state of Washington, with the exception of the Easton CDP. The community of Easton has a higher percentage of people indicating Hispanic or Latino origin (9.1 percent) than the other impacts communities in the Study Area, with a comparable percentage to Washington State as a whole. Easton also has a higher percentage of people indicating themselves to be of some other race (6.5 percent) in comparison to the other communities in the Study Area (U.S. Census Bureau 2000), with a comparable percentage to Washington State as a whole.

The Snoqualmie Pass area was traditionally used by the Snoqualmie and Yakama Indian Tribes for hunting, fishing, gathering, and as a travel route. The Snoqualmie were signatories of the Point Elliott Treaty of 1855, and were assigned to the Tulalip Indian Reservation, approximately 50 miles northwest of the Study Area in Snohomish County. The Snoqualmie Tribe was federally recognized as in independent tribe in 1999, but has no federally reserved land base. The Yakama signed the Yakama Treaty of 1855, and were assigned to the Yakama Indian Reservation, approximately 50 miles southeast of the Study Area, in Yakima and Klickitat Counties.

Section 3.3.1 - Heritage Resources and Reserved Treaty Rights discusses historic and current uses of Snoqualmie Pass by the Snoqualmie and Yakama. No Traditional Cultural Places or existing uses have been identified within the Area of Potential Effect (as defined for Heritage Resource impacts) for The Summit-at-Snoqualmie MDP Proposal.

Illustration 3.10.12-2:
2000 Population Distribution by Race and Hispanic or Latino Origin for Washington State and the Vicinity of The Summit-at-Snoqualmie



Source: U.S. Census Bureau 2000
Note: According to the U. S. Office of Management and Budget directive 15, the term Hispanic does not refer to a race, but an Origin. Therefore, persons of Hispanic Origin may be of any race. The Hispanic Origin statistics contained in this table represent the percentage of the total population that are of Hispanic Origin, regardless of race. Individuals of two or more races were included in the numbers for all races they identified, resulting in a percentage of more than 100 percent for the total population.

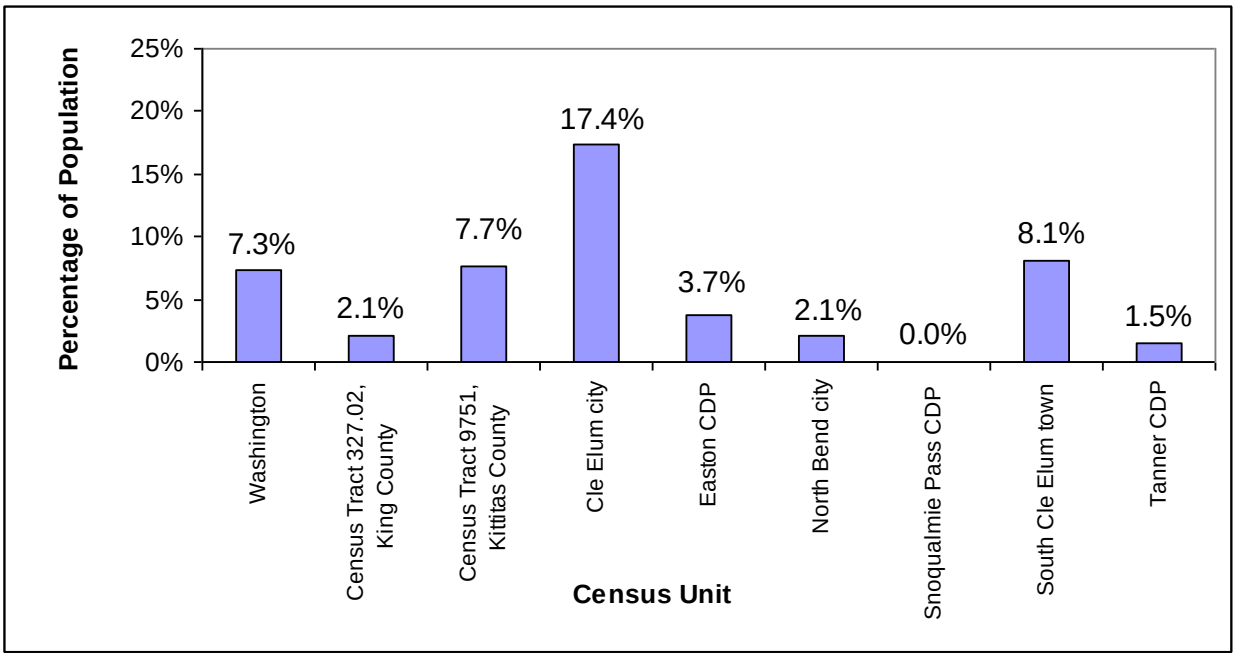
Median family income is compared across the impact communities and the state of Washington in Table 3.10.12-2. As indicated, median family income is lower in Kittitas County Census Tract 9751 ($47,902) and the communities of Easton CDP ($37,917), Cle Elum city ($39,000), and South Cle Elum town ($53,750) than in Washington state as a whole ($53,760). Illustration 3.10-3 shows that the percentage of families living below the poverty level is higher in Kittitas County Census Tract 9751 (7.7 percent), Cle Elum city (17.4 percent), and South Cle Elum town (8.1 percent) than in Washington State as a whole (7.3 percent).

Table 3.10.12-2:
1999 Median Family Income in Washington State and the Vicinity of The Summit-at-Snoqualmie

Census Unit	Median family income in 1999 (dollars)
Washington	$53,760
Census Tract 327.02, King County	$72,574
Census Tract 9751, Kittitas County	$47,902
Cle Elum City	$39,000
Easton CDP	$37,917
North Bend City	$69,402
Snoqualmie Pass CDP	$89,532
South Cle Elum town	$53,750

Source: U.S. Census Bureau 2000

Illustration 3.10.12-3:
1999 Percentage of Families Below Poverty Level in Washington State and the Vicinity of The Summit-at-Snoqualmie



Source: U.S. Census Bureau 2000

3.11 RECREATION

The Summit-at-Snoqualmie is situated in the Cascade Mountain Range of western Washington, approximately 46 miles east of Seattle and is accessed via I-90. The Summit-at-Snoqualmie is located on a combination of private lands (in King and Kittitas Counties) and NFSL, which are governed by the Snoqualmie Ranger District of the MBSNF and the Cle Elum Ranger District of the OWNF.

Of the approximate 1.7 million acres on the MBSNF, the *MBSNF Forest Plan* allocates approximately 288,300 acres (17 percent) to dispersed recreation, of which approximately 45,300 acres are classified as primitive and approximately 225,100 acres are classified as semi-primitive non-motorized. Approximately 8,400 acres (0.5 percent) of the MBSNF are allocated to developed recreation, of which approximately 6,041 acres (0.35 percent) lay within ski area SUP areas. Approximately 42 percent (721,700 acres) of the Forest is designated wilderness (USDA 1990a).

Of the approximate 2.2 million acres on the OWNF, the *WNF Forest Plan* allocates approximately 219,061 acres (10.1 percent) to dispersed recreation, of which approximately 96,355 acres are classified as RE-2 (Unroaded Motorized), approximately 116,092 acres are classified as RE-3 (Unroaded Nonmotorized), and approximately 6,614 acres are classified as RE-4 (Unroaded Timber Harvest). Approximately 6,012 acres (0.3 percent) of the OWNF are allocated to developed recreation. Approximately 38.9 percent (841,034 acres) of the Forest is designated Wilderness (USDA 1990b).

The Summit-at-Snoqualmie is owned by CNL Income Snoqualmie, LLC and operated by Ski Lifts, Inc. The Summit-at-Snoqualmie is comprised of four ski areas: Summit West, Summit Central, Summit East, and Alpental. The Summit-at-Snoqualmie operates under a SUP, which encompasses approximately 883 acres on the MBSNF and approximately 889 acres on the OWNF for a total of approximately 1,772 acres within the SUP boundary. The permit is valid through December 2046.

The Study Area provides an array of diverse recreation opportunities. The developed ski area provides alpine, backcountry, Nordic skiing, snowshoeing, and tubing. Other activities available to the public, but not provided by the ski area, include opportunities for backcountry skiing, mountaineering/climbing, snowshoeing, picnicking, primitive wilderness experiences, lake and stream fishing, hunting, hiking, horseback riding, mountain and road biking, scenery and nature observation and photography, and other activities in both developed and dispersed recreation settings.

3.11.1 Recreation Opportunity Spectrum

The Recreation Opportunity Spectrum (ROS) is a classification system created by the USFS that categorizes NFSL by its setting and defines classes of probable outdoor recreation activities and experience opportunities that are likely to be provided. In short, the land and water of NFSL are inventoried and mapped by ROS class to identify which areas currently provide what kinds of opportunities. This is accomplished by inventorying three settings of an area:

- physical – size, remoteness, and evidence of human activity,
- social – number and type of human encounters, opportunity for solitude, and
- managerial – the amount and type of restrictions placed on people's actions. Inventorying these settings helps identify the quality and quantity of recreation opportunities, inconsistencies, and the current mix of opportunities.

The ROS ranges from *Primitive* to *Urban*. The ROS map in the *MBSNF Forest Plan* designates The Summit-at-Snoqualmie Study Area as *Rural, Roaded Natural,* and *Unknown*. In the *Rural* class settings, the sights and sounds of human activity are readily evident, though less pronounced and less concentrated than in the *Urban* class. Levels of use vary, but do not reach those concentrations of the *Urban* class except at specialized and developed sites. While the characteristic landscape is often dominated by human-caused geometric patterns, there is also a dominant sense of open, green space. This class is assigned to Alpental and the northern portion of Summit West.

The *Roaded Natural* class is assigned to the remainder of Summit West and all of Summit Central and East. This class is characterized by predominantly natural-appearing settings, with moderate sights and sounds of human activities and structures. Roads and vehicles are common in this setting.

A portion of the Study Area that is classified as *unknown* and falls between Summit Central and Summit West, just above the property owned by the Mountaineers.

3.11.2 Recreation Demand

Skiing Market Trends

National

Skier visitation is influenced primarily by economics, weather and snowfall. Nationally, over the past ten seasons (1997/98 through 2006/07), the average number of skier visits was 55.6 million.

The 2004/05 season saw increased skier visits in much of the country, led by New Mexico, with an 18 percent increase. However, the low snowfall in the Pacific Northwest resulted in low visitation in this region. The tally for the 2004/05 season was 56.9 million skier visits nationally, well above the ten-year average and making it the fourth best season on record. The 2003/04 season saw national skier visits decline slightly from the previous year to 57.1 million visits, down 0.9 percent from the all-time record 2002/03 season and up 4.9 percent from the 2001/02 season. The ski industry performed strongly in the five seasons prior to 2004/2005, with the four best seasons, and five of the best six seasons, all occurring during that five-year span.

The solid performance of skier visits across the country between 2000/01 and 2004/05 is considered a notable achievement in light of many factors, including: dismal weather conditions in the Pacific Northwest (see the discussion under the Regional heading, below) in 2004/05; a slowly rebounding

economy; a jobless recovery in many sectors of the economy; high gas prices; moderate consumer confidence levels; the war in Iraq; and related national/international tensions.

With 19.6 million visits in 2004/05, the Rocky Mountain region set a new all time record. The Rockies were up 2.4 percent from the 2003/04 season. The Northeast region also gained, up 6.3 percent, while losses occurred in the Southeast (-0.7 percent), Midwest (-3.3 percent), and Pacific West (-13.9 percent).[52] In longer-term context, each region except the Pacific West performed above its ten-year average, including the Northeast (up 5.6 percent), Southeast (up 8.5 percent), Midwest (up 5.1 percent), and Rockies (up 3.3 percent). The Pacific West region was down 4.8 percent from its recent ten-year average.

Benefiting from the weakness of the U.S. dollar, ski resorts gained in international visitation during 2004/05. The proportion of visitors from Canada rose slightly, to 1.8 percent from 1.7 percent the previous season, while the proportion of visitors from other countries rose more significantly, to 4.3 percent from 3.8 percent the season before.

Alpine skier visits to U.S. resorts hovered around 40 million per year between 2000/01 and 2004/05. Over the same period, total snowboard visits increased from 12.1 million to 17.5 million. Snowboarding continues to grow and participation rates nearly quadrupled since the 1992/93 season. While people aged 18 to 24 made up almost a third of snowboarders, those aged 25 to 44 account for more than a third. In the 2003/04 season, nearly five percent of snowboarders surveyed were over the age of 45.

National season pass sales have continued their steady growth, 29 percent over the past four seasons, with the highest growth in the Northeast (55 percent) and Pacific West (47 percent), followed by the Southeast (32 percent), Rocky Mountains (15 percent) and Midwest (14 percent) (NSAA 2005).

Total national skier visitation in 2006/07 was 55.1 million, down 6.5 percent from the record 2005/06 season, when total visitation reached 58.9 million. The 2006/07 season was a challenging year for the national ski industry as abnormally warm temperatures and below average snowfall impacted most of the country, delaying planned openings, interrupting the season with periodic resort closures, and otherwise shortening the effective length of the season significantly in all regions except the Rocky Mountains, which set a new all-time record of 20.8 million visits. The Southeast and Pacific West were particularly hard hit in 2006/07, with declines of 16.3 and 14.3 percent respectively. The Northeast (-5.6 percent) and Midwest (-7.5 percent) both rebounded in the second half of the season to avert what would have been far more significant declines. Despite declining from the previous five-season streak of 57+ million national visits, the 2006/07 season remained the sixth best among the 29 seasons on record, and was better than any season prior to 2000/01 (NSAA 2007).

[52] Note: the Pacific West Region, as defined by the National Ski Areas Association, includes WA, OR, NV, CA, AZ and AK. Hence, the poor performance of WA and OR ski areas was compensated for by exceptional performance in states such as CA, and AZ.

Nationally, snowboarding as a proportion of total visits declined slightly in 2006/07 to 29.6 percent of total skier visits, as compared to 29.9 percent in 2005/06. However, both the Midwest and Pacific West reported growth in the proportion of snowboarding, snowboarding visits remained strongest at the small and mid-sized resorts, and all resorts anticipate that snowboard participation will rise within five years.

Despite the comparatively weak U.S. dollar in 2006/07, international visitation decreased slightly to 6.4 percent of visits from 6.7 percent in 2005/06. In addition, season pass sales grew by 3 percent in 2006/07, primarily as a result of strong sales in the Rocky Mountains and Midwest.

Regional

A lack of early and mid-season snow throughout the Pacific West (including Alaska, Idaho, Oregon, Washington and Montana) during the 2004/05 season not only disappointed a great number of skiers and snowboarders but created a challenging situation for ski area operators and their employees. While somewhat normal conditions returned late in the 2005 season, enabling many ski areas to finish strong, collectively, ski area operators in the Pacific Northwest are likely to achieve 2004-2005 visitation of approximately 2.51 million skier visits, or 44 percent less than the region's yearly average of 4.51 million skier visits. Washington State ski areas probably faired the worst in the Pacific Northwest, followed by Oregon and Idaho.

Washington State

In the 2004/05 season, Washington State saw a decline in skier visits of 74 percent, experiencing the worst year ever in the history of Washington snow sports. Washington State's 2004/05 season is considered the worst of any of the Pacific Northwest ski areas. The State achieved visitation of under 492,000 skier visits (see Table 3.11.2-1) – down sharply from the 1.86 million skier visit mark set in 2003/04 (PNSAA 2005).

Aside from the 2004/05 season, similar to national skier visit trends, skier visitation in Washington has fluctuated widely over the past decade (see Table 3.11.2-1). While unpredictable weather patterns affect skier visit growth, the absence of substantial lift upgrades, terrain expansion, and snowmaking capability, combined with competition from other regional destination resorts, such as Whistler/Blackcomb, Sun Valley, Mount Bachelor, Big Sky, and a host of Colorado, Utah, and Tahoe area resorts have also contributed to the lackluster performance.

Table 3.11.2-1:
Washington State Skier Visits from 1997/98 to 2004/05 (in Thousands)

Ski Area/Resort	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
Crystal Mountain	318.5	311.3	332.3	230.5	391.6	255.4	348.9	123.2	371.8	306.8
49 Degrees North	52.2	66.2	65.9	59.9	76.9	52.5	71.5	28.0	75.6	79.5
Hurricane Ridge	4.2	2.1	5.1	3.0	5.4	3.9	5.2	-	2.5	3.5
Leavenworth	14.3	12.3	12.2	12.3	6.2	7.1	9.0	3.3	16.2	17.7
Loup Loup	9.2	27.0	15.9	5.7	16.0	13.9	13.4	1.2	19.7	16.1
Mission Ridge	79.1	96.5	108.2	91.4	111.2	89.8	109.1	23.0	116.4	102.8
Mt. Baker	114.5	124.5	138.6	123.5	134.8	107.5	115.0	81.3	204.0	180.0
Mt. Spokane	50.8	62.9	72.1	85.1	94.8	46.3	87.5	19.8	90.5	85.9
North Cascade (helicopter)	0.3	0.4	0.7	0.6	0.4	0.4	0.4	0.2	-	0.5
Sitzmark	2.1	-	2.0	1.3	-	-	-	-	-	-
Ski Bluewood	48.0	54.5	49.3	49.8	61.7	27.0	43.0	3.4	37.5	34.6
Stevens Pass	379.6	404.2	485.5	426.1	498.4	378.9	450.2	133.8	452.5	377.6
Summit-at-Snoqualmie	410.3	502.2	506.0	507.8	611.6	328.7	475.0	55.2	618.5	618.4
White Pass	103.3	105.8	130.2	114.4	142.6	123.3	131.2	19.1	132.7	127.3
Total, WASHINGTON	1586.5	1769.9	1924.1	1711.3	2151.5	1434.8	1859.5	491.5	2137.9	1950.8

Source: PNSAA 2007

A comparison of ski area market share provided in Table 3.11.2-1 indicates that The Summit-at-Snoqualmie, Stevens Pass, and Crystal Mountain continue to dominate the Washington State skier market, combined, accounting for about 70 percent of the total statewide skier visits. The dominance in market share that The Summit-at-Snoqualmie, Stevens Pass, and Crystal Mountain exhibit in Washington is primarily the result of their proximities to the central Puget Sound area as well as their skier capacities, compared to other Washington resorts.

Demand for Recreation – National and Regional Trends

The United States is an increasingly urban nation. Four of every five residents now live in a metropolitan area. At the time of the 2000 Census this meant that almost 226 of the Nation's 281 million residents (80 percent) were living in one of the 276 U.S. metropolitan areas. This was up from 77 percent in 1990. The percentage of the U.S. population living in these metropolitan areas is projected to grow by 48 million - to 81.3 percent - by 2020. Metro residency is projected to continue its growth adding 48 million people by 2020. The source of outdoor tourism activity participation rates is the National Survey on Recreation and the Environment (NSRE), a nationwide survey of people 16 or older (USFS 2000b).

Generally, larger percentages of Denver, Minneapolis, Phoenix, and Seattle populations participate in nature-based tourism activities relative to all the major western metro areas combined. Of the nature-based outdoor tourism activities identified in the NSRE survey, downhill skiing was listed in the top 20 (#17) for overall participation rate for the U.S.

Region 6 (the Pacific Northwest region) includes National Forest units in Oregon and Washington. It received 33.9 million national forest visits in 2000, including 3.1 million Wilderness site visits. Five National Forests in Region 6 were sampled in the first year of the project. The results from these Forests were then expanded to estimate total regional recreation use (USFS Region 6 2001).

Overall, recreational demand for many activities is difficult to quantify, as accurate records on a per user basis are not typically counted for non-fee pursuits such as hiking, biking, Nordic skiing, fishing and many other pursuits. In order to gain an understanding of demand for outdoor recreation nationwide, several federal agencies have sponsored a series of national surveys over several decades. The most recent surveys are the 1994/95 NSRE and the 1999/2000 NSRE, which were sponsored by the USFS, the BLM, the USACE, the USEPA, and the USDA Economic Research Services, among others.[53] The 1994/95 NSRE was accomplished by interviewing approximately 17,000 Americans 16 years of age or older in random-digit-dialing telephone sampling. The 1999/2000 NSRE was accomplished using the same methods, interviewing approximately 58,000 Americans.

[53] The NSRE represents the continuation of the ongoing National Recreation Survey (NRS) series. Begun in 1960 by the congressionally created Outdoor Recreation Resources Review Commission, the first NRS was a four-season, in-the-home survey of outdoor recreation participation in the United States. Since that time, five additional NRSs have been conducted in 1965, 1970, 1972, 1977, and 1982/83, and two NSREs in 1994/95 and 1999/2000.

The primary purpose of the 1994/95 and 1999/2000 NSRE was to learn about the outdoor recreation activities of people 16 years of age or older in the United States. The results of these survey are summarized in Table 3.11.2-2, and compared to each other and the results of a similar survey that was done in 1982-83 and published in the NSRE (USFS 1995c).

Table 3.11.2-2:
National Recreation Participation Trends, 1982/83, 1994/95, and 1999/2000

Activity	Millions of Participants[a]			Percent	
	1982-83	1994-95	1999-00	Change from 1982/83 to 1994/95	Change from 1994/95 to 1999/2000
Bird Watching	21.1	54.1	67.8	155.2	25.3
Hiking	24.7	47.8	69.7	93.5	45.8
Backpacking	8.8	15.2	22.2	72.7	46.1
Downhill Skiing	10.6	16.8	18.1	58.5	7.7
Camping – Primitive Area	17.7	28	33.9	58.2	21.1
Attending Outdoor Concert/Play	44.2	68.4	-	54.7	-
Off-Road Driving	19.4	27.9	37.1	43.8	33.0
Walking	93.6	133.7	175.4	42.8	31.2
Motor boating	33.6	47	51.8	39.9	10.2
Sightseeing	81.3	113.4	107.8	39.5	-4.9
Camping – Developed Area	30	41.5	56.3	38.3	35.7
Swimming/river, lake, ocean	56.5	78.1	88	38.2	12.7
Snowmobiling	5.3	7.1	11.7	34	64.8
Outdoor Team Sports	42.4	53	48.4	25	-8.7
Golf	23	29.7	-	29.1	-
Cross-country Skiing	5.3	6.5	8.1	22.6	24.6
Swimming/Pool	76	88.6	-	16.4	-
Picnicking	84.8	98.3	116.4	15.9	18.4
Sledding	17.7	20.5	-	15.8	-
Running/Jogging	45.9	52.5	-	14.4	-
Water Skiing	15.9	17.9	17.1	12.6	-4.5
Bicycling	56.5	57.4	83.9	1.6	46.2
Ice Skating	10.6	10.5	-	-0.9	-
Fishing	60.1	57.8	72.2	-3.8	24.9
Sailing	10.6	9.6	11.1	-9.4	15.6
Horseback Riding	15.9	14.3	20.5	-10.1	43.4
Hunting	21.2	18.6	23.7	-12.3	27.4
Tennis	30	21.2		-29.3	

Source: USFS 1995c, 2000b
[a] Millions of participants 16 years of age or older.

The National Sporting Goods Association (NSGA) also conducts an annual survey of sports participation. Table 3.11.2-3 depicts the increase/decrease for certain activities that are popular in mountain settings from 1991 through 2001.

Table 3.11.2-3:
Comparison of 1991, 1996 and 2001 Sports Participation

Sport	Millions of Participants[a]		
	1991	1996	2001
Exercise Walking	69.6	73.3	71.2
Bicycle Riding	54.0	53.3	39.0
Fishing	47.0	45.6	44.4
Camping	47.1	44.7	45.5
Hiking	22.7	26.5	26.1
Hunting with Firearms	17.1	19.3	19.2
Mountain Biking - on road	10.5	11.3	14.0
Backpacking/Wilderness Camp	10.4	11.5	14.5
Alpine Skiing	10.4	10.5	7.7
Mountain Biking - off road	4.6	7.3	6.3
Snowboarding	1.6	3.7	5.3
Nordic Skiing	4.4	3.4	2.3

Source: NSGA 1996, 2002
[a] Participated more than once, 7 years of age or older.

Though the NSGA data shows nominal growth and decline for alpine skiing, snowboarding has witnessed significant increases in participation. More than alpine skiing, Nordic skiing participation is affected by fluctuations in the weather, as snowmaking is rarely utilized to cover trails. Nonetheless, Nordic skiing, which reached a peak of 5.8 million participants in 1988, has not surpassed an estimated four million participants since 1991 (NSGA 1991, 1996).

Differences in the NSRE and NSGA data are not readily explainable. However, it should be noted that the NSRE data represents participation estimates only for those 16 years of age or older, while the NSGA data includes estimated participation for those 7 years of age or older. Also, the NSRE data includes those who may have participated in a particular activity only one time during the year, while the NSGA data includes only those who participated two or more times. On this basis, the NSRE data is likely more representative of total participation for those 16 years of age or older and may be a better predictor of potential latent or unmet demand. Nonetheless, the NSRE data does not reflect the size of the market under the age of 16. For example, the 1997 NSGA survey found that 7 to 17 year olds account for about 25 percent of those who alpine ski and 56 percent of those who snowboard.

Mount Baker-Snoqualmie National Forest

The methodology for counting and/or calculating recreation use on the MBSNF has changed radically several times over the past decade. As a result, consistently reliable data on recreation use trends for the Forest are unavailable.

National Visitor Use Monitoring Report

In September 2001, the USDA Forest Service published the *National Visitor Use Monitoring Report* (USFS Region 6 2001). According to this document, on a national basis, there were 209 million National Forest visits in 2000, including 14.3 million Wilderness visits. Additionally, another 258 million people enjoyed viewing National Forest scenery from non-Forest Service managed travel ways (USFS Region 6 2001).

Region 6 (the Pacific Northwest region) includes National Forest units in Oregon and Washington. It received 33.9 million National Forest visits in 2000, including 3.1 million Wilderness site visits. Five National Forests in Region 6 were sampled in the first year of the project. The results from these Forests were then expanded to estimate total regional recreation use (USFS Region 6 2001).

The MBSNF participated in the National Visitor Use Monitoring project from January 1 through December 31, 2000. During the first winter of the sample (January 2000) the Forest experienced the highest snowfall in 100 years. This meant snow closed trails, Wilderness access and some campgrounds until later than usual. Winter use was more sporadic because of access to the ski areas and poor weather for recreation (USFS Region 6 2001).

According to the National Visitor Use Monitoring report, recreation use on the MBSNF for calendar year 2000 was 5,006,932 National Forest visits, with 5,379,362 site visits, for an average of 1.1 site visits per national forest visit. Included in the site visit estimate are 700,814 Wilderness visits. Table 3.11.2-4 presents a summary of participation on the MBSNF based upon the results of the National Visitor Use Monitoring project.

Table 3.11.2-4:
Activity Participation for the MBSNF in 2000

Activity	Percent Participation	Percent Who Said It Was Their Primary Activity
Downhill skiing or snowboarding	64	60
General/other- relaxing, hanging out, escaping noise and heat, etc,	36	12
Viewing wildlife, birds, fish, etc on national forest system lands	35	8
Viewing natural features such as scenery, flowers, etc on national forest system lands	23	2
Hiking or walking	21	13
Driving for pleasure on roads	7	3
Picnicking and family day gatherings in developed sites (family or group)	6	1
Visiting a nature center, nature trail or visitor information services	6	0
Camping in developed sites (family or group)	4	1
Resorts, cabins and other accommodations on Forest Service managed lands	4	2
Nature Study	4	0
Off-highway vehicle travel (4-wheelers, dirt bikes, etc)	4	2
Snowmobile travel	4	3
Cross-country skiing, snow shoeing	4	5
Backpacking, camping in unroaded areas	3	3
Primitive camping	2	2
Fishing- all types	2	2
Gathering mushrooms, berries, firewood, or other natural products	2	1
Hunting- all types	1	1
Bicycling, including mountain bikes	1	1
Other non-motorized activities (swimming, games and sports)	1	0
Visiting historic and prehistoric sites/area	0	0
Motorized water travel (boats, ski sleds, etc)	0	0
Other motorized land/air activities (plane, other)	0	0
Horseback riding	0	0
Non-motorized water travel (canoe, raft, etc.)	0	0

Source: USFS Region 6 2001

The data in Table 3.11.2-4 include several interesting factors, the most notable of which is that downhill skiing or snowboarding is listed as having a 64 percent participation rate, with 60 percent of the users reporting that this was their primary activity on the MBSNF. If this were actually the case, one would infer that 60 percent of the 5,006,932 forest visits during the year 2000 were for downhill skiing, or 3,004,159 visits on the MBSNF were skiers or snowboarders.

1994 Grouped Activities, Recreational Visitor Days, and Visits

Available recreation use estimates for 1994 are shown in Table 3.11.2-5.

Table 3.11.2-5:
1994 MBSNF Recreation Use (in Thousands)

Activity Grouping	Total Occasions	Percent of Total	Total Recreational Visitor Days[a]	Percent of Total
Road and mountain biking	76.9	0.3	29.2	0.4
Camping	1,546.3	6.1	1,227.6	16.3
Day use/picnicking	4,685.2	18.4	696.6	9.2
Driving for pleasure	14,469.5	56.9	3,858.4	51.1
Fishing	266.3	1.0	94.4	1.3
Gathering forest products	71.3	0.3	27.9	0.4
Hiking, walking, mountain climbing	1,770.0	7.0	644.2	8.5
Horseback riding	59.9	0.2	22.0	0.3
Hunting	164.4	0.6	90.2	1.2
Off Road Vehicle summer	40.3	0.2	10.2	0.1
Other recreation	7.1	0.0	0.8	0.0
Resort, commercial cabin use	81.2	0.3	67.3	0.9
Swimming, water play	143.1	0.6	25.0	0.3
Water recreation-motorized	5.5	0.0	1.2	0.0
Water recreation-non motorized	142.7	0.6	32.5	0.4
Winter recreation-downhill skiing[b]	1,453.2	5.7	593.4	7.9
Winter recreation-motorized	51.8	0.2	6.3	0.1
Winter recreation-non motorized	407.7	1.6	123.5	1.6
Total Use	**25,442.2**	**100.0**	**7,550.7**	**100.0**

Source: USFS, MBSNF, RRIS, Grouped Activities RVDs and Visits, January 17, 1995.
[a] One Recreational Visitor Day is equivalent to one visitor spending 12 hours on the National Forest.
[b] Based on actual lift ticket counts.

When compared to 1994 data (see Table 3.11.2-5), in which 1,453,200 skiing/snowboarding visits were counted, the data in Table 3.11.2-4 appears to contain some bias toward downhill recreation, with a significantly different projection of total visits/occasions. Nonetheless, the data provide a display of the varying uses on the MBSNF and do correlate with the 1994 data in that activities such as driving for pleasure and "hanging out" represent high-scoring categories in both analyses.

Skier Visits

Skier visits to the resorts in the United States hovered around 40 million per year between the 1999/00 and 2003/04 seasons.[54] Over the same time period, total snowboarder visits increased from 12.1 million to 17.5 million – a 45 percent increase. Snowboarding continues to grow in popularity and participation has nearly quadrupled since the 1992/93 season (BBC Research and Consulting 2005).

Approximately 13 million Americans participated in snow sports in 2001 (NSGA 2002). This represents an overall increase in snow sport participation since 1996. Similar to national skier visit trends,

[54] Here, *skiers* are defined as those who participate in alpine, telemark and snowboarding.

Washington skier visits have vacillated over the past decade, from a peak of almost 2.1 million in 2001/02 to a low of less than half-a-million in the 2004/05 season.

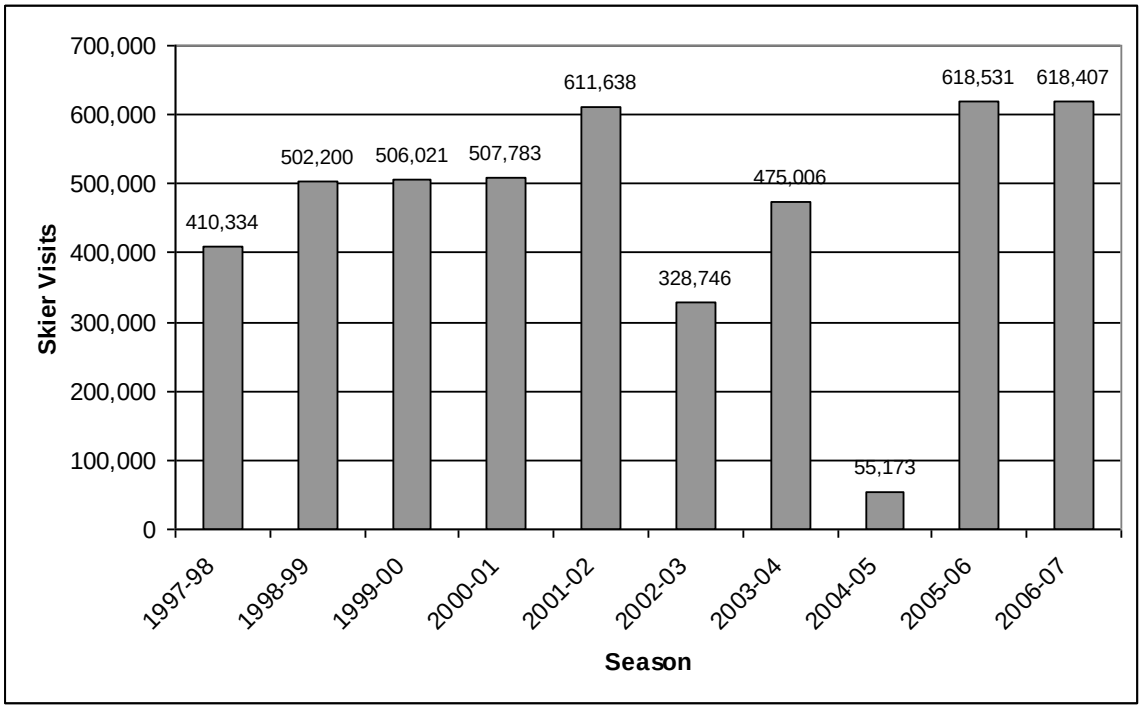
Skier visitation at The Summit-at-Snoqualmie has also fluctuated (see Table 3.11.2-5 and Illustration 3.11-FEIS-1). Since 1998/99, the area has experienced a 20 percent increase in visitation, peaking at over 618,531 visits in the 2005/06 season - the highest recorded visitation since 1998/99. During 2006/07, The Summit-at-Snoqualmie maintained near-record visitation by reaching 618,407 visits. The historical visitation pattern at The Summit-at-Snoqualmie (when comparing average visitation for the last two consecutive five-year periods, see Appendix J - Assumptions used in the Recreation, Social and Economic Analysis) represents a 1 to 2 percent average annual growth rate from 1999 through 2007. This increase is nominal when compared to the average population growth rates of 15.2 percent and 20 percent for King and Kittitas Counties, respectively, over the past ten years (see Section 3.10 - Social and Economic Factors). The dramatic fluctuation in visitation over the last decade is largely attributed to varying weather and snow conditions.

Table 3.11.2-5:
Skier Visitation at The Summit-at-Snoqualmie

Year	Skier Visits
1997-1998	410,334
1998-1999	502,200
1999-2000	506,021
2000-2001	507,783
2001-2002	611,638
2002-2003	328,746
2003-2004	475,006
2004-2005	55,173
2005-2006	618,531
2006-2007	618,407
Ten-Year Average	**463,384**

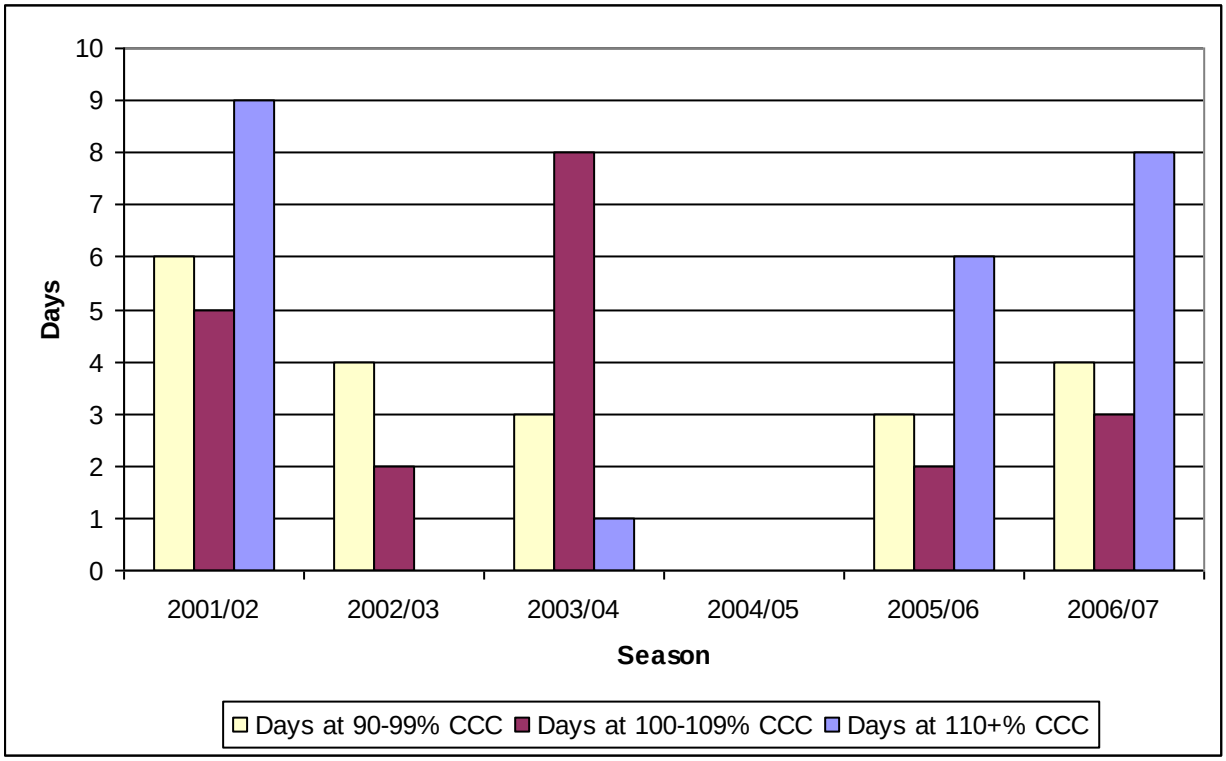
Source: PNSAA 2007

Illustration 3.11-FEIS-1:
Skier Visitation at The Summit-at-Snoqualmie 1997/98-2006/07



The Summit-at-Snoqualmie typically observes 1 to 20 days at or above capacity each season, as is shown in Illustration 3.11-FEIS-2. The dramatic fluctuation of over and near-capacity visitation also results from variable snow and weather conditions, especially in 2004/05, a particularly warm, low-snow season.

Illustration 3.11-FEIS-2:
Above and Near-Capacity Visitation at The Summit-at-Snoqualmie



Competitive Market/Market Share

Demographics

The demographics of the Washington state skier differ from that of the national skier. In Washington, Approximately 40 percent of the skiers are female, 27 percent are in the 18 to 24 year age group, and only 12 percent are in the over 45 years age group. Approximately 43 percent of the market rides a snowboard rather than a pair of skis. In Washington, approximately 86 percent of skier visitation is derived from in-state residents. Approximately 27 percent, which is the greatest share by approximately 15 percent, of all skiers at Washington ski areas live in King County and approximately 51 percent of skiers come from the Seattle-Tacoma area (Lillstrom 2001).

The Summit-at-Snoqualmie competes most directly with Crystal Mountain, White Pass, and Stevens Pass within the local/day skier market. Its proximity to the Seattle and Ellensburg markets, as well as ease of I-90 access helps make The Summit-at-Snoqualmie an easy choice for day skiers. A majority of The Summit-at-Snoqualmie's visits come from western Washington, although significant visitations come from areas east, including Ellensburg and Cle Elum. The majority of Yakima's skier days are spent at White Pass. During the 2001/02 peak Washington skier visit season, The Summit-at-Snoqualmie captured approximately 30 percent of the skier market.

Stevens Pass is The Summit-at-Snoqualmie's main competitor; it attracts the majority of its skiers from Seattle, Bellevue, and areas north, but also benefits from its proximity to Leavenworth and Wenatchee. Stevens Pass exhibits a wide variety of terrain and 11 chairlifts (two detachable quads, one quad, four triples, and four doubles). Stevens Pass is successful at attracting night skiing business, largely due to a wide variety of lighted trails, multiple après-ski facilities, and a liberal extension policy for evening lift tickets.

Crystal Mountain is another competitor of The Summit-at-Snoqualmie. Its relative proximity to Seattle, Tacoma, Olympia and areas south help draw many visitors. Crystal Mountain currently has nine lifts (three doubles, two triples, two detachable quads, and two detachable six passenger lifts). Crystal Mountain has also recently completed a NEPA process for their MDP proposal that allows for an increase in the number of lifts to 16 (including two surface lifts and a tram), add 22 trails, increase night skiing acreage from 62.6 to 198.5, and improve skier support services. A ROD was issued in August 2004, and Crystal Mountain began implementation of its Phase I projects during the 2007 summer construction season.

The Summit-at-Snoqualmie's primary core market is defined as: married; over 35 years old; skier; high intermediate to advanced skill level has remained fairly stable over the past few years, ranging from 9 to 18 percent since 1998/99 (RRC Associates 2002). Historically, the majority of visits to The Summit-at-Snoqualmie have been attributed to day visits (88 percent), and local visits steadily declined between 1998/99 and 2001/02 – from seven percent to three percent (RRC Associates 2003).[55] Between 1997/98 and 2001/02, the proportion of skier visits from Washington remained remarkably stable (hovering around 94 percent). The next tier of geographic markets includes Oregon (1.1 percent) and California (0.7 percent). Less than half a percent originate from New York, Texas, Arizona, Florida, and Wisconsin. International visitors accounts for one percent, with the U.K. being the primary international market (0.4 percent). There has been little change over the years with respect to visitors' state or country of origin. Within Washington, the greatest percentage of skiers visiting The Summit-at-Snoqualmie comes from King County (74 percent), followed by Pierce (eight percent), Snohomish (4 percent), Kittitas (2 percent) and Kitsap Counties (2 percent) (RRC Associates 2002).

The 2001/02 season saw a reversal of the multi-year trend of declining families. In 2001/02, families accounted for 35 percent of visits compared to 28-29 percent in the previous years. The visitor base at The Summit-at-Snoqualmie is primarily Caucasian (hovering around 90 percent).

Alpental's visitation patterns are similar to those of most day-use areas located in western North America. The majority of Alpental's visitation occurs on weekends and during holiday periods, with peak crowds

[55] Local visits are attributed to skiers who come from communities in very close proximity to the ski area, while day skiers are those who drive considerably longer distances to a ski area – typically up to two hours or more – for the day and then return home at the end of the day.

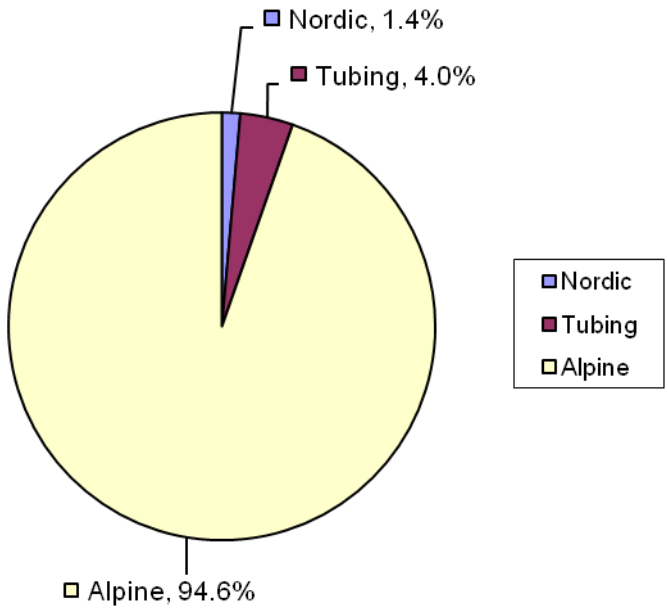
occasionally exceeding the mountain's CCC of 1,880. On weekdays, Alpental receives modest visitation and operates at a level significantly below the mountain's CCC.

3.11.3 Developed Winter Recreation

The Summit

The Summit is accessed via Exits 52, 53 and 54 off I-90 and SR 906. The Summit West Rental Center has a base elevation of approximately 3,000 feet with lift access to over 3,800 feet. The Summit offers approximately 545 acres of lift-served downhill ski terrain as well as hike-to/lift-served access to thousands of additional acres of backcountry ski terrain and Nordic skiing/snowshoe trails. However, the resort is principally supported by revenues contributed by alpine skiers with approximately 4 percent and 1.38 percent of overall revenue contributed by the winter tubing and Nordic operations respectively (see Illustration 3.11-FEIS-3).

Illustration 3.11-FEIS-3:
The Summit-at-Snoqualmie Revenue by Recreation Type



Historic land use and checkerboard ownership patterns at The Summit have had a significant influence on lift and trail development. Lands at Summit East and Central are primarily privately-owned while lands at Summit West and portions of Summit East (Section 16 - AMA) are NFSL. A majority of the development at The Summit occurred while Summit East, Summit Central and Summit West were owned by three separate entities. The individual ski areas were not designed to accommodate skier circulation amongst the ski areas. The ski areas presented a collage of chairlifts that do not follow current ski area design standards.

The evolving nature and changing trends of the ski industry during the 1980s and 1990s did not favor the unique ownership pattern of Summit East, Summit Central and Summit West. Ski Lifts, Inc. currently operates all three areas, collectively referred to as The Summit. In an effort to meet with the changing demands of the ski industry, The Summit has made several changes to the operations and maintenance of the ski area. Some chairlifts have been updated and realigned along more appropriate slope gradients, entryways have been redesigned, and new guest-service buildings have been developed.

Although ski area hours of operation may vary from season to season, chairlifts at Summit West and Summit Central operate five to seven days a week during the winter. Night skiing is available two to four nights per week (depending on the season) on all chairs at Summit West and Summit Central, except *Silver Fir*. Chairlifts at Summit East do not run as frequently and are snow condition dependent. Chairlifts at Summit East usually operate weekend days during the winter. Although the trails at Summit East are equipped with night lighting, they are not open for night skiing.

Trails and lifts at Summit West are not well defined and skier circulation is poor. Historic clearing for ski trails at Summit West has left the slope cleared, with few tree islands, as shown below in Illustration 3.11-1. As a result, trail boundaries and routes to chairlifts/facilities are not clearly defined, largely due to the lack of trees and surrounding vegetation (see Figure 2.3.2-1, Alternative 1 - Existing Conditions – The Summit). The resulting landscape does not provide separation between beginner areas/trails and more advanced terrain. Chairlifts are located so that skiers are often required to traverse across another's path to reach their destination.

Several lifts and facilities at The Summit are old, poorly located, and reduce the quality of the recreation experience. Some lifts (e.g., *Triple 60* at Summit Central) are old and frequently break down, creating long lift lines and long lift rides. Poorly aligned chairlifts require skiers to hike up-hill in order to reach bottom terminals, cause skiers to cross active runs in order to reach lift terminals or base facilities, and impede skier circulation, causing crowding and long lift lines. At these intersections, skiers of all ability levels may be found in unacceptably high densities, particularly during the mid-day lunch time and afternoon closing time. This situation results in skier conflicts and potential safety concerns along these trails. Poorly located base facilities require skiers to hike up-hill or for long distances from their cars in order to reach ticket sales, ski school or food/beverage facilities. In addition, the beginner areas are not located close to the base area/ticketing areas, resulting in long walks for first-time beginners, which detracts from the arrival experience for these guests. These factors detract from the quality of the recreation experience at The Summit.

Illustration 3.11-1:
Trail Conditions at Summit West

The Summit West rental center is a newly constructed facility in the base area. The patio surrounding the rental center is a heated plaza and remains snow free during most of the winter. Surrounding buildings provide ticket sales and food service amenities. Several ski school buildings are located throughout Summit West and are used during the weekend. Most of The Summit's ski school programs are based out of Summit Central.

Lands between Summit West and Summit Central are privately owned by The Mountaineers. Trail 16 (Summit West-Summit Central crossover) and Trail 41 (Summit Central-Summit West crossover) are located on The Mountaineer's property. The trails provide access between Summit West and Summit Central. Trail 42 (Parachute), located at the end of the route from Summit West to Summit Central, is an advanced trail that is not suitable for intermediate and beginner skiers. As a result, the existing trail network at Summit West and Summit Central does not provide adequate circulation between Summit West and Summit Central for all ability levels (see Figure 2.3.2-1, Alternative 1 - Existing Conditions – The Summit).

Located across SR-906 from Summit Central, and sharing the Summit Central Parking Lot is the Summit Tubing Center. Comprised of two separate handle tows and two distinct tubing areas, the tubing center provided for a daily peak of approximately 2,500 visitors (Kostanich 2005 pers. comm.).

A more distinct trail network exists for the *Silver Fir* pod (within Section 16). Trail boundaries are clearly defined by surrounding forest vegetation. Trail 49 (Summit Central-Summit East crossover) traverses through Section 16 utilizing the existing power line clearing. Slope gradients along Trail 49 up-hill from the power line are flat in sections and often require skiers to "pole" along the trail and snowboarders to remove their equipment and walk.

Summit East is the most underutilized of all the ski areas comprising The Summit. At Summit East, a 700-square foot lodge is provided. When installed, the previously approved *Mt. Hyak* chairlift will be the most prominent chairlift at Summit East. The *Mt. Hyak* chairlift will provide base to summit access (approximately 1,000 vertical feet) and access to all trails at Summit East. The *Easy Gold* chairlift is a beginner chairlift providing access to beginner slopes adjacent to the base area. Trail 54 is an egress trail providing access from the *Mt. Hyak* chairlift to trails in Section 16. The trails are short and do not provide more than 350 vertical feet of fall line descent before traversing cross-slope to the Summit East base area and lower terminal of *Mt. Hyak.* Nordic skiers and snowshoers utilize the existing *Keechelus* chairlift, which has been approved for replacement with the *Mt. Hyak* chairlift, to access Nordic and backcountry terrain.

Trail 55 at Summit East provides access to Trail 71 (Summit East-Summit Central crossover). Trail 71 is utilized by skiers, snowboarders, Nordic skiers and snowshoers. Flat slopes along the trail often require skiers to "pole" along the trail and snowboarders to remove their equipment and walk.

Although trails at Summit East are equipped for night skiing, the lack of convenient egress between Summit East and Summit Central and the lack of a cohesive lift and trail system result in a comparatively poor recreation experience at Summit East. Therefore, night skiing is not currently being operated at Summit East.

Summit East is the oldest ski facility at Snoqualmie Pass and has been operated intermittently since the 1930s by different owners and managers. Over the past 35 years, Summit East has failed to successfully operate, primarily due to undercapitalization, lack of suitable access to and from Summit Central and the turnover of ownership prompted by several bankruptcies.

Alpental

Alpental is accessed via Exit 52 off I-90, at the north end of Alpental Road. Alpental has a base elevation of approximately 3,140 feet with lift access to approximately 5,420 feet. With a vertical drop of 2,280 feet, Alpental offers a more diverse and challenging ski experience, as compared to The Summit, on approximately 200 acres of lift-served terrain. Alpental also provides access to hundreds of acres of backcountry skiing. Alpental is serviced by four chairlifts and one surface lift.

Alpental hosts a majority of The Summit-at-Snoqualmie's advanced terrain. Higher elevations, more vertical terrain and less complicating land use and ownership patterns offer an experience entirely

different than offered at The Summit. Alpental terrain attracts more advanced level skiers as well as backcountry skiers who access Alpental Valley's backcountry via the *Edelweiss* chairlift. Backcountry surrounding Alpental is very popular with backcountry skiers and snowboarders throughout Washington State. Due to all the accessible, lift served backcountry being solely served via the *Edelweiss* chairlift, crowded lift lines are common. In addition, crowding at the off-loading area at the top of the *Edelweiss* chairlift occurs due to limited space at the summit of Denny mountain. These crowded conditions detract from the quality of the recreational experience at Alpental.

Alpental does have beginner terrain, but lacks accommodations for first-time beginners. First-time beginner terrain and accommodations are primarily located at Summit Central.

Alpental is open every day except Monday throughout the season. Terrain accessible from the *Armstrong Express* is open for night skiing five days a week. Alpental guest service facilities offer cafeteria-style food and beverage options.

Parking

The Summit-at-Snoqualmie, currently provides approximately 47.4 acres of parking accommodating approximately 5,612 vehicles. The Summit provides approximately 39.6 acres of parking on 12 surface lots, and Alpental provides approximately 7.8 acres of parking on 7 surface lots as shown in Table 2.3.2-4. In total, The Summit-at-Snoqualmie currently provides parking capacity for approximately 12,346 people at one time, which is lower than the total parking requirement, including the ski area CCC of 10,020, a capacity of 500 Nordic skiers, and 2,500 tubing area guests (a total of 13,020), not including those parking at the area but not purchasing ski area tickets. Insufficient parking is most notable at Alpental during peak visitation periods as parking at Alpental is less than the capacity of the lift and trail network. During these times, Alpental's parking lots become "parked out", forcing Alpental guests to park in other areas of The Summit-at-Snoqualmie. This deficit in available parking at The Summit-at-Snoqualmie, particularly at Alpental, has a detrimental effect on the recreational experience at the ski area by interrupting the arrival experience and necessitating additional driving and shuttle trips for the ski area guest.

The Summit-at-Snoqualmie operates an intra-resort shuttle service. Comprised of three 15-passenger vans, the shuttle system operates Friday evenings (5:00 pm to 10:30 pm), Saturdays and holidays (8:00 am to 10:30 pm), and Sundays (8:00 am to 5:30 pm). The shuttle system serves Alpental, the Alpental Community Club and other points on the Alpental Road, The Summit Inn, The Summit's various base areas, The Summit Tubing Center, and The Summit Nordic Center. As a result, during peak visitation periods (i.e., holidays and weekends), Alpental guests may be required to park distant from Alpental, and to ride the shuttle bus from the more remote lots to Alpental.

Dispersed Winter Recreation

Alpental

In addition to the lift-served terrain at Alpental, skiers and snowboarders ride the *Edelweiss* chairlift to the top of Alpental. From there, skiers and snowboarders traverse the rock band in Upper International Bowl to access over 500 acres of backcountry terrain through one of two gates. The upper access gate provides access to the Great Scott Traverse, which opens up to several unofficial descents with approximately 2,000 vertical feet of skiing. The lower gate provides access to The Bluffs, a little lower on the mountain. From either access gate, skiers and snowboarders are funneled at the bottom along back to Alpental's base area on a groomed traverse along the Upper South Fork of the Snoqualmie River to regain access to the Alpental base area. Snowshoers often utilize Alpental's upper parking on the weekends as a starting point before trekking into the Alpental Valley. Portable toilets are available in the parking lot for these people. Because of the multi-use nature of this trail, Ski Lifts, Inc. has closed the trail to uphill traffic. Activities accessed along Alpental Road include sledding, ice-climbing and snowshoeing.

The Summit

Nordic facilities are located within Summit East's base area. The Nordic Center provides access to areas adjacent to Summit East and Central. Rentals and equipment are available. Nordic skiers and snowshoers also utilize the existing *Keechelus* chairlift, previously approved for replacement by the *Mt. Hyak* chairlift, to access the Nordic trail network. The trail network continues behind Summit East, around Mt. Catherine, up Windy Pass, and on to Nordic Pass (see Table 3.11.3-1 and Figure 2.3.2-5, Nordic Trail Network). The Nordic trail network receives the majority of its snowshoeing, backcountry and Nordic skiing use on weekends, with approximately 500 Nordic skiers representing the peak Nordic daily visitation at Summit East (Kostanich 2005 pers. comm.). The Nordic facilities at Summit East represent approximately 1.4 percent of the overall revenue for The Summit-at-Snoqualmie (see Illustration 3.11-FEIS-3).

The Nordic Pass route (see Figure 2.3.2-5, Nordic Trail Network) provides access to the Nordic Pass area for backcountry skiers. The route begins in the Hyak Estates area near Summit East and ascends to the Olallie Meadow area near the Jim Brooks Warming Hut along a general, unmarked trail. The route continues along the existing Cold Creek Cross-Country Trail around the south side Mt. Catherine branching off the trail near Mill Creek and ending where the creek meets the John Wayne Trail. Users of the Nordic Pass Trail enjoy a high quality recreational experience due to the amount of solitude, lack of motorized vehicles, available backcountry, low avalanche danger, mature forest, lakes, moderately gentle terrain, good snow, available winter parking, and a Nordic facility near the Seattle metropolitan area. Although use of the route in the past is known, the current level of use is unknown.

Table 3.11.3-1:
The Summit-at-Snoqualmie
Nordic Trail Network

Trail Name	Kilometers
Cold Creek	8.12
Creek Run	1.22
Cut Off	0.83
Dawn's Run	1.03
Decision Loop	0.37
Frog Legs	1.19
Gary Requa's Way	0.37
Hidden Valley	4.05
Kid's Teaching Area	0.18
Low Cross Over	0.99
Milwaukee Ridge	1.00
Nob Hill	0.78
Not Down There	0.22
Ollie's Slide	1.99
Power Surge	0.48
Ripsaw	4.46
Rockdale Bowl	1.36
Rockdale Loop	1.53
School's Out	0.44
Serpentine	0.49
Silver Streak	0.98
Skidaddle	0.91
Snow Train	0.79
Sunrise Outer Loop	3.04
Sunshine Inner Loop	2.07
White Rabbit	0.56
Windy Acres	3.38
Yellow Brick Road	0.31
Total Distance	**43.14**

Due to the proximity of Nordic developed and backcountry facilities and alpine trails and facilities, the crossing of Nordic and alpine trails occurs, sometimes resulting in the potential for collisions.

Backcountry skiing is gaining in popularity, as evident in sales and marketing of backcountry gear, reporting in ski and snowboard magazines, inquiries for backcountry guide permits, abundance of websites relating to backcountry skiing, and publication of "how to" and "where to" backcountry skiing books. Due to its proximity to the Seattle and Ellensburg populations and its ease of access along I-90, backcountry use throughout Snoqualmie Pass is popular. The backcountry can be accessed by the *Silver Fir, Mt. Hyak* (currently the *Keechelus* lift) and *Pacific Crest* chairlifts at The Summit. The MBSNF has had several inquiries from outfitters providing backcountry skiing guiding services, but no permits have yet been issued for these services. Backcountry ski locations in the vicinity of The Summit-at-Snoqualmie are listed in Table 3.11.3-2.

Table 3.11.3-2:
Backcountry Skiing Areas within The Summit-at-Snoqualmie Vicinity

Location	Parking	Approximate Round-Trip Distance (miles)	Notes	Skill Level[a]
Granite Mountain	Exit 47 I-90, North, Trailhead Parking Lot	8 miles	3,800 feet elevation gain	Advanced
McClellan Butte	McClellan Butte Trailhead	7 miles		Advanced
Mount Catherine	Snoqualmie Summit East Ski Area Parking Lot	5 miles		Advanced
Mount Hyak	Snoqualmie Summit East Ski Area Parking Lot	2.1 miles		Intermediate
Kendal Peak	Gold Creek Sno-Park	8 miles		Intermediate
Red Mountain	Snoqualmie Summit West Ski Area Parking Lot	10 miles		Advanced
Lundin Peak	Snoqualmie Summit West Ski Area Parking Lot	5.6 miles		Advanced
Snoqualmie Mountain	Alpental Ski Area Parking Lot	6 miles		Advanced
Pineapple Basin	Alpental Ski Area Parking Lot	3.7 miles		Intermediate
Snow Lake Divide	Alpental Ski Area Parking Lot	4.3 miles		Intermediate
Chair Peak Basin	Alpental Ski Area Parking Lot	5.3 miles		Alpine
Kaleetan Peak	Alpental Ski Area Parking Lot	7.4 miles	5,219 feet elevation gain	Advanced
Mount Roosevelt	Alpental Ski Area Parking Lot	6.2 miles		Advanced
Jolly Mountain	Salmon La Sac Guard Station	12 miles	4,040 feet elevation gain	Intermediate
Amabilis Mountain	Cabin Creek Sno-Park	8 miles		Intermediate

Table 3.11.3-2:
Backcountry Skiing Areas within The Summit-at-Snoqualmie Vicinity

Location	Parking	Approximate Round-Trip Distance (miles)	Notes	Skill Level[a]
Mount Margaret	Gold Creek Sno-Park	15 miles		Intermediate
Silver Peak	Keechelus Sno-Park	8 miles		Advanced
Humpback Mountain	Exit 47 I-90, South, Park at T-Intersection	9 miles		Intermediate

Source: Volken 2002 and Burgdorfer 1999
a Skill Level: Intermediate indicates ability to climb up and slide down moderate slopes, experience with winter conditions, camping, survival, alpine travel, and understanding of basics of avalanche hazard avoidance and navigation. Advanced indicates ability to ascend and descend steeper slopes under varying conditions, including tree and gully skiing in deep, soft, or icy snow conditions, and a high degree of skill in snow climbing and avalanche hazard avoidance. Alpine indicates serious undertakings, involving routefinding and travel over extremely steep terrain, with high avalanche potential over virtually the entire route.
Note: Most of the backcountry ski tours listed in this table are in locations that must be hiked to (hike-to backcountry) as opposed to accessed by chairlift (lift-served backcountry).

3.11.4 Developed Summer Recreation

Hiking

Hikers utilize parking facilities at Alpental during the summer months to access hiking trails in the vicinity of Alpental. Trail 1013 provides access to the Alpine Lakes Wilderness and Snow Lake (7 miles round trip). Trail 1013 is one of the most heavily used trails in Western Washington and used by 25,000 hikers per year (Schrenk 2005 pers. comm.). The PCNST is another very popular summer hiking trail that can be accessed from the Study Area at I-90.

Hikers utilize parking areas at The Summit and along SR-906 in the summer months to access hiking trails throughout the Snoqualmie Pass area.

Mountain Biking

Dispersed mountain biking occurs in and adjacent to The Summit's SUP boundary. The Summit has not operated a mountain bike program since the summer of 2002, and discontinued the operation of the *Central Express* chairlift for scenic rides and other summer activities. As a result, mountain biking will not be further analyzed in this FEIS.

Summer Concert Series

The Summit-at-Snoqualmie has offered a summer concert series on weekends at Alpental. The series consists of two concerts; one in July, and one in August. These concerts are held outdoors and are weather dependent. Previous concerts have been well attended in the debut seasons and are planned to continue in the coming summer seasons.

Scenic Rides

As of 2002, The Summit has closed its mountain biking program, and discontinued the operation of the *Central Express* chairlift for scenic rides and other summer activities. As a result, scenic chairlift rides on the *Central Express* will not be further analyzed in this FEIS.

3.11.5 Dispersed Summer Recreation

Alpine Lakes Wilderness

The Alpine Lakes Wilderness is adjacent to Alpental's SUP and is administered by the MBSNF and the OWNF. In total, the Alpine Lakes Wilderness occupies approximately 394,000 acres within the MBSNF and OWNF. The primary goal of The Alpine Lakes Wilderness is to preserve and protect the wilderness character of the area, allowing for naturalness and providing opportunities for solitude, challenge and inspiration. With these constraints, and following a policy of non-degradation management, the Wilderness provides for recreation, scenic, educational, scientific and historical uses.

Ski areas located adjacent to wilderness lands is common in the western United States (i.e., Alpental, Crystal Mountain, White Pass, Mt. Baker, Timberline, Red Lodge Mountain, Steven's Pass, Grand Targhee, Jackson Hole and Snowmass). This condition is supported by the Congressional Record for the U.S. Senate (S126622, October 2, 1984, Section 9 Buffer Zones) which states:

> "The Congress does not intend that the designation of a wilderness area under this act lead to the creation of protective perimeters or buffer zones around such wilderness areas. The fact that non-wilderness activities or uses can be seen or heard from areas within a wilderness shall not preclude such activities or uses up to the boundary of the wilderness area."

Accordingly, any buffer exists inside the wilderness boundary and a wilderness experience should not be expected on its edge.

Guests access the Alpental Valley and the Alpine Lakes Wilderness from parking facilities at Alpental. Trail 1013 provides access from Parking Lot 2 at Alpental to the Alpine Lakes Wilderness and Snow Lake (7 miles round trip), with an elevation gain of approximately 1,300 feet. Trail 1013 is one of the most heavily used trails in Western Washington and used by 25,000 hikers per year, as previously described. On most weekends during the summer, there are over 100 vehicles belonging to people hiking Trail 1013 in the Alpental parking lots.

Pacific Crest National Scenic Trail

The PCNST, also known as the Pacific Crest Trail, traverses the Cascade Mountain and Sierra Mountain crests from Mexico to Canada. The PCNST is designated as part of the National Trails System. Section 7(a) of the 1968 Act established the relationship between the trail and the management of adjacent land:

> "Management and development of each segment of the National Trails System shall be designed to harmonize with and complement any established multiple-use plans for that specific area in order to ensure continued benefits from the land" (National Trails System Act – P.L. 90-543)."

The selected management alternative in the *Comprehensive Management Plan for the Pacific Crest National Scenic Trail* (USDA 1982) clarifies the relationship between the trail and management of adjacent lands and is consistent with Section 7(a) of the 1968 Act. Specifically pertaining to National Forest lands, the selected alternative states:

> "The entire landscape and its scenic quality are important to the purposes of the Pacific Crest National Scenic Trail. Viewing and understanding resource management and other cultural activities are considered to be part of the normal character of the trail. The management of various resources will give due consideration to the existence of the trail and trail users within the multiple-use concept" (USDA 1982 p.17)."

The PCNST is accessed from Exit 52 along I-90. Heading north, hikers can reach the trailhead east of Alpental Road. The PCNST crosses underneath I-90 where Alpental Road and SR 906 coincide. The PCNST traverses through Summit West on the MBSNF side of the ski area and works its way past Beaver Lake.

The PCNST is utilized by hikers of all abilities from day-hikers to hikers completing the entire trek from Mexico to Canada. Facilities at SR 906 are used as a food pick-up and rest areas for hikers along the PCNST.

3.12 TRANSPORTATION

3.12.1 Introduction

The following section describes existing and background traffic, parking, and transit conditions in the Study Area along the major transportation routes to The Summit-at-Snoqualmie. The Study Area includes Interstate 90 (I-90), State Route 906 (SR 906), Alpental Road, and interchanges 52, 53, and 54 along I-90.

3.12.2 Existing Conditions

The Summit-at-Snoqualmie is located approximately 50 miles southeast of the Seattle metropolitan area, which comprises the majority of skiers at The Summit-at-Snoqualmie. As a result, The Summit-at-Snoqualmie is primarily accessed via I-90 and State Route 906. Mountain access roads are discussed in Section 3.2.1.3 – Soils.

Access and Street System

Interstate 90

I-90 is the major east-west corridor connecting the Seattle/Puget Sound areas with eastern Washington and points east. The interstate is an eight-lane road over Snoqualmie Pass. The road narrows to six lanes from interchange 53 to interchange 54. East of Hyak, I-90 is a four-lane road. This Interstate provides the principle access to The Summit-at-Snoqualmie from the Seattle/Tacoma and Yakima/Ellensburg metropolitan areas.

State Route 906

SR 906 is a two-lane Class 4 access managed highway with a posted speed limit of 35 mph. It is approximately 2.8 miles in length, extending from interchange 52 to interchange 54 parallel to I-90. SR 906 provides the principal access to Summit West, Summit Central and Summit East. Although not analyzed in the total parking capacity for The Summit-at-Snoqualmie, WSDOT has generally permitted on-street parking where sufficient shoulder width exists between mileposts 0.22 to 1.54. Parking is restricted from midnight to 7:00 am to accommodate snow removal in the segment. Resort patrons utilize on-street parking during times of peak visitation and is considered overflow to the established parking system.

Alpental Road

Alpental Road is a two-lane road with narrow shoulders and limited turnouts. The road is approximately 1.2 miles long, extending from interchange 52 off of I-90 to the Alpental Lodge. Alpental Road is a privately owned road and provides public access to Alpental.

Interchanges 52, 53, and 54

Drivers on I-90 can access The Summit-at-Snoqualmie from interchanges 52, 53, or 54. Interchanges 53 and 54 provide both eastbound and westbound exit ramps and on ramps. Interchange 52 provides only an

eastbound exit-ramp and a westbound on-ramp. Consequently, visitors traveling westbound to The Summit-at-Snoqualmie must exit at interchanges 53 or 54, while visitors traveling eastbound can use exits 52, 53 and 54. In addition, visitors leaving The Summit-at-Snoqualmie must return to I-90 via interchanges 53 or 54 when traveling eastbound, and exits 52, 53, and 54 when traveling westbound.

Interchanges 52 and 53 receive higher traffic volumes as shown in Table 3.12.2-2. The higher traffic volume at interchange 52 is due to the fact that the majority of the visitors at The Summit-at-Snoqualmie arrive from the Seattle metropolitan area. Interchange 53 enters State Route 906 along the base areas of The Summit; as a result, it receives a higher traffic volume.

Pedestrian Access

Currently there are no pedestrian or bicycle pathways along State Route 906 or Alpental Road that provide access to The Summit or Alpental. Consequently, there is limited pedestrian and bicycle activity occurring along State Route 906 and Alpental Road.

Existing Parking and Shuttle System

The Summit-at-Snoqualmie currently provides approximately 47.4 acres of parking accommodating approximately 5,612 vehicles. The parking lots are located along State Route 906 and at the end of Alpental Road as shown in Figure 2.3.2-2, Alternative 1 Existing Conditions – Alpental. See Table 3.12.2-1 for a detailed list of lots and capacities.

Table 3.12.2-1:
Existing Parking at The Summit-at-Snoqualmie

Parking Location	Area (acres)	Cars per Acre	Total Car Capacity	Total Capacity (people)
Alpental				
Lot 1	0.8	104	83	183
Lot 2	1.9	155	295	649
Lot 3	0.9	72	65	143
Lot 4	0.6	133	80	176
Lot 5	0.9	90	81	178
Lot 6	2.5	121	303	667
Lot 7	0.2	125	25	55
Subtotal	**7.8**	**119**	**932**	**2,050**
The Summit				
Summit West Lot 1	5.2	125	651	1,432
Summit West Lot 2	4.3	99	426	937
Summit West, First Western	1.8	106	190	418
Summit West, SR 906	2.3	130	300	660
Summit Central Lot 1	10.9	147	1,606	3,533
Summit Central Lot 2	4.2	96	405	891
Silver Fir Lot 1	2.7	109	295	649
Silver Fir Lot 2	1.4	125	175	385
Silver Fir Lot 3	0.6	132	172	378
Summit East Lot 1	1.8	83	150	330
Summit East Lot 2	2.6	75	195	429
Summit East Lot 3	1.1	105	115	253
Subtotal	**39.6**	**118**	**4,680**	**10,296**
Total	**47.4**	**118**	**5,612**	**12,346**

Source: SE GROUP 2004

The Summit provides 39.6 acres of parking on 12 surface lots, and Alpental provides 7.8 acres of parking on 7 surface lots. In total, The Summit-at-Snoqualmie provides parking capacity for approximately 12,346 people at one time, which is lower than the total parking requirement, including the ski area CCC of 10,020, a capacity of 500 Nordic skiers, and 2,500 tubing area guests (a total of 13,020), not including those parking at the area but not purchasing ski area tickets.[56] At Alpental, space for 2,050 people is provided, while the CCC at Alpental is 1,880. With use by non-skiing visitors, parking at Alpental becomes overcrowded on peak days, increasing pressure on other parking areas at The Summit, and requiring some guests to take a shuttle bus to access Alpental.

[56] Based on an estimated 2.2 people per car. Parking is also provided for busses, which park in designated areas. However the number of busses varies widely. For this reason, parking is evaluated in this EIS based on car per acre densities shown in Table 3.12.2-1.

The parking lots at both The Summit and Alpental parking lots have gravel surfaces that are maintained by ski area personnel. The alpine environment, as well as plowing and other operational activities cause the parking lots to have washouts and sink holes. The parking lots are considered to be in moderate condition.

The Summit-at-Snoqualmie operates an intra-resort shuttle service. Comprised of three, 15-passenger vans, the shuttle system operates Friday evenings (5:00 pm to 10:30 pm), Saturdays and holidays (8:00 am to 10:30 pm), and Sundays (8:00 am to 5:30 pm). The shuttle system serves Alpental, the Alpental Community Club and other points on Alpental Road, The Summit Inn, The Summit's various base areas, The Summit Tubing Center, and The Summit Nordic Center.

3.12.2.1 Data Collection

No independent studies or surveys were conducted for the transportation analysis. Most data was collected from the Washington State Department of Transportation (WSDOT). Pertinent publications include the *2002* and *2006 Annual Traffic Report* (WSDOT 2003a, 2007a), the *2002* and *2006 Peak Hour Report* (WSDOT 2003b, 2007b), and the I-90 East DEIS (WSDOT 2005). Additional information was gathered from personal communication with WSDOT staff, through data requests, and WSDOT transportation studies and/or surveys.

In 1999, TDA Inc. completed a transportation study for Snoqualmie Pass Community Advisory Council (SNOPAC). Although this report was unpublished, the draft document is included in the project file. Peak Hour Projection data from the report includes projected private land development and implementation of The Summit-at-Snoqualmie MDP, through the year 2015. The SNOPAC analysis was used in Chapter 4 – Environmental Consequences of this transportation analysis (SNOPAC 1999).

Traffic Safety

The current layout of The Summit parking lots along State Route 906 poses a potential safety hazard to pedestrians. Currently, the existing parking lots lie on the east side of State Route 906 opposite of The Summit ski areas. This requires visitors to cross the highway to access the base areas. In addition, visitors may be forced to travel along the shoulders of State Route 906 to find suitable access to the base areas, as many areas are inaccessible due to the steep slopes and heights of the embankments. Since 2000, two non-fatal incidents involving pedestrian-motor vehicles have occurred on State Route 906, one at Mile Post 0.49 and another at Mile Post 1.3 (Giles 2007 pers. comm.). The number of incidents that are a result of ski area operations is unknown.

3.12.2.2 Traffic Operations

Annual Traffic Volumes

WSDOT has conducted traffic surveys on I-90, State Route 906, and at interchanges 52, 53, and 54 utilizing permanent traffic recorders embedded in the I-90 roadway and short-duration mechanical traffic

counts along SR-906 and at interchanges. The 2006 Peak Hour Report documents the average daily traffic and top 200 peak hour volumes for I-90 at Mile Post 52.24 (SR 906 crossing near Summit West) (WSDOT 2007b). Based on this report, the average daily traffic at this location totals 27,189. Table 3.12.2-2 presents a breakdown of the average daily traffic on I-90.

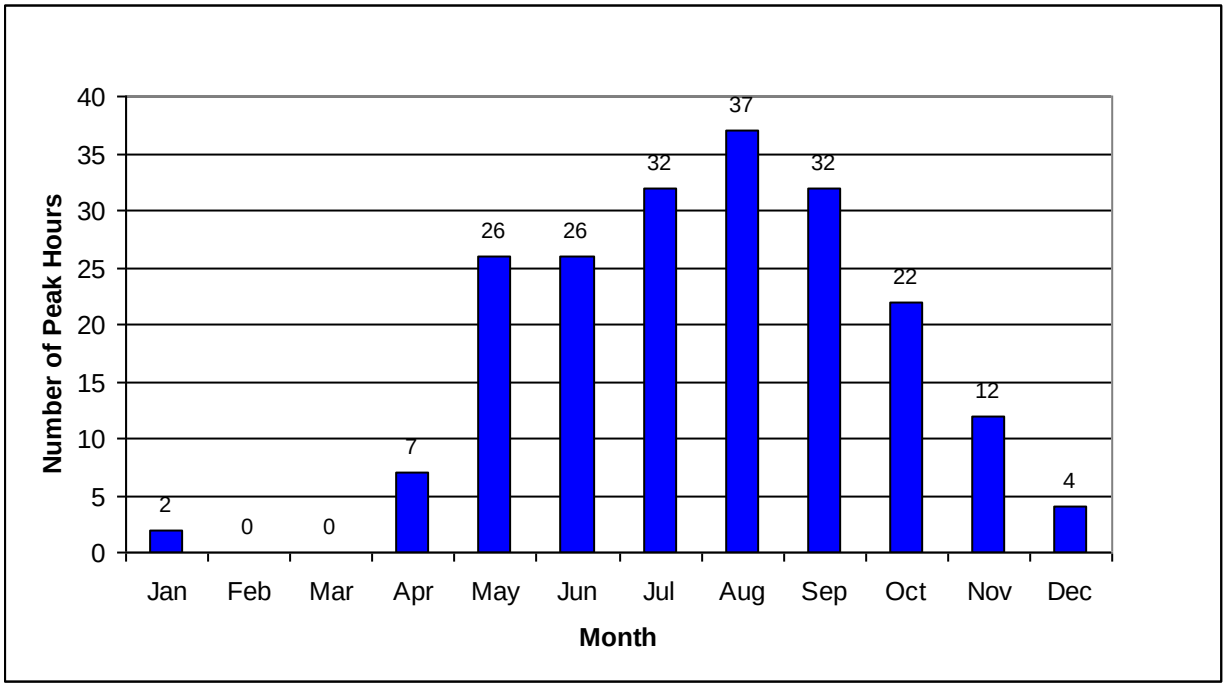
Table 3.12.2-2:
Average Daily Traffic for 2006

Location	Average Daily Traffic
State Route 906 (Mile Post)	
0.00 (At begin route)	1,216
0.07 (After I-90 Interchange)	2,268
0.63 (Before Yellowstone Rd.)	2,644
0.63 (After Yellowstone Rd.)	741
2.55 (Before SR 906 Hyak Spur)	531
2.65 (At I-90 Undercrossing)	380
Interstate 90	
Eastbound	13,613
Westbound	13,576
Interchange 52	
Eastbound Off	1,178
Westbound On	808
Interchange 53	
Eastbound On	866
Westbound Off	662
Westbound On	226
Eastbound Off	136
Interchange 54	
Eastbound On	177
Westbound Off	175
Westbound On	224
Eastbound Off	219

Source: St. Charles 2007 pers. comm.

Table 3.12.2-2 shows that the average daily traffic on I-90 is evenly divided between eastbound and westbound vehicles. According to the *2006 Peak Hour Report* (WSDOT 2007b), the highest peak hour traffic volume for I-90 on December 26, 2006 (Between 2:00-3:00 pm) was 3,826 vehicles. This peak hour included 1,563 eastbound vehicles (41 percent of total) and 2,263 westbound vehicles (59 percent of total). Peak Hour Volumes represent the morning and evening hours that coincide with the highest traffic volumes for a particular road segment. Illustration 3.12.2-1 shows the monthly distribution of the top 200 peak hours in 2006.

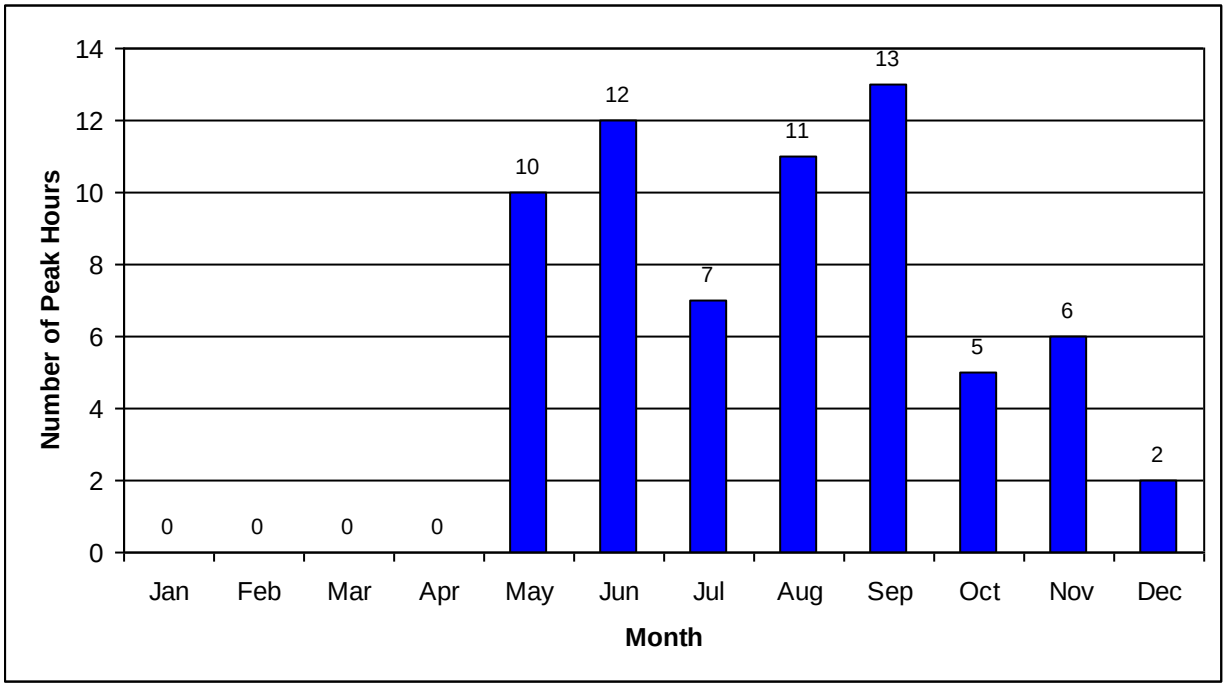
Illustration 3.12.2-1:
Distribution of the Top 200 2006 Peak Hours on I-90 at SR-906 Near Summit West



Source: WSDOT 2007b

Based on the WSDOT report, the majority of peak hours occur between May and October (175 of the top 200), when The Summit-at-Snoqualmie receives the least visitation (see Section 3.11 – Recreation). Of the top 200 peak hours in 2006, 134 occurred in the westbound lanes (away from the Study Area) and 66 occurred in the eastbound lanes. Illustration 3.12.2-2 shows the monthly distribution of these eastbound peak hours.

Illustration 3.12.2-2:
Distribution of the Top Eastbound 2006 Peak Hours on I-90 at SR-906 Near Summit West



Source: WSDOT 2007b

As shown in Illustration 3.2.12-2, the top eastbound peak hours occurred between May and November with 53 of the 66 top eastbound peak hours occurring between May and September. The information presented in the WSDOT report (WSDOT 2007b) shows that the peak use of I-90 is highly correlated with the non-skiing season and that ski area operations have not greatly influenced peak conditions on I-90.

Accident Rates

The WSDOT Collision Data and Analysis Branch maintains a database of all reported collisions on Washington State's highways, roads and streets. Since publication of the DEIS, WSDOT has implemented a new collision data records system allowing near real-time analysis of statewide collision data. Through personal conversation with WSDOT staff, a summary of vehicle collisions during 2006 in the vicinity of The Summit-at-Snoqualmie on I-90 and SR 906 was provided for this analysis (Giles 2007 pers. comm.). Table 3.12.2-3 presents a summary of the 2006 accident data for SR 906 and I-90 in the vicinity of the Study Area. (Note: The number of accidents that are a result of ski area operations is unknown.)

Table 3.12.2-3:
Summary of 2006 Accident Data for the Vicinity of The Summit-at-Snoqualmie

State Route Segment	Milepost	Total Collisions	Total Injuries	Total Fatalities
Interstate 90[a]	52.61 to 54.70	58	21	0
State Route 906[b]	0.00 to 2.55	9	3	0
State Route 906 Spur Hyak[c]	2.55 to 2.98	0	0	0

[a] 2.09-mile segment between Kittitas County Line and SR 906 at Exit 54
[b] 2.55-mile segment between Interstate 90 Exit 52 to SR 906 Spur Hyak intersection
[c] 0.43-mile SPUR from SR 906 to DOT Maintenance Area Access
Source: Giles 2007 pers. comm.

3.13 UTILITIES

3.13.1 Introduction

This section describes utilities at The Summit-at-Snoqualmie. For the purposes of this analysis, utilities are discussed under the following categories: domestic water, wastewater treatment, power, communications, electronic sites, cable television, fuel storage, and solid waste.

3.13.2 Existing Conditions

Domestic Water

The Summit's domestic water is supplied by the Snoqualmie Pass Utility District (SPUD). SPUD also provides storage for domestic water at tanks located at Summit West (combined storage capacity of 465,000 gallons). Based upon historic visitation records and generally accepted water consumption assumptions, The Summit's total water consumption does not exceed 85,000 gallons daily. Therefore, The Summit's existing water supply and water storage system is adequate to meet the resort's peak domestic water demand.

At Summit East, the "Oly Tank" is an abandoned water tank that is no longer connected to the water system. The tank remains on the mountain and is an icon of the area, particularly for its use as a terrain feature by snowboarders.

Alpental's domestic water is supplied by two wells. In addition to the resort, the wells supply water to the Alpental Community Club and two condominium associations. SPUD currently holds the water rights to the wells. Alpental's existing water supply is provided by two wells with an estimated combined flow of approximately 620,640 gallons per day. A 100,000-gallon concrete tank provides domestic water storage. Based upon historical water consumption records, the peak daily consumption for the resort is approximately 28,000 gallons.

Wastewater Treatment

The Summit-at-Snoqualmie is connected to a consolidated wastewater treatment system that is also serviced by SPUD. The SPUD treatment facility has a design capacity of 0.368 million gallons of wastewater per day, and the plant's current average daily flow is 0.188 million gallons per day, or approximately 51 percent of the capacity (SPUD 2002, 2007). SPUD has indicated that the wastewater treatment facility has ample capacity to accommodate The Summit-at-Snoqualmie (SPUD 2002, 2007).

Power

Puget Sound Energy supplies electrical power to The Summit and Alpental and furnishes most of the high voltage power lines, as well as the requisite transformers and distribution lines. The power supplied to Puget Sound Energy is drawn from Bonneville Power. The Bonneville power line corridor is situated west of the Summit East Special Use Permit Boundary and runs in a northwest direction, crossing the lower

Backside lift (C-2) and Trail 52. The Puget Sound Energy power line corridor in the vicinity of the Study Area begins at the northwest corner of Summit East Lot 3. The corridor is positioned north of the Summit East trails and runs due west through Summit East. The corridor continues west, running parallel to the southern-most border of the Summit Central Special Use Permit Boundary. Puget Sound Energy has indicated that the power supply infrastructure has ample capacity to fully accommodate The Summit-at-Snoqualmie (Sno.engineering 1998).

Communications

PTI Communications furnishes telecommunication service to each of The Summit's three base areas and Alpental. Primary communication between each base area, and various on-mountain locations, is provided via telephone service (Telephone Utilities of Washington, doing business as PTI Communications, provides telephone service to the Alpental Valley). The Summit's incoming lines are fed into several telephone systems, which work in tandem to provide resort-wide, four digit dialing capability. Alpental's incoming lines are fed into a Mitel SX 200 telephone system. Telecommunication lines radiate from the base areas to various on-mountain locations.

Electronic Sites

To accommodate the needs of a number of companies, Booth Creek Resorts provides leased space on their private lands (i.e., electronic sites) for cellular transmission service providers. Included in the lease arrangements for the telecommunications and paging systems is power, transportation to and from the site (which depends on snow and weather conditions), and weatherproof enclosures for electronic equipment. Currently, there are three developed sites; these locations are at the Summit East Day Lodge, the Thunderbird Lodge, and the former location of the upper terminal of Beaver Lake Chairlift, which has been removed. A lease agreement for each of these sites is kept at the administrative offices at the base of Summit West.

The Alpental facility does not operate any electronic sites, nor does it lease land to operators of electronic sites.

Cable Television

Cable television lines are installed subsurface at Summit East. Utilities are buried along Trail 63, from the summit at Summit East to private lands near the base area. In all, approximately 4,000 feet of cable television wire is buried and provides access to homes and condos near Summit East.

Fuel Storage

Presently, The Summit has fueling stations, both gas and diesel, situated in the shop yards at Summit West's and Summit Central's maintenance facilities. The Summit West maintenance facility is equipped with two underground fuel storage tanks – one dedicated to gas and one dedicated to diesel. Each of Summit West's storage tanks has a 4,000-gallon capacity. Summit Central also has two, underground fuel storage tanks (one for gas and one for diesel). Each of these tanks has a 4,500-gallon capacity.

While Summit East does not have fuel storage facilities, overall fuel storage capacity is adequate for The Summit's existing resort operations. All storage tanks are in compliance with applicable federal, state, and local regulations.

Alpental has two, aboveground fuel storage tanks located adjacent to the maintenance facility. The unleaded gasoline tank (500-gallon storage capacity) and the diesel fuel tank (1,500-gallon storage capacity) are in one self-contained unit, located just outside the maintenance facility. Alpental's fueling stations are in compliance with applicable local, state, and federal environmental regulations.

Solid Waste

Solid Waste from The Summit-at-Snoqualmie operations is disposed of through landfill application and recycling. Waste Management of Ellensburg hauls solid waste to a landfill near the City of Ellensburg, Washington, approximately 40 miles east of the ski area. During the 2002-03 operating season, Booth Creek Resorts coordinated with King County to open the Snoqualmie Pass Recycling Center, which is located south of the Fire Station along SR 906. Internally, the ski area recycles cardboard, paper, glass and aluminum at the recycling center. Recycling receptacles for glass and aluminum are provided in all food and beverage area for guests. Eastside Disposal (Rabanco) hauls recycled materials to King County for processing with materials from other King County recycling centers.

Table 3.13.2-1 displays the solid waste generated by the ski area during the 2001-02 and 2002-03 operating seasons.

Table 3.13.2-1:
Solid Waste Generation at The Summit-at-Snoqualmie

Ski Season	Solid Waste (tons)	Recycling (tons)	Total (tons)	Skier Visits	Pounds per skier visit
2002	273		273	611,638	1.12
2003	179.4	24	203.4	328,746	0.81
Average					**0.96**

Based on Table 3.13.2-1, solid waste generation at the ski area averages 0.96 pounds per skier visit. Of this solid waste, approximately 12 percent (24 out of 203.4 tons) is recycled.

3.14 LAND USE

The Study Area for land use encompasses lands around The Summit-at-Snoqualmie including NFSL, private lands (Ski Lifts, Inc. owned and other private land owners) that are in both King County and Kittitas County, I-90, and SR-906.

The Summit-at-Snoqualmie MDP proposal would include actions on both federal and private lands. Actions proposed on federal lands are under USFS administration and must fit into the framework of the management direction, and Standards and Guidelines contained in the Forest Plan and related documents (see Section 1.2 - Tiering, Management Direction, U.S. Forest Service Policy). Actions proposed on private lands are not under administration of the USFS, however, they are viewed as connected actions, and are under the jurisdiction of either King County or Kittitas County.

The Study Area is located along SR-906 and I-90, between the Alpine Lakes Wilderness Area and the developed Snoqualmie Pass corridor along the busy I-90 mountain pass. The Snoqualmie Pass area is nestled among the “checkerboard ownership” pattern, and as a result, includes a wide range of land uses. Among these are the Snoqualmie Pass area, with a resident population of 201 (year 2000) occupying 88 of the 330 residential units in the area, with the remaining units largely occupied by seasonal residents (see Table 3.10.3-1). The area also includes commercial uses, including a gas station, small markets, and a hotel. The Snoqualmie Pass area realizes high summer and winter use patterns based on the availability of recreation activities, including one of the busiest sections of the PCNST during the summer and The Summit-at-Snoqualmie Ski Area during the winter (see Section 3.11 - Recreation).

At The Summit-at-Snoqualmie, Puget Sound Energy supplies electrical power via high voltage power lines, transformers, and distribution lines. PTI Communications furnishes telecommunication services to The Summit-at-Snoqualmie. Telecommunication lines radiate from the base areas to various on-mountain locations. Puget Sound Energy has its own permit with the USFS regarding power line corridors. Cable television lines are installed subsurface at Summit East, with approximately 4,000 feet of cable buried to provide access to homes and condominiums near Summit East. For a more detailed description utilities at The Summit-at-Snoqualmie, see Section 3.13 - Utilities.

3.14.1 Lands within The Summit-at-Snoqualmie Study Area

3.14.1.1 Public Lands

For a detailed discussion of land allocations on NFSL in the Study Area, see Section 1.2 - Tiering, Management Direction, U.S. Forest Service Policy, and Figure 1.1.1-FEIS-2, Existing NFSL Allocation.

3.14.1.2 Private Lands

Private lands owned by Ski Lifts, Inc. make up approximately 21 percent of the total lands within the Study Area (approximately 500 acres at The Summit and approximately 113 acres at Alpental). Land use

and zoning is administered by Kittitas County at Summit East, Summit Central and the southern portion of Summit West, and King County for Alpental and the northern portion of Summit West.

King County Zoning

Private lands at The Summit-at-Snoqualmie within King County (approximately 114 acres) include three zoning designations: Commercial Business, Residential - four dwelling units per acre (R-4), and Residential - 18 dwelling units per acre (R-18). Commercial Business zoning, which encompasses all proposed activities on Ski Lifts, Inc. private land, is intended to allow for mixed use (housing and retail/service) developments. R-4 zoning is a mix of predominantly single detached dwelling units and other development types. R-18 zoning provides a mix of predominantly apartment and townhouse dwelling units and other development types. There are no proposed activities on Ski Lifts, Inc. private lands within the R-4 or R-18 zoning designations.

Kittitas County Zoning

Within Kittitas County, the approximately 1,014 acres of private land at The Summit are zoned Forest and Range, except for an approximately 90-acre parcel located between SR-906 and I-90 at Summit Central (see Figure 1.1.1-FEIS-3, Existing Private Lands Ownership and Zoning), which is zoned Planned Unit Development (PUD). The Forest and Range Zone is intended for lands where natural resource management is the highest priority and where the subdivision and development of lands for uses and activities incompatible with resource management are discouraged. The purpose and intent of PUD zone is to provide for and encourage a harmonious mixture of land uses with greater flexibility in land use controls. Permitted PUD zone uses include residential, hotels, condominiums, retail businesses, commercial-recreation businesses, restaurants, cafes, taverns, and cocktail bars.

Plum Creek Timber Lands within Section 21 (T23, R11E) are zoned Forest and Range.

Electronic Sites

Currently there are three developed electronic sites for cellular transmission service providers at The Summit-at-Snoqualmie; the Summit East Day Lodge, Thunderbird Lodge, and the former location of the upper terminal of Beaver Lake chairlift, and all of these cell towers are located in Kittitas County. For a more detailed description of electronic sites at The Summit-at-Snoqualmie, see Section 3.13 - Utilities.

3.14.2 Lands Adjacent to, or Nearby The Summit-at-Snoqualmie Study Area

3.14.2.1 Public Lands

Roadless and Unroaded

On January 12, 2001, the USDA promulgated the roadless rule at 36 CFR part 294 (66 FR 3244). The roadless rule changed the USFS approach to management of inventoried roadless areas (IRAs) by establishing nationwide prohibitions that generally limit timber harvest, road construction, and road reconstruction within IRAs.

On May 4, 2001, the Secretary of Agriculture expressed the administration's commitment to the objective of conserving IRA values in the NFS, and also acknowledged concerns raised by local communities, Tribes, and States impacted by the roadless rule. On July 10, 2001, the Forest Service published an advance notice of proposed rulemaking (66 FR 35918) seeking public comment concerning how best to proceed with long-term conservation and management of IRAs. The responses received on the advance notice of proposed rulemaking represented two main points of view on natural resource management and perspectives on resource decision-making:

- Emphasis on environmental protection and preservation, and support for making national decisions; and
- Emphasis on responsible active management, and support for local conservation decisions made through the land management planning process.

The agency issued an interim directive for the management of IRAs in December of 2001 for 18 months, and reinstated it again on July 16, 2004 for another 18 months. This interim directive reserves to the Chief, except in specific circumstances that are generally consistent with the prohibition exceptions in the roadless rule, the authority to make decisions in IRAs regarding:

- Road construction or road reconstruction on any NFS unit until a forest-scale roads analysis is completed and incorporated into a forest plan, or a determination is made that an amendment is not necessary; and
- Timber harvesting on any NFS unit until a revision of a forest plan or adoption of a plan amendment that has considered the protection and management of IRAs.

On May 13, 2005 (Federal Register: Volume 70, Number 92) the USDA revised Subpart B of Title 36, Code of Federal Regulations, Protection of IRAs, by adopting a new rule that establishes a petitioning process that provides Governors an opportunity to seek establishment of or adjustment to management requirements for IRAs within their States. The opportunity for submitting State petitions was available for 18 months following the effective date of the final rule.

Under the final 2005 rule, submission of a petition was voluntary and management requirements for IRAs was guided by individual Forest Plans unless the management requirements were changed through a State-specific rulemaking. Also under the final 2005 rule, the July 16, 2004 interim directive for the management of IRAs (69 FR 42648) remained in place until January 16, 2006, and the USFS had the option to renew the interim directive for an additional 18 months. On September 20, 2006, the U.S. District Court for the Northern District of California set aside the 2005 final rule and reinstated the 2001 Roadless Rule. As of the publication date of this FEIS, the 2001 Rule applies to management of the IRAs.

The Study Area is bounded to the north by the Alpine Lakes Wilderness. Within the MBSNF, no IRAs exist within 20 miles of the Study Area. The nearest IRAs in the MBSNF include those immediately north

of the Crystal Mountain SUP area (approximately 30 miles south) and those located between Highway 2 and the Henry M. Jackson Wilderness (approximately 25 miles north). In the OWNF, three small IRAs (partial sections are within 1-2 miles of the Study Area) are present along the opposite side of I-90 from the Study Area. Further to the east (approximately 10 miles) larger blocks of IRA exist between the OWNF boundary and the Alpine Lakes Wilderness Area. Within the SUP area, the northern portion of Alpental exhibits an unroaded character. However, the area sees substantial lift-served backcountry skier use during the winter, resulting in less opportunity for solitude during the winter than in the non-skiing season.

3.14.2.2 Private Lands

Private lands adjacent to The Summit-at-Snoqualmie Study Area are typically residential areas consisting of houses or condominiums (Alpental and Summit East) or commercial businesses such as the First Western Summit Inn, the Chevron Station, and the Timewise convenience store on SR-906 across from Summit West. Ski Lifts, Inc. also owns land across from Summit Central, which is used as The Summit Tubing Center and parking for the Silver Fir area.

Sahalie Ski Club

The Sahalie Ski Club is a private ski club that owns 85 acres of land off of Alpental Rd. The Sahalie ski lodge and the two rope tows operated on this land are available to members only. Because it is in King County, the land belonging to the Sahalie Ski Club is allocated as Commercial Business.

3.14.2.3 Pacific Crest National Scenic Trail

The PCNST is designated as part of the National Trails System. The management guidelines for public lands adjacent to the PCNST are discussed in the *Comprehensive Management Plan for the Pacific Crest National Scenic Trail* (USDA 1982). According to this management plan, the entire landscape and its scenic quality are important to the purposes of the PCNST. Viewing and understanding resource management and other cultural activities are considered to be part of the normal character of the PCNST. The management of various resources will give due consideration to the existence of the trail and trail users within the multiple-use concept. On federal lands outside National Parks and Wilderness, the trail must co-exist in harmony with all other resource uses and activities of the land as determined through the land management planning process. The trail will cross a mosaic of areas differing in primary management emphasis. Viewing and understanding this array of resources and management is one of the primary recreation opportunities to be made available over these portions of trail (USDA 1982).

3.15 VISUAL RESOURCES

The Summit-at-Snoqualmie is located along Interstate 90 (I-90) at the crest of the Cascade Mountain range, bordering the MBSNF and OWNF. The Summit-at-Snoqualmie MDP Proposal involves the development of ski lifts and trails, guest service buildings, and maintenance facilities that have the potential to affect the scenic resources of both National Forests. As such, the scenic quality of the area will be analyzed in the context of the management direction, goals, and objectives of the respective National Forests.

The USFS Visual Resources Management System (USFS 1974) has been used to analyze the visual conditions on NFSL at The Summit-at-Snoqualmie. The Visual Resources Management System helps establish Visual Quality Objectives (VQOs) for various landscapes and helps define how the landscape will be managed, the level of acceptable modification in the area, and under what circumstances modifications are allowed.

Analysis of whether the proposed Summit-at-Snoqualmie MDP meets the VQOs for the area includes evaluating the inherent ability of the landscape to absorb the effects of change (i.e., physical characteristics of the area and their ability to overcome the effects of modification). Slope, vegetation (type, pattern, contrast, and regeneration potential), landform, and viewing distance are important factors affecting the landscape's capability to absorb visual changes. For further information on the Visual Resources Management System and its use, see *USDA Handbook 462 - National Forest Landscape Management, Vol. 2* (USFS 1974).

3.15.1 Management Guidelines

3.15.1.1 Mount Baker-Snoqualmie National Forest

The portions of Alpental and the northern part of Summit West that lie on public lands are within the South Fork Snoqualmie River Viewshed. The Existing Visual Condition (EVC) for these lands is Moderately Altered (USDA 1990a). Moderately Altered landscapes are easily noticed by the average visitor and may attract attention; disturbances are apparent and correspond to a VQO of Modification (USDA 1990a p. IV-129). As a result, the VQO of Retention is not met at the portions of Alpental and Summit West that lie within the MBSNF.

3.15.1.2 Okanogan-Wenatchee National Forest

The portions of Summit Central and Summit East that lie on public lands are within the Snoqualmie Pass Viewshed. The EVC for these lands is characterized as Heavily Altered, primarily due to land ownership patterns and uses (USDA 1998b p. IV-37).

VQO designation for OWNF lands are based on existing land allocations (see Figure 1.1.1-FEIS-2, Existing NFSL Allocation). All OWNF lands at The Summit-at-Snoqualmie are prescribed a VQO of Retention.

3.15.2 Existing Visual Conditions

3.15.2.1 Alpental

Elevations at Alpental range from about 2,650 feet along the South Fork Snoqualmie River to 6,278 feet on Snoqualmie Mountain. Topography at Alpental is dominated by steep slopes, vertical cliffs, and talus and avalanche chutes on either side of a narrow valley bottom.

Clearing for ski trails at Alpental is less pronounced than elsewhere within the Study Area. Clearings are evident to the casual observer; however, the modified landscape repeats the natural form, line, color and texture of the natural surrounding landscape and remains visually subordinate to the surrounding environment.

Developed alpine ski facilities (including chairlifts, guest service buildings, maintenance facilities, etc.) and private housing is evident along the valley floor at Alpental. Existing developed ski facilities on public land do not reflect current USFS Cascadian Architecture standards, however most facilities borrow from the naturally established form and line (e.g., peaked roofs, earth tones, etc.) of the surrounding natural landscape. Facilities are evident to the observer; however, these structures remain visually subordinate to the dramatic landscape comprising the Alpental valley and remain characteristic of what one may expect to see when traveling in a developed alpine community. Despite the fact that development at Alpental is visually subordinate to the surrounding landscape, Alpental does not meet the prescribed VQO of Retention. The visual conditions at Alpental correspond with the EVC of Moderately Altered.

3.15.2.2 The Summit

Elevations at The Summit range from about 2,517 feet, where Coal Creek enters Keechelus Lake, to over 6,800 feet on Kendall Peak. Mount Hyak (3,745 feet) is another prominent mountain peak within the Study Area. Topography at The Summit ranges from gentler, well-rounded knolls near Summit West, to irregular slopes with steep pitches, benches, and flat areas at Summit East. The historic land use and mixed land ownership within and surrounding The Summit has resulted in a landscape with a patchwork of clear-cuts and second growth forests on both private and public lands, as shown in Illustration 3.15-1. The primary ownership and land use activities that have affected the scenic integrity of The Summit include vegetative clearing for alpine ski development, timber harvesting, and utility right-of-way clearings.

Illustration 3.15-1:
Previous Clearing at Summit West and Summit Central

Mount Baker-Snoqualmie National Forest

Historic ski trail clearing activities at Summit West has resulted in strong forms and lines uncharacteristic of any natural landscape (see Illustration 3.15-1). The existing clearings do not reflect any shape or pattern that occurs naturally, and past clearing activities dominate the surrounding landscape. Existing ski trail clearings at Summit West correspond with the EVC of Moderately Altered, and do not meet the VQO of Retention.

Most developed ski facilities at Summit West are located in the base area along State Route 906. Most of the base area facilities at Summit West were constructed several decades ago. These structures do not borrow from characteristics of the surrounding landscape and do not reflect current USFS Cascadian Architecture standards. As with the ski trails at Summit West, the older base area structures at Summit West correspond with the EVC of Moderately Altered and do not meet the prescribed VQO of Retention.

Structures and walkways constructed more recently (i.e., within the last five years), follow the Cascadian Architecture standards and borrow from naturally established form, texture, and color, making them aesthetically pleasing and compatible with the natural environment. Because of their developed character, these facilities do not meet the prescribed VQO of Retention.

Okanogan-Wenatchee National Forest

The lands at Summit West that are on the OWNF have also been affected by historic ski trail clearing activities. Past clearing activities dominate the surrounding landscape; therefore, existing ski trail clearings at Summit West meet a Forest Service definition of Maximum Modification. The maintenance facility at Summit West is also located on OWNF land. The maintenance facility does not borrow from characteristics of the surrounding landscape and does not reflect current USFS Cascadian Architecture standards and thus meets a Forest Service definition of Maximum Modification.

Other OWNF lands comprising the Study Area include lands within Section 16; including portions of the *Silver Fir* chairlift and Summit East (see Illustration 3.15-2). Although changes in forms and lines are less evident as compared to public lands at Summit West, historic ski trail clearing activities on public lands at Silver Fir and Summit East produce a strong form unrelated to natural occurrences. However, the extent and intensity of the clearing remains visually subordinate to the surrounding landscape. As such, clearing for ski trails on OWNF lands at The Summit meet the definition of Partial Retention, and the prescribed VQO of Retention is not met. However, the overall EVC at Summit Central and Summit East meets the definition of Modification because of the above-mentioned ski trail development in conjunction with ski trail development that has occurred on private lands at Summit Central and Summit East.

Illustration 3.15-2:
Lands Within Section 16 as Viewed from Lands East of I-90

A shown in Illustration 3.15-3, the existing power line traverses through the middle of Section 16. The clearing produces a strong line with a straight form that is uncharacteristic to the surrounding forested landscape. The clearing for the power line meets a VQO of Modification (see Illustration 3.15-3).

Illustration 3.15-3:
Existing Power Line Clearing within Section 16

3.15.3 Critical Viewpoints

In order to analyze potential visual impacts associated with proposed development on NFSL, four critical viewpoints were identified by the USFS ID Team (see Figure 3.15.3-1, Critical Viewpoints). These viewpoints are intended to represent the most commonly traveled and used viewpoints from which development may affect the scenic quality and integrity of the area.

3.15.3.1 Snow Lake Trail

Trail 1013 (Snow Lake Trail) is one of the most heavily used trails in western Washington and is used by 15,000 hikers per year (The Mountaineers 1998). The trail originates at Parking Lots 2 and 3 at Alpental and ascends along the east side of the valley floor towards Snow Lake. The trail ascends through a dense forest for the first ¼ to ½ mile along the trail. Views down the valley to Alpental are screened due to the dense vegetation.

Approximately 0.5 mile from the base area, the trail enters a rock/talus landscape and the views open up down valley. The landscape appears unaltered and ski area development is either not visible or not

discernable to the casual observer, as shown below in Illustration 3.15-4. The landscape meets the prescribed VQO of middle-ground Retention.[57]

Illustration 3.15-4:
Alpental from Trail 1013 (Snow Lake Trail)

3.15.3.2 Pacific Crest National Scenic Trail

The PCNST runs along the Sierra and Cascade Mountains from Mexico to Canada crossing a myriad of landscapes. The PCNST enters the Study Area at Summit West, near Beaver Lake. The PCNST crosses through cleared ski trails then descends through the base area at Summit West. The PCNST then follows SR-906 underneath an I-90 overpass, ascends into the Forest on the east side of I-90 and continues north. Two viewpoints along the PCNST will be analyzed in this EIS.

Development at Summit West (ski area facilities, chairlifts, maintenance shop, etc.) is clearly visible to the observer along the PCNST as one descends from Beaver Lake through the ski area, as shown in

[57] Middle-ground refers to the viewing zone that is ½ to 4 miles from the observer.

Illustration 3.15-5. However, the development remains visually subordinate to the surrounding landscape and meets the definition of foreground Partial Retention.[58]

Historic ski trail clearing at Summit West, as viewed from the PCNST (near Beaver Lake), does not reflect any shape, form or pattern of natural occurrences. Background views dominate the landscape in this area. Similar tree cutting patterns and openings are visible on all lands surrounding the Study Area. Existing ski trail clearings at Summit West meet the definition of foreground Modification, as viewed from the PCNST (near Beaver Lake).

Illustration 3.15-5:
Summit West Base Area From the PCNST

Along the PCNST on the east side of I-90, ski area development is not apparent to the casual observer. Although ski trail clearings are discernable to the careful eye, vegetative cover screens developed facilities from observers along the PCNST, as shown in Illustration 3.15-6. As such, ski trail clearings and developed facilities at Summit West meet middle-ground Partial Retention from the PCNST on the east side of I-90.

[58] Foreground refers to the viewing zone within 0 to ½ mile from the observer.

Illustration 3.15-6:
Summit West from PCNST Looking West

3.15.3.3 I-90 Heading West

Historic ski trail clearing and ski area facilities are evident to the casual observer along I-90. NFSL, as viewed from Scenic Viewsheds (I-90 included), shall be managed at forest VQOs for both foreground and middleground viewing zones. Scenic quality will be maintained and gradually improved within these scenic viewsheds (USDA 1990a p. 4-24).

Immediate foreground views are dominated by I-90 itself and associated signage and development. Ski trail clearing and ski area development would comprise middle-ground views. The ski area and surrounding development do not repeat the natural form, line, or shape of the naturally occurring landscape. Regardless, middle-ground views remain visually subordinate to the surrounding landscape in comparison to the developed foreground. The public lands adjacent to I-90 at The Summit are consistent with the EVC of Moderately Altered and do not meet the prescribed VQO of Retention, as discussed in Section 3.15.2.2 – The Summit.

3.16 NOISE

3.16.1 Noise Standards and Regulations

The Summit-at-Snoqualmie is located on a combination of private lands (in King and Kittitas Counties) and NFSL. State, county, and local noise regulations specify standards that restrict both the level and duration of noise measured at any given point within a receiving property.

King County

King County is governed by a list of county codes, which are enforced by the King County government. Chapter 12.88 in the Public Peace, Safety, and Morals section of the county code describes Environmental Sound Levels. The maximum permissible environmental noise levels for King County depend on the land use of the property that contains the noise source (e.g., industrial, commercial, or residential) and the land use of the property receiving that noise. Maximum permissible sound levels are outlined for sound sources located outside the city of Seattle are in Table 3.16.1-1. For purposes of this analysis, The Summit-at-Snoqualmie Ski Area is considered to be a Class B area.

Table 3.16.1-1:
Maximum Allowable Noise Levels

EDNA[a] of Noise Source	District of Receiving Property within King County			
	Rural (dBA)[b]	Residential (dBA)	Commercial (dBA)	Industrial (dBA)
Class A (Residential/ Recreational)	52	55	57	60
Class B (Commercial)	55	57	60	65
Class C (Industrial)	57	60	65	70

Source: MSRC County Code 12.88.020
[a] EDNA = Environmental Designation for Noise Abatement
[b] dBA is the abbreviation for the A-weighted decibel scale, which is a unit for expressing the relative intensity of sounds on a scale from zero for the average least perceptible sound to about 130 for the average pain level

The King County noise code also describes parameters for construction and equipment operation. For the equipment and activities described in this section, the maximum permissible sound levels described above may be exceeded between 7:00 am and 10:00 pm on weekdays and between 9:00 am and 10:00 pm on weekends, by no more than:

- 25 dBA for equipment used on construction sites;
- 20 dBA for portable powered equipment used in temporary locations in support of construction activities; and
- 15 dBA for powered equipment used in temporary or periodic maintenance or repair of the grounds of any property.

Chapter 12.90 of the King County code describes motor vehicle sound levels. It is unlawful to exceed the maximum permissible sound levels for the category of vehicle as described in Table 3.16.1-2.

Table 3.16.1-2:
Maximum Allowable Noise Levels for Motor Vehicles

Vehicle Category	35 mph or Less (dBA)	Over 35 mph (dBA)
Motorcycles	80	84
Motor Vehicles Over Five Tons	86	90
All Other Motor Vehicles	76	80

Kittitas County

Kittitas County is governed by a list of county codes, which are enforced by the Kittitas County government. Chapter 9.45 in the Public Peace, Safety, and Morals section of the county code describes noise and disturbance for Kittitas County. The maximum permissible environmental noise levels for Kittitas County do not relate to designated land use, as described for King County. However, similar to King County, there is a restriction on excessive noise levels from 10:30 pm to 7:00 am.

3.16.2 Existing Noise Source and Levels

The Study Area is in an area that is regularly impacted by noise. I-90 is the major east-west travel corridor in WA, and lies between Alpental and The Summit. Alpental lies to the north of the highway, and The Summit lies to the south. SR 906 travels along the base area of The Summit between Summit East and Summit West. SR 906 is a major rest and fuel stop for semi-trucks and regular vehicles along I-90. As a result of these two major thoroughfares, the primary source of noise in the project vicinity is that associated with traffic along I-90 and SR 906.

Noise impacts in the Study Area are also generated by operations and maintenance at The Summit-at-Snoqualmie. Construction of new facilities (e.g., Summit West rental shop) and/or the renovation of existing facilities is common at the ski area during the summer. During the operating season, construction noise is not typically generated. Operational noise (e.g., traffic, groomers, chairlifts) are the most prevalent noise sources during the ski season. In particular, avalanche control practices at Alpental generate the greatest noise impacts. However, this noise is infrequent and only occurs as avalanche control is deemed necessary (see Section 3.1 - Climate and Snow Conditions). The detonation of explosives to initiate a controlled avalanche and subsequent reverberation exceeds the allowable noise generation level for Class B areas in King County. However, this unique noise generator is a recognized safety precaution and occurs infrequently. No other noise-related issues have been identified at The Summit-at-Snoqualmie.

In October 2003, noise data was collected at six different locations at The Summit-at-Snoqualmie using a Datalogging Sound Level Meter, which has a range of 30 dBA to 130 dBA with a 0.1 dBA resolution. Data was collected at two second intervals over the course of several minutes from each of these locations. These data were taken to evaluate the primary noise generation at Snoqualmie Pass, along I-90

and SR-906. The data is summarized in Table 3.16.1-3 and displays the high and low values for each location.

Table 3.16.1-3:
Noise Levels at The Summit-at-Snoqualmie Locations

Location	Time Interval	Low Value (dBA)	High Value (dBA)
Alpental (Lot 6)	8:30:43-8:32:39	43.1	63.0
Summit West (base area/day lodge)	8:58:03-9:02:21	50.9	73.0
Summit Central (parking area)	9:17:20-9:25:20	54.3	66.1
Summit East/Hyak (base area parking)	9:46:25-9:49:13	53.9	67.9
Summit East (top of *Keechelus* chairlift/front side)	9:58:57-10:07:25	41.5	58.0
Summit East (top of *Keechelus* chairlift /back side)	10:08:21-10:10:29	33.5	47.3