3.3 WATERSHED RESOURCES

3.3.1 Introduction

The White Pass Study Area for the watershed resources analysis is approximately 1,572 acres in size and encompasses the existing White Pass SUP area and the proposed SUP expansion area.[25] The White Pass Study Area encompasses the upper portions of the Upper Tieton River and Upper Clear Fork Cowlitz River watersheds. This section presents the analysis of watershed resources as five distinct topics: Streams, Wetlands, Riparian Reserves, Water Quality, and Flow Regime. Documents that were commonly used for references during this analysis include: *Wetland and Stream Survey for the White Pass Expansion Proposal* (SE Group 2004), *Wenatchee National Forest Land and Resource Management Plan* (USDA 1990b), *Gifford Pinchot National Forest Land and Resource Management Plan* (GPNF Forest Plan) (USDA 1990a), *The Clear Fork Watershed Analysis* (USDA 1998a) and *The Upper Tieton Watershed Assessment* (USDA 1998b).

The primary focus of the analysis of the affected environment and potential impacts to watershed resources from the Action Alternatives is at the site scale (White Pass Study Area). Since impacts at a given point in a watershed may be transmitted downstream, potential effects to watershed resources are also analyzed at the fifth field watershed scale at the end of this section under the heading of Cumulative Effects. Since the streams in the White Pass Study Area drain into two different watershed networks, site scale analysis by watershed is provided for impact types that have the potential to affect resources downstream (e.g., water quality and flow regime).

Clear Creek drains east into the Columbia River Basin via the Tieton River, while Millridge Creek drains west into the Columbia River via the Cowlitz River. Specifically, watersheds occurring within the White Pass Study Area are made up of portions of two 5th field watersheds, and labeled for the purposes of this FEIS as the Upper Clear Fork Cowlitz and the Upper Tieton watersheds (refer to Figure 3-11). A customized 5th field watershed area of the Clear Fork Cowlitz watershed was used in the cumulative effects analysis because part of it is located within Mount Rainier National Park. Therefore, this customized 5th field watershed area was termed the Upper Clear Fork Cowlitz River watershed, and the portion of the watershed within the National Park was eliminated from the analysis area because no projects resulting in cumulative effects would occur within park boundaries. The Upper Clear Fork Cowlitz watershed incorporates Carlton Creek, Summit Creek, the Clear Fork Cowlitz River, and their tributaries, while the Upper Tieton watershed incorporates Rimrock Lake, the North and South Fork Tieton Rivers, Clear Creek, and their tributaries. A watershed analysis was completed in 1998 for the Upper Tieton watershed portion of the Yakima River Basin (USDA 1998b) and the Clear Fork Cowlitz

[25] The current SUP indicates that the permit area is 710 acres. However, GIS analysis indicates that the actual SUP area is approximately 805 acres. As a result of the NEPA process, of which this FEIS is a part, the acreage has been re-calculated based on the best available data.

River Basin including Millridge Creek (USDA 1998a). The Clear Fork Cowlitz watershed is classified as a Tier 2 Key Watershed under the Northwest Forest Plan (USDA and USDI 1994).

Direct impacts include clearing trees and vegetation (over 3 feet high) for ski trails that cross streams and wetlands, the placement of utility lines across streams and wetlands, construction activities within streamside areas that would interrupt riparian functions, and any restoration activities.

Indirect impacts include construction of impervious surfaces, removal of natural vegetation (affecting hydrologic function), removal or maintenance of vegetation in wetlands or Riparian Reserves, construction activities that result in water quality degradation in streams and wetlands, introduction of noxious weeds from construction activities, changes in land cover that alter flow rates and discharge timing, and windthrow impacts.

3.3.2 Affected Environment

3.3.2.1 Streams

The streams in the eastern part of the existing SUP area flow into Clear Creek and the Upper Tieton River watershed. The Upper Tieton River watershed is a 5th field watershed that encompasses 52,190 acres. According to the Northwest Forest Plan (USDA and USDI 1994), the Upper Tieton River watershed is not designated as a Key Watershed. The SUP area contains a cliffband that separates the upper and lower portions of the SUP area. The primary source of hydrology to ephemeral and intermittent stream channels above the cliff band is runoff from snow melt and seasonal storm events. Below the cliff band, groundwater seeps and springs feed perennial stream reaches. Additional information on stream flow can be referenced in the Flow Regime discussion in this section.

The Upper Clear Fork Cowlitz River watershed is fed by streams located in the proposed expansion area and in the western portion of the existing SUP area that drain into Millridge Creek. The Clear Fork Cowlitz River watershed is a 21,712-acre, Tier 2 Key Watershed. As defined in the Northwest Forest Plan, Tier 2 Key Watersheds are those watersheds “where high water quality is important”. Small ephemeral and intermittent stream channels have formed above the cliff band within Pigtail and Hogback Basins that are best characterized as snowmelt channels (USDA 1998a; SE Group 2004). Water from snowmelt and seasonal storm events on the upper slopes collectively drain to a low-gradient bench near 5,400 feet elevation, where it flows down to Millridge Creek in small surface channels. This bench area in Pigtail Basin supports a small meadow with small wetlands (less than 0.5 acre) (refer to Appendix C – Wetland and Stream Survey). Below the cliff band, a series of groundwater seeps and springs feed perennial streams that flow into Millridge Creek.

The White Pass Study Area contains approximately 15.3 miles of natural streams that meet the definition of "Waters of the United States" provided in 33 CFR 328.3 (a)(1)-(8) (refer to Table 3.3-1). Drainage density in the White Pass Study Area is 6.2 miles of stream per square mile of drainage area (mi/mi^2), with a drainage density of 6.6 mi/mi^2 in the Upper Tieton watershed and 6.1 mi/mi^2 in the Upper Clear Fork Cowlitz watershed. The small variation in drainage densities for the Upper Clear Fork Cowlitz and the Upper Tieton watersheds indicates the White Pass Study Area streams are evenly distributed across these areas (refer to Table 3.3-1). Ditches and water bars in the White Pass Study Area that provide surface water drainage along roads and parking lots and on ski trails during runoff-producing storm events have not been mapped as Waters of the U.S., unless they convey flow from regulated streams.

Table 3.3-1:
Summary of Existing Stream Characteristics within the White Pass Study Area

Parameter	Upper Clear Fork Cowlitz	Upper Tieton	White Pass Study Area Total
Watershed Area (acres)	1119.1	450.9	**1570.0**
Watershed Area ($miles^2$)	1.7	0.7	**2.5**
Drainage Density (mi/mi^2)	6.1	6.6	**6.2**
Stream Length (miles) by Rosgen Type:			
A3	0.2	0.0	**0.2**
A3a+	2.8	0.4	**3.2**
A4	2.0	0.2	**2.2**
A4a+	5.0	2.0	**7.0**
A5	0.0	0.5	**0.5**
A5a+	0.0	0.9	**0.9**
Culvert	0.3	0.3	**0.6**
Flume	0.3	0.1	**0.4**
Ford	0.0	0.3	**0.3**
Total Stream Length (miles)	**10.6**	**4.6**	**15.3**
Stream Length (miles) by Flow Regime:			
Ephemeral	6.9	0.0	**6.9**
Intermittent	2.0	3.3	**5.3**
Perennial	1.8	1.3	**3.1**
Total Stream Length (miles)	**10.6**	**4.6**	**15.3**

Note: Totals may vary due to rounding.

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 commonly used on NFSL. Rosgen classification uses a letter designation to indicate the channel type based on gradient, entrenchment, width to depth ratio, and sinuosity. A number designation is used to indicate the dominant substrate type in the channel. Within the White Pass Study Area, Rosgen type Aa+ and A streams are the most prevalent (refer to Figure 3-13 – Streams by Rosgen Types – Existing Conditions).

Type Aa+ streams are characterized as debris transport streams with high gradients, and deeply entrenched channels that usually lack a floodplain. Type Aa+ streams in the White Pass Study Area are typically intermittent and ephemeral, headwater streams located on steep, medium erosion potential slopes. The primary hydrology source to most Aa+ streams in the White Pass Study Area is surface water runoff during snowmelt and storm events. Additionally, Type Aa+ streams originating below the cliff band are fed by groundwater seeps and springs. Due to the steep channel gradient of Type Aa+ streams, channel sinuosity is very low and channel migration is naturally limited. Riffles and cascades are the dominant segment types, with pools and glides occurring very infrequently.

Type A streams have similar channel dimensions and patterns to Type Aa+ streams, but are not as steep and slightly less confined. Type A streams are also located on steep, medium erosion potential slopes, but are usually fed by Type Aa+ streams and can be either intermittent or perennial. The primary hydrologic input to Type A streams in the White Pass Study Area is surface flow from tributary streams.

The number designation indicates the dominant substrate type within the stream channel. Within the White Pass Study Area, the main substrate types are sand (5), gravel (4), and cobble (3). When combined with the letter designation, a complete stream type is formed, for example a Type A4a+ stream, typically found within the Hogback Basin, is a steep, incised channel with a low width to depth ratio and a dominant substrate of gravel.

Rosgen type A and Aa+ streams have a naturally high sediment transport potential and a low sediment storage capacity due to their inherent steepness, high entrenchment ratio and typically unconsolidated channel materials (Rosgen 1996). These channel types are typically associated with high energy flow and naturally function for sediment transport and debris flow. Therefore, a large proportion of the natural and human induced sediment yield to Type A and Aa+ streams is transported downstream. While naturally sensitive to disturbance, human induced management practices adjacent to Type A and Aa+ streams could potentially increase the risk and amount of downstream sedimentation impacts, particularly during peak flow events. Potential impacts of this downstream transport include, but are not limited to decreased water quality from increased turbidity, and increased sedimentation resulting in decreased spawning habitat for fish.

In addition to the Rosgen classification, stream segments modified as a result of human induced management activities have resulted in three artificial channel types; culverted segments, flumes, and fords. The following provides a brief discussion of each type and how they were classified within the White Pass Study Area.

- Culverted: Culverted segments were identified in existing ski trails and road crossings where the stream has been contained within metal or concrete structures or segments covered by timbers or similar material for extended lengths for the purpose of maintaining contiguous, skiable terrain.

- Flume: Flumes were identified in areas where the stream has been contained in an excavated, lined channel, with a cover and fill material placed over the channel to maintain contiguous, skiable terrain.

- Ford: Fords were identified where management activities have resulted in an altered stream channel through grading and subsequent armoring (e.g., riprap). Fords typically occur where unpaved roads cross streams. Fords are generally used when culverts and bridges are not an option because of high debris loading in the stream channel, or because the crossing is too difficult to maintain.

In the existing stream network, approximately 0.6 mile of stream (4 percent) have been placed in extended lengths of metal or concrete culverts, or have been completely overlaid with railroad ties, timbers, or other materials side-by-side in corduroy fashion making up the 0.4 mile of flume (refer to Table 3.3-1). 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.

Road-stream crossings provide opportunities for road-related sediment to be delivered directly to streams. There are 28 existing stream crossings within the White Pass Study Area (refer to Table 3.3-2). Approximately 70 percent of the stream crossings in the White Pass Study Area occur in the Upper Tieton watershed within the existing SUP area.

Table 3.3-2:
Existing Road Network and Stream Crossings within the White Pass Study Area

Parameter	Upper Clear Fork Cowlitz	Upper Tieton	White Pass Study Area
Number of Perennial Stream Crossings:			
Aerial Utilities	0	0	**0**
Culverts	5	1	**6**
Fords	0	0	**0**
Bridges	0	0	**0**
Number of Non-perennial Stream Crossings:			
Aerial Utilities	0	0	**0**
Culverts	2	10	**12**
Fords	2	8	**10**
Bridges	0	0	**0**
Total Stream Crossings	**9**	**19**	**28**
Permanent Road length by Surface:			
Paved (miles)	0.2	0.3	**0.5**
Unpaved (miles)	2.3	3.9	**6.2**
Total Road Length (miles)	**2.6**	**4.2**	**6.6**
White Pass Study Area Road Density (mi/mi^2)	1.5	6.0	**2.7**
5^{th} Field Road Density (mi/mi^2)	0.7	0.6	**N/A**

Note: Totals may vary due to rounding.

As indicated in Table 3.3-2, there are 28 existing stream crossings in the White Pass Study Area, 18 are culverts and 10 are open channel road crossings (fords) (refer to Figure 3.14). However, open channel ski trail crossings do not typically include channel modifications, while fords generally result in grading the channel bed and bank and the placement of rock armoring to prevent channel erosion.

As shown in Table 3.3-2, the road density in the entire White Pass Study Area is 2.7 miles of roads per square mile of land area. According to road density thresholds developed by the USFS, the White Pass Study Area density is considered a moderate road density (USFS 1993). High road densities can cause indirect impacts to streams by increasing sediment yield, increasing the magnitude of peak flows, and intercepting groundwater. While evaluating road densities in the White Pass Study Area is informative, road density is intended to be evaluated at the 5th field watershed scale (USFS 1993). The road density in the Upper Tieton River watershed portion of the White Pass Study Area is 6.0 miles per square mile, which indicates a high potential for impacts to watershed function. The road density in the Upper Clear Fork Cowlitz River watershed portion of the White Pass Study Area is 1.5 miles per square mile, which indicates a low potential for impacts to watershed function.

3.3.2.2 Wetlands

Executive Order 11990, Protection of Wetlands, calls for the identification, assessment, and protection of wetlands by requiring federal agencies to avoid, if possible and practicable, adverse impacts to wetlands and to preserve and enhance the natural and beneficial values of wetlands. Section 401 of the Clean Water Act includes provisions that ensure compliance with the Clean Water Act and state water quality laws with respect to activities that are federally permitted. Jurisdictional wetlands and streams are subject to the regulations of the Clean Water Act, in particular, Section 404, which regulates discharges of fill to wetlands and streams.

A recent court decision, referred to as the SWANCC decision, clarified the definition of “isolated waters” by stating that they are waters that lack a hydrologic connection to other waters that are part of or adjacent to interstate waters, a tributary system, or traditionally navigable waters. The SWANCC decision will affect any federal or state agency, or tribe implementing provisions of the Clean Water Act that apply the definition of “Waters of the U. S.”.

In order to satisfy conditions of Executive Order 11990, wetlands were identified and mapped throughout the entire White Pass Study Area for impact analysis. Wetlands were identified and mapped using the three-parameter approach outlined in the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987). Wetlands within the White Pass Study Area were also classified using the hydrogeomorphic approach to wetland classification (Brinson 1993). The wetlands in this FEIS analysis are grouped according to their hydrogeomorphic class: slope wetland, depressional wetland, or riverine wetland. Additional information regarding the methods used for delineating and classifying the wetlands within the White Pass Study Area can be found in the document entitled the Wetland and Stream Survey for the White Pass Expansion Proposal (refer to Appendix C).

The White Pass Study Area contains 114 wetlands that encompass a total area of 5.3 acres (refer to Figure 3-18). Historic impacts to wetlands in the White Pass Study Area include the creation of lift terminals, ski trails, and roads within the existing SUP area. Wetlands found in Pigtail and Hogback Basins are pristine and exhibit no historic impacts. Table 3.3-3 summarizes the area, hydrogeomorphic class, condition, and watershed location of the wetlands in the White Pass Study Area.

Table 3.3-3:
Summary of Existing Wetland Characteristics in the White Pass Study Area

Details	Parameter	Upper Clear Fork Cowlitz	Upper Tieton River	White Pass Study Area
Wetland Acreage (acres)	Depressional Wetlands	0.6	0	**0.6**
	Riverine Wetlands	1.6	0.2	**1.9**
	Slope Wetlands	0.1	2.7	**2.8**
	Total Wetland Area	**2.3**	**2.9**	**5.3**
Existing Wetland Impacts (acres)		**0**	**2.3**	**2.3**
Number of Wetlands	Number of Depressional Wetlands	4	0	**4**
	Number of Riverine Wetlands	92	1	**93**
	Number of Slope Wetlands	6	11	**17**
	Total Number of Wetlands	**102**	**12**	**114**

Note: Totals may vary due to rounding.

Of the total 114 wetlands within the White Pass Study Area, there exist 17 slope wetlands which total 2.8 acres. Most of the slope wetlands are generally located within the existing SUP (refer to Table 3.3-3 and Figure 3-18). The vegetation in the slope wetlands is typically dominated by herbaceous plant communities with limited shrub and tree dominated components along the margins of the wetlands. The composition of the soils observed in the slope wetlands ranges from mucky organic soils to mineral soils with sandy loam texture classes. Most of the slope wetlands in the White Pass Study Area originate from a series of groundwater seeps that form when Landtype B converges with Landtype C (refer to Section 3.2 – Geology and Soils).

Additionally, 93 riverine wetlands (of the total 114 wetlands) are present in the White Pass Study Area and comprise 1.9 acres (refer to Table 3.3-3). The riverine wetlands in the White Pass Study Area are typically located along ephemeral and intermittent reaches of streams in the expansion area. The primary hydrologic input to the riverine wetlands is surface water that floods out of the stream channel and onto adjacent floodplains during high flow events (e.g., spring melt). Secondary hydrology sources to these wetlands include surface flow from adjacent hillsides and groundwater from seeps in the inner gorge of the stream. Native hydrophytic shrub species dominate the vegetation communities in the riverine wetlands in the White Pass Study Area. The soils within the riverine wetlands range from mucky organic soils to mineral soils with loamy sand texture.

Finally, there are four depressional wetlands within the White Pass Study Area covering a total of 0.6 acre. Two of these depressional wetlands are located in Pigtail Basin approximately 5,400 feet in elevation. The primary hydrologic input into depressional wetlands is groundwater and overland flow. The soils within the depressional wetlands range from mucky organic soils to mineral soils with loamy sand texture, and the vegetation in depressional wetlands is typically dominated with herbaceous plant communities with limited shrub and tree dominated components along the edges.

Wetlands with existing direct impacts are defined as those wetlands that have been modified by activities that displace wetland areas by filling or excavating, modifying the wetland hydrology by ditching or creating impoundments, or modifying plant communities in the wetland through trimming or clearing. There is no data available to document historic impacts to wetlands resulting from grading or filling. Historic impacts to wetlands are estimated in this analysis by calculating the approximate area of wetlands that have modified vegetation communities. The modified vegetation resulted from clearing operations to construct the existing ski trails, thereby impacting wetland vegetation communities. Approximately 2.3 acres of wetlands exhibit historic impacts from clearing within the White Pass Study Area (refer to Table 3.3-3). It is assumed that wetlands within the existing SUP area have been directly impacted from the past construction of ski lifts, ski trails, buildings, and roads. The past impacts to these wetlands would likely have reduced the amount of wetland area and modified wetland hydrology. These wetlands are considered to be functioning below their full potential, due to the historic disturbance. The wetlands within the proposed expansion portion of the White Pass Study Area are all in an undisturbed condition, with no observable direct impacts to soils and topography, wetland hydrology, or native shrub and herbaceous plant communities. Therefore, it is assumed that these undisturbed wetlands are functioning at their full potential.

Development activities in the uplands along the wetland boundary can affect wetland functions. The location of the development activity with relation to the wetland and the type of development activity dictates the degree of impact and what wetland functions would be affected. Primary indirect impacts to wetlands typically occur from changes in hydrology and sediment sources. The wetlands in the proposed expansion portion of the White Pass Study Area have upslope conditions that are undisturbed, and therefore do not have existing indirect impacts. The upslope source areas of most of the wetlands in the existing SUP portion of the White Pass Study Area are either roads or ski trails, which increases the potential for increased sediment inputs and modified wetland hydrology. Existing roads and other artificial forest openings (e.g., ski trails) in the existing SUP portion of the White Pass Study Area also increase the potential for establishment of noxious weeds in wetlands within this portion of the White Pass Study Area (refer to Section 3.5 – Vegetation).

3.3.2.3 Riparian Zones

Riparian zones are the transitional lands between aquatic ecosystems (e.g., streams, lakes, and wetlands) and terrestrial ecosystem. Riparian zones are typically characterized as having a sharp gradient of environmental conditions, functional processes, and plant communities. Protection of riparian zones through sound regulatory and land management practices is important because these ecosystems serve many important ecosystem functions and are laterally connected to adjacent uplands as well as upstream and downstream aquatic ecosystems. On NFSL within the range of the Northern spotted owl, the Aquatic Conservation Strategy (ACS) from the *Northwest Forest Plan* specifies variable-width land allocations along various classes of streams, lakes, and wetlands that are called Riparian Reserves (USDA and USDI 1994). Riparian Reserves are land allocation designations intended to provide protection to aquatic resources and may not reflect the extent of the actual riparian zone for a particular site. The width designations for Riparian Reserves are designed to always include the extent of the riparian vegetation at a minimum, and usually encompass an area much larger than the actual riparian zone.

Similar protection areas, called riparian influence areas (RIAs), are designated in the GPNF Forest Plan, and the classification system and width designations are different than those provided for Riparian Reserves in the Aquatic Conservation Strategy. RIA widths are based on the classification of the associated stream or wetland and the extent of the RIA, and are typically less than the width of the Riparian Reserves (USDA 1990a; USDA and USDI 1994). Refer to Table 3.3 FEIS1 for a comparison of the default widths for Riparian Reserves and RIAs. Both Riparian Reserves and RIAs are analyzed in this section even though Riparian Reserves are larger and provide more protection to aquatic resources. The RIAs are sized more closely with the actual riparian zones observed in the field and the GPNF Forest Plan has very specific standards and guidelines that provide additional protection in certain circumstances (USDA 1990a; USDA and USDI 1994).

Table 3.3 FEIS1:
Comparison of Default Widths for Riparian Reserve and Riparian Influence Areas

Waterbody	Riparian Reserve Width (feet)	Riparian Influence Area Width (feet)
Streams		
Perennial, Fish-bearing	300	100[a]
Perennial, Non fish-bearing	150	100[a]
Intermittent/Seasonal	100	25
Wetlands less than 1 acre	150	300[b]
Wetlands greater than 1 acre	300	300[b]
Lakes/Ponds	300	300

[a] The GPNF Forest Plan does not differentiate widths based on fish presence. All perennial streams are assigned the same RIA width.
[b] The GPNF Forest Plan does not differentiate widths based on wetland acreage. All wetlands are assigned the same RIA width.

For the purposes of this FEIS, the RIA for wetlands was not evaluated because the required 300-foot buffer on the 114 mapped wetlands within the White Pass Study Area does not provide a riparian associated measure from which to gain information concerning impacts to the actual riparian zone. That is, including the 300-foot buffer analysis for wetland RIAs would duplicate the analysis performed for Riparian Reserves. Therefore, for the RIA of streams in Pigtail and Hogback basins, a width of 25 feet was chosen to more clearly resemble the actual riparian zone and provide a reasonable measure for evaluating impacts from the Action Alternatives. As a result, this analysis evaluates impacts to the 25-foot RIA along streams in order to measure the effect of the Forest Plan amendment on riparian zones. The analysis of Riparian Reserves includes impacts to both streams and wetlands.

This section discusses the current conditions and potential impacts to the existing 632.3 acres of Riparian Reserves and 147.4 acres of RIAs located within the limits of the Riparian Reserves (refer to Figures 3-22 and 3-27). The riparian functions analyzed in this section include stream shading, LWD recruitment, sediment filtration, and stream bank stability. Table 3.3-4 identifies the classes and protective widths of Riparian Reserves and RIAs found within the White Pass Study Area. Figures 3-22 and 3-27 show the distribution of Riparian Reserves and RIAs within the White Pass Study Area.

Riparian Reserves

As stated above, the ACS was developed to improve and maintain the ecological health of watersheds and aquatic ecosystems on public lands (USDA and USDI 1994). One of the four primary components of the ACS, Riparian Reserves, are applied to maintain and restore the productivity and resiliency of riparian and aquatic ecosystems. Riparian Reserves are lands along streams, wetlands, and lakes, and unstable and potentially unstable areas where special Standards and Guidelines direct land use. The widths of the Riparian Reserves for the streams, wetlands, and lakes within the White Pass Study Area were determined by consulting the Northwest Forest Plan (USDA and USDI 1994), the GPNF Forest Plan – Amendment 11 (USDA 1998a), the Clear Fork Watershed Assessment (USDA 1998a), and the Upper Tieton Watershed Assessment (USDA 1998b). The Riparian Reserve widths assigned to the streams, wetlands, and lakes in the White Pass Study Area are presented in Table 3.3-4.

Most of the Riparian Reserve widths are based on the values provided in the Northwest Forest Plan because the site potential tree height for the Pacific silver fir/Cascade azalea-big huckleberry plant association is the same as the buffer width in the Upper Tieton Watershed Analysis (USDA 1998b; USDA and USDI 1994). The Riparian Reserve widths are also used in the Upper Clear Fork Cowlitz River watershed side of the White Pass Study Area because the Clear Fork Watershed Assessment does not identify any site-specific or general changes to the widths contained in the Northwest Forest Plan (USDA 1998a; USDA and USDI 1994). The one exception to the Riparian Reserve standards presented in the Northwest Forest Plan is the 300-foot Riparian Reserve width specified for wetlands less than 1 acre in size in the GPNF Forest Plan – Amendment 11 (USDA 1998a). The 300-foot Riparian Reserve width was applied to all wetlands less than 1 acre in the White Pass Study Area regardless of what

National Forest the wetland was located on in order to provide a conservative analysis of Riparian Reserve impacts (refer to Figure 3-18).

Due to the conservative nature of the Riparian Reserve designations, most of the land area within the Riparian Reserves in the White Pass Study Area does not contain riparian vegetation because the extent of the riparian zone is very limited in steep, alpine stream and wetland systems. The actual riparian zone associated with the streams and wetlands in the White Pass Study Area is typically 5 to 20 feet wide, which is about the same width as the RIA for intermittent streams (refer to next section). Due to the differences in functional riparian zones and designated riparian zones, this analysis utilizes Riparian Reserve boundaries for analysis of upland functions, and the RIA boundaries for analysis of riparian functions. The upland forest communities located within Riparian Reserves are analyzed in order to characterize the following functions: LWD recruitment potential, stream and wetland shading potential, and overall land cover patterns. The RIAs are used to analyze particular riparian functions that occur only at that scale. These riparian functions include sediment filtration, stream bank stability, floodwater storage, LWD input to streams, stream channel shade, and stabilizing stream banks via root structure.

Table 3.3-4:
Riparian Reserve Width Rationale for Streams, Wetlands, and Lakes in the White Pass Study Area

Classification Rationale	Reserve Width	Riparian Reserve Width Rationale
Permanently flowing fish bearing streams	300 feet	The default 300-foot slope distance is greater than the distance equal to the two times the height of one site-potential tree (100 feet), the outer edges of 100-year floodplain, the top of the inner gorge, and the outer edges of riparian vegetation.
Permanently flowing, non-fish bearing streams	150 feet	The default 150-foot slope distance is greater than the distance equal to the height of one site-potential tree (100 feet), the outer edges of 100-year floodplain, the top of the inner gorge, and the outer edges of riparian vegetation.
Seasonally flowing or intermittent streams	100 feet	The distance equal to the height of one site-potential tree (100 feet) is equal to the default 100-foot slope distance, and larger than the extent of unstable and potentially unstable areas, the outer edge of riparian vegetation, and the top of the inner gorge.
Wetland greater than 1 acre	150 feet	The wetland boundary is defined, in part, as the outer edge of riparian vegetation and saturated soil, so the Riparian Reserve includes the wetland plus the default 150-foot slope distance which is greater than the one site potential tree height (100 feet).
Wetland less than 1 acre	300 feet	The GPNF Forest Plan - Amendment 11 states that the Riparian Reserve boundary for wetlands less than 1 acre is 300 feet, which is greater than the extent of the riparian vegetation, saturated soil, and one site potential tree height (100 feet).
Natural Lakes and Ponds	300 feet	The default 300-foot slope distance is greater than the distance equal to the height of one site-potential tree (100 feet), the outer edges of riparian vegetation, and the extent of saturated soil.

Source: USDA 1998a, 1998b; USDA and USDI 1994

The vegetative conditions of Riparian Reserves within the White Pass Study Area include all natural forest and natural non-forest vegetation types as well as historically altered non-forest vegetation types, such as modified shrub and herbaceous communities. The total area of Riparian Reserves within the White Pass Study Area is 632.3 acres (refer to Figure 3-22). A total of 395.3 acres of Riparian Reserves are present in the Upper Clear Fork Cowlitz River watershed and 237.0 acres of Riparian Reserves have been mapped in the Upper Tieton River watershed. Refer to Table 3.3-5 for a summary the existing Riparian Reserve characteristics within the White Pass Study Area.

The largest existing impact to Riparian Reserves in the White Pass Study Area, on the basis of intensity, is the complete removal of riparian function through the creation of impervious surfaces (roads, buildings, and parking lots) and also by the installation of stream culverts. Approximately 10.4 acres of impervious surfaces (developed cover) have been constructed within Riparian Reserves in the White Pass Study Area, which represents approximately 1.6 percent of the total Riparian Reserve area (refer to Table 3.3-5 and Figure 3-22). Approximately 75 percent of the existing developed cover in the White Pass Study Area is located in the Upper Tieton River watershed. These developed areas are located primarily within the upland forest portion of the Riparian Reserves. Most existing direct impacts to Riparian Reserves occur at the 28 road crossings of streams by culverts and fords within the White Pass Study Area (refer to Figure 3-14). Approximately 0.6 mile (3,010 feet) of streams in the White Pass Study Area do not have functioning Riparian Reserves because they have been placed in culverts for road crossings and diversion under parking lots, which completely eliminates most riparian functions (refer to Table 3.3-1). The length of streams that have been placed in culverts is evenly balanced between the two watersheds in the White Pass Study Area.

Table 3.3-5:
Summary of Existing Riparian Reserve Characteristics in the White Pass Study Area

Parameter	Upper Clear Fork Cowlitz	Upper Tieton	White Pass Study Area
Area of Riparian Reserves (acres)	395.3	237.0	**632.3**
Landcover Types within Riparian Reserves (acres):			
Forested	365.3	157.4	**522.7**
Talus	2.2	2.6	**4.8**
Modified Herbaceous	25.1	42.4	**67.6**
Developed	2.7	7.8	**10.4**
Lakes and Ponds	0	26.8	**26.8**
Total Area	**395.3**	**237**	**632.3**
Shade Potential and LWD Recruitment:			
Average Forest Canopy Cover	46.5%	49.5%	48.0%
High Canopy Cover Range	69.8%	74.3%	72.1%
Low Canopy Cover Range	23.2%	24.7%	24.0%

Note: Totals may vary due to rounding.

The largest historic direct impact to Riparian Reserves in the White Pass Study Area is from the removal of forest vegetation for the construction and maintenance of existing lifts and ski trails, which involved the removal of approximately 67.6 acres of forest (refer to Table 3.3-5). These existing ski trails are represented by the modified herbaceous landcover type and represent approximately 10.7 percent of the total Riparian Reserves in the White Pass Study Area. Forest clearing in these Riparian Reserves has reduced the level of riparian function for wildlife habitat, filtering sediment, floodwater storage, LWD input to streams, stream channel shade, and stabilizing stream banks via root structure. However, none of these functions have been completely eliminated in the White Pass Study Area because native herbaceous and shrub cover is maintained on ski trails to reduce erosion and improve bank stabilization. In addition, tree islands are preserved around streams in many areas to retain basic riparian functions even when the outer limits of the Riparian Reserve have been cleared (refer to Figure 3-22).

While it is well documented in scientific literature that LWD plays a key role in multiple stream ecosystem functions, LWD is not a dominant component of stream channel structure or function in most alpine systems (Naiman and Bilby 1998). This finding is supported by the low LWD densities observed in the streams within the White Pass Study Area. The low LWD densities are likely due to the location of most streams in meadows and in avalanche paths, where there are very few large trees present in the Riparian Reserve to provide LWD recruitment to the stream channels. This pattern is particularly evident in the ephemeral stream channels located in the proposed SUP expansion area. Even though Rosgen Type Aa+ and Type A streams are characterized as debris transport systems, most of the Type Aa+ and Type A streams in the White Pass Study Area have ephemeral flow regimes and generally do not have sufficient channel dimensions or discharge to transport LWD to down gradient stream reaches. However, many of these intermittent and ephemeral streams may transport sediment, gravels and cobbles, and Coarse Woody Debris downstream during small (one to five-year return interval) peak flow events in response to intense rain events or rain on snow events. Large peak flow events (50 to 100-year return interval) in these ephemeral streams in the White Pass Study Area may transport LWD as part of a large debris flow that could be initiated during large peak flow event. Although LWD is present in some of the ephemeral stream channels, it does not play a significant role in stream morphology and function. LWD does play a larger role in stream morphology in the intermittent and perennial streams in the White Pass Study Area, but only under extreme circumstances would these streams contribute LWD to larger, fish bearing streams lower in the watersheds.

Stream channel shading by riparian vegetation is an important moderator of water temperature in 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. The streams in the White Pass Study Area have very high channel gradients; thus, stream temperatures are likely to decrease with increasing distance downstream from areas that lack shade because of evaporative cooling in turbulent cascades, riffles, and falls. Stream temperatures and riparian shade were not directly measured by field instrumentation in the White Pass Study Area. Instead, riparian shade was estimated analyzing existing tree canopy cover within Riparian

Reserves using GIS analysis. Canopy cover analysis indicates that the average canopy cover in Riparian Reserves within the Upper Clear Fork Cowlitz watershed is 46.5 percent (refer to Table 3.3-5). As illustrated in Figure 3-22, the canopy cover in the Upper Clear Fork Cowlitz watershed varies substantially, with a range from 23.2 percent to 69.8 percent based on one standard deviation from the average. The canopy cover is generally more open in Hogback Basin and cover is denser along the perennial streams below the cliff band in the existing ski area. The canopy cover in the Riparian Reserves within the Upper Tieton River watershed is also highly variable, but instead of naturally low canopy cover like in Hogback Basin, the low canopy cover is attributed to the exiting ski trail clearing (refer to Figure 3-22). The average canopy cover in the Upper Tieton watershed is 49.5 percent with a range from 24.7 percent to 74.3 percent (refer to Table 3.3-5).

The existing direct effects to Riparian Reserves from developed cover and ski trails mentioned above also have indirect effects on adjacent Riparian Reserves and stream channels. The removal of forest cover in Riparian Reserves may have increased the frequency and magnitude of debris flows and reduced the ability of the riparian vegetation to attenuate debris flow impacts once they occur. Historic forest clearing for chairlifts and ski trails in and adjacent to Riparian Reserves may have also increased the potential for windthrow (tree blowdown), especially when there is a hard forest edge without any forest thinning or feathering in the transition zone. The ski trails and roads within and adjacent to Riparian Reserves also increase potential for noxious weed transport and establishment into these areas. The increase in noxious weed potential is greatest at the 28 road crossings of streams where vehicular traffic has the greatest potential for spreading noxious weeds.

Riparian Influence Areas

The GPNF Forest Plan designates five different types of Riparian Areas based on the physical characteristics of the streams and wetlands to be classified. Riparian Area A includes all perennial streams, and they are assigned an influence area of 100 feet wide on either side of the stream to which specific management standards and guidelines are applied. All intermittent and ephemeral streams are classified as Riparian Area B, and they are assigned an influence area of 25 feet wide on either side of the stream. There are no streams in the White Pass Study Area that meet the criteria for Riparian Area C, which includes floodplains and side channels. Riparian Area D includes lakes, ponds, and wetlands on slopes less than 20 percent, and are assigned an influence area of 300 feet. As described earlier, the RIA for Riparian Area D is not used for analysis purposes in this EIS so that a more detailed analysis of the effects to the actual riparian zone could be conducted, and to evaluate the effects of the Forest Plan amendment on the actual riparian zone. Riparian Area E includes wetlands on slopes greater than 20 percent and may have a RIA that is 300 feet wide. There are no wetlands on slopes greater than 20 percent within the White Pass Study Area. The various Riparian Area types will be collectively referred to as RIAs for the remainder of this analysis for simplicity. Figure 3-27 displays the appropriate RIA for all of the streams in the White Pass Study Area.

The primary functions of the RIAs include stabilizing stream banks via root structure, filtering sediment, and floodwater storage. Even though the RIAs also contribute LWD input to streams and provide stream channel shade, these riparian functions are best analyzed at the larger Riparian Reserve scale, which includes at least one site potential tree height. The extent of the riparian vegetation along intermittent and perennial stream reaches in the White Pass Study Area is typically between 5 to 20 feet on each side of the stream channel, which includes the adjacent floodplain (if any), and in some cases, the adjacent wetland. The RIA is the appropriate scale for analyzing the potential impacts to riparian vegetation and stream functions because they encompass the ecosystem components that are the most significant drivers in these systems. A summary of the existing condition of the RIAs within the White Pass Study Area is presented in Table 3.3-6.

The distribution of various soil types in the RIA is an important indicator of the potential for soil erosion and subsequent sediment yield to adjacent waterbodies from proposed clearing and grading activities. As indicated in Table 3.3-6, most (approximately 63 percent) of the soil located in RIAs within the White Pass Study Area is considered to be medium erosion hazard. Approximately 38.7 acres (26.5 percent) of the RIAs in the White Pass Study Area contain low erosion hazard soil and the remaining 15.3 (approximately 10.5 percent) of the RIAs contain high erosion hazard soil. Based on the distribution of the erosion hazard classes in the White Pass Study Area, most of the existing and proposed development in RIAs within the White Pass Study Area would occur on low and medium erosion hazard soil. The sediment yield to waterbodies from existing development is generally low based on the small amount of high erosion hazard soil in RIAs, the high amount of forested Riparian Reserves, and field observations of limited soil erosion and sediment yield.

Table 3.3-6:
Summary of Existing Riparian Influence Area Characteristics in the White Pass Study Area

Parameter	Upper Clear Fork Cowlitz River Watershed	Upper Tieton River Watershed	Total White Pass Study Area (acres)
Riparian Influence Area (acres)	94.5	52.9	**147.4**
Stream Bank Stability (miles):			
Streams with potentially stable banks	10.0	3.8	**13.7**
Streams with potentially unstable banks	0.7	0.9	**1.5**
Total Stream Length (miles)	**10.6**	**4.6**	**15.3**
Soil Erosion Hazard within RIAs (acres):			
High Erosion Potential Soils	14.8	0.5	**15.3**
Medium Erosion Potential Soils	76.7	15.4	**92.1**
Low Erosion Potential Soils	2.2	36.5	**38.7**
Total Area (acres)	**93.7**	**52.4**	**146.1**

Note: Totals may vary due to rounding.

Construction activities near streams can cause direct impacts to RIAs and indirect impacts to stream channels and water quality through increased mass wasting and erosion, decreased sediment filtration, and decreased stream bank stability. An analysis of the length of streams with potentially unstable banks was performed in order to quantify these direct and indirect impacts to RIAs and streams. Stream lengths with potentially unstable banks include stream banks that do not have forest or shrub cover. Streams with potentially unstable banks can be the result of human management activities, or they can be naturally unstable. Human management activities that create potentially unstable stream banks include tree removal, grading activities, road crossings, and construction of impervious surfaces. Stream segments with naturally unstable banks include stream banks with naturally nonvegetated or sparsely vegetated herbaceous cover. All stream banks covered with natural forest and shrub communities are considered to be potentially stable and do not have specific management concerns in this analysis.

As summarized in Table 3.3-6, the length of streams with potentially stable banks in the White Pass Study Area is 13.7 miles. Streams with potentially stable banks comprise approximately 90 percent of the streams in the White Pass Study Area, with most of the potentially stable stream banks (10.0 miles) occurring in the Upper Clear Fork Cowlitz River watershed (refer to Table 3.3-6). These reaches typically occur within forested areas of the existing and proposed SUP areas (refer to Figure 3-27). Approximately 1.5 miles of streams, or 10 percent of streams in the White Pass Study Area have potentially unstable stream banks. These stream reaches are typically located within existing ski trails on ephemeral and intermittent streams. Several potentially unstable banks occur on perennial streams within existing ski trails near the base of the existing ski area (refer to Figure 3-27).

3.3.2.4 Water Quality

Surface Water Quality Standards

<u>Current Legislative Framework</u>

In July, 2003, revisions to State of Washington surface water quality standards (SWQS) were adopted by the WDOE (WAC 1997). The revised SWQS require review by the EPA 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 (WDOE 2003). On August 6 and December 1, 2004, the WDOE received two letters from the EPA requesting additional review and clarification of the SWQS provisions. Two additional letters from the EPA were received by the WDOE on January 12 and February 14, 2005, which approved portions of the SWQS revision submittal (WDOE website 2006). WDOE is required to respond to the EPA's disapproval of specific SWQS by December 18, 2006, by submitting revised changes to the SWQS. A final decision from the EPA is expected during the summer of 2007 (Hicks, pers. comm.). As required by the regulations and guidance at the time of publication, this FEIS follows the EPA-approved revisions to the SWQS, but uses the 1997 standards for sections still under review by the EPA. The most current SWQS would be utilized following the final decision from the EPA and relevant agencies. A summary of current SWQS in use can be found on the WDOE website (www.ecy.wa.gov).

1997 Surface Water Quality Standards

Under the existing 1997 SWQS, specific surface waters (rivers and lakes) of the State of Washington are classified according to the class-based criteria system outlined under WAC 173-201A-130 and 140. The criteria classes include: Class AA (extraordinary), Class A (excellent), Class B (good), Class C (fair), and Lake Class. For each criteria class, a set of characteristic uses and water quality criteria are listed in WAC 173-201A-030.

2003 Surface Water Quality Standards

Under the revised SWQS currently under review by the EPA (WAC 173-201A), the WDOE has established the following designated uses for specific fresh water rivers and lakes in the state: Aquatic Life uses, Recreational uses, Water Supply uses, and Miscellaneous uses. These designated uses are further broken down into specific categories. Aquatic Life uses include Char, Core Salmon/Trout, Non-Core Salmon/Trout, Salmon/Trout Rearing, Redband Trout, and Warm Water Species. Recreational uses include Extraordinary Primary Contact, Primary Contact, and Secondary Contact. Water Supply uses include Domestic, Industrial, Agricultural and Stock Water. Finally, Miscellaneous uses include Wildlife Habitat, Harvesting, Commerce/Navigation, Boating and Aesthetics. For each designated use, a set of general and water quality criteria are listed in WAC 173-201A-200 of the 2003 SWQS. Until such a time that EPA approves all the revised use designation tables, WDOE will continue to use the 1997 class-based standards for specific freshwater and marine waterbodies of the state, as detailed in the 1997 version of WAC 173-201A-120 and 130 (WDOE 2006).

Table 3.3 FEIS2 provides a summary of water quality standards currently in effect for surface waters in the White Pass Study Area (for more information, refer to WDOE 2006 and www.ecy.wa.gov/programs/wq/swqs/rev_rule.html).

Table 3.3 FEIS2:
Water Quality Criteria for Various Classes of Freshwater Surface Waters within the White Pass Study Area

Existing 1997 Surface Water Quality Standards (WAC 173-201A)		
Criteria Class	**Class AA (extraordinary)**	**Lake Class**
Fecal Coliform Organisms	Geometric mean: ≤50 colonies/100 mL AND ≤10%of all samples obtained for calculating the Geometric mean value exceeding 100 colonies/100 mL	Geometric mean: ≤50 colonies/100 mL AND ≤10%of all samples obtained for calculating the Geometric mean value exceeding 100 colonies/100 mL
Dissolved Oxygen	≥9.5 mg/L	No measurable decrease from natural conditions
Total Dissolved Gas	≤110% of saturation at any point of collection	≤110% of saturation at any point of collection
Temperature	Natural conditions ≤16.0°C: Temperature to be ≤16.0°C due to human activities; When natural conditions ≥16.0°C: Receiving water temperature rise ≤0.3°C; Incremental temp increases: Point source activities:≤ t=23/(T+5)[a]; Non-point source activities ≤ 2.8°C.	No measurable change from natural conditions
pH	6.5-8.5 (human caused variation < 0.2)	No measurable change from natural conditions
Turbidity	Background ≤50 NTU: ≤5 NTU over background; Background >50 NTU: ≤10% increase	≤5 NTU over background conditions
Revised, EPA-Approved 2003 Surface Water Quality Standards		
All Use Designations, Classes, and Waters of the State		
Aesthetic Values	Shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch or taste.	
Lakes		
Establishing Lake Nutrient Criteria	For lakes within the Cascades Ecoregion, if ambient total phosphorus (μg/L) range of lake is 0-4, the lake is ultra-oligotrophic, and the criteria should be set at 4 or less. If ambient total phosphorus (μg/L) range of lake is 4-10, the lakes is oligotrophic, and the criteria should be set at 10 or less.	

[a] "t" represents the maximum permissible temperature increase measured at a mixing zone boundary; and "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge.

When surface water features do not meet established standards, they are identified as impaired under Section 303(d) of the Clean Water Act. The WDOE 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, WDOE develops a pollutant management plan where total maximum daily loads are established to rectify and maintain water quality within standards for those exceeded parameters.

White Pass Watersheds

Under the 1997 SWQS, both the Tieton River and the Upper Cowlitz River, which includes the Clear Fork Cowlitz River, are designated as Class AA (extraordinary) (WAC 1997). All lakes within the Upper Tieton River and Upper Clear Fork Cowlitz River watersheds of the White Pass Study Area not designated Class AA, are Lake Class (such as Leech Lake).

Table 3.3-7 details the current classification of watersheds within the White Pass Study Area, as well as potential use designations under the proposed 2003 SWQS revisions (currently under review by EPA). Criteria class (Class AA, Lake Class, etc.), or the proposed use designations (Aquatic Life, Recreational, Water Supply, and Miscellaneous uses), indicate how stringent the water quality requirements of the relevant waterbody will be.

Table 3.3-7:
Surface Water Quality Standards Applicable within the White Pass Study Area

Water-shed	1997	2003			
	Criteria Class Under 1997 SWQS (Current)[a]	**Aquatic Life Uses Under Proposed 2003 SWQS (Proposed)[b]**	**Recreational Uses Under Proposed 2003 SWQS (Proposed)[b]**	**Water Supply Uses Under Proposed 2003 SWQS (Proposed)[b]**	**Miscellaneous Uses Under Proposed 2003 SWQS (Proposed)[b]**
Upper Clear Fork Cowlitz River	Class AA (Extraordinary)	Core Salmon Spawning and Rearing	Extraordinary primary contact recreation	Domestic, Industrial, Agricultural, and Stock Water	Wildlife Habitat, Harvesting, Commerce/ Navigation, Boating, and Aesthetics
Upper Tieton River	Class AA (Extraordinary)	Char and Core[c]	Extraordinary primary contact recreation	Domestic, Industrial, Agricultural, and Stock Water	Wildlife Habitat, Harvesting, Commerce/ Navigation, Boating, and Aesthetics

[a] Specific classification for named surface waters are listed in WAC-173-201A-130 (WAC 1997). The WDOE continues to apply the 1997 criteria classifications to surface waters, as the EPA has not yet approved the proposed use designations outlined in the revised 2003 SWQS (WDOE 2006).

[b] Use designations (Aquatic Life, Recreational, Water Supply and Miscellaneous uses) are classifications outlined under WAC-176-201A-600 (WAC 2003). The EPA has not yet approved these proposed revisions to the SWQS, and are not in use by the WDOE at this time. Upon approval by the EPA, possibly in summer 2007, these use designations and applicable water quality criteria would come into effect (Hicks, pers. comm.).

[c] The majority of the Upper Tieton River Watershed was designated Char by the WDOE (WAC 173-201A) and approved by the EPA. Fish and Spencer Creeks in the western end of the watershed, south of Rimrock Lake, have been designated Core by the WDOE. However, the EPA has disapproved this decision, and designated the two creeks Char. Cold Creek, Bear Creek, and some creeks that flow into Rimrock Lake from the north have been designated Core by the WDOE, and have been approved such by the EPA. Please refer to the EPA Website (2006) for additional information.

Refer to discussion above, and www.ecy.wa.gov/programs/wq/swqs/rev_rule.html for additional information regarding the current and proposed SWQS.

Water Quality Data

Water Quality Parameters

A limited amount of water quality data has been documented within the Upper Clear Fork Cowlitz and Upper Tieton watersheds (USDA 1998a, 1998b). Best available data has been collected from an online database maintained by the WDOE Environmental Information Management (EIM) office. According to EIM data, there is one monitoring station located on Clear Creek in the Upper Tieton watershed and none within the Upper Clear Fork Cowlitz watershed (refer to Figure 3-11 – Upper 5th Field Watersheds for location of Clear Creek).

Water quality within the White Pass Study Area is considered to be good for Aquatic Life uses in both watersheds, and waters draining Hogback Basin meet State of Washington Class AA (exceptional) standards (USDA 1998a). Primary parameters typically evaluated for Aquatic Life uses include temperature, dissolved oxygen (DO), turbidity, and pH. A brief description of each parameter is given below in relation to the current 1997 SWQS (summarized in Table 3.3 FEIS2), and the proposed Aquatic Use standard from the revised 2003 SWQS. Due to the limited amount of water quality data collected within the Upper Tieton and the Upper Clear Fork Cowlitz watersheds, existing conditions for each parameter are identified, where data is available. Previous concerns over sewage problems led White Pass to construct a recirculating gravel filter for the resort wastewater treatment system in the 1990s (refer to Section 3.13 – Utilities and Infrastructure). According to the watershed assessments, no 303(d) listed water bodies occur within the Upper Tieton River or Upper Clear Fork Cowlitz River watersheds (USDA 1998a, 1998b).

Temperature

Stream temperature is an important water quality parameter for fish and other aquatic species that can potentially be affected by ski area management practices. Changes in water temperatures resulting from management activities such as removal of shade-providing vegetation can cause stream temperatures to exceed maximum temperature standards. Increased solar radiation has the potential to warm water as forest canopy vegetation is removed. While shading does not directly cool water temperatures, it reduces the amount of solar radiation reaching the water allowing for other processes, such as groundwater influx, to physically cool the water. Under the current 1997 SWQS, water temperature may not exceed 16.0°C in Class AA surface waters. Under the proposed 2003 SWQS, the maximum temperature standards are 53.6°F for Char and 60.8°F for Core Salmon and Trout, represented as a seven-day average maximum. Within Clear Creek, the seven-day average maximum temperature is 11.2°C, or 52.2°F (USFS 1997b), and is below the standard for Class AA waters, as well as proposed standards for Char, Core Salmon and Trout. Within the Upper Clear Fork Cowlitz River watershed, in Millridge Creek (feeds Knuppenburg

Lake), stream temperatures ranged from 8 to 9°C (44.8-48.2°F), which meets the standard for Class AA waters, and proposed rules for Core Salmon and Trout (USFS 1983).

Dissolved Oxygen

Increases in stream temperature reduce the ability of the water column to accommodate DO. The amount of DO that can be held by water can also be affected by other parameters such as salinity and pressure. Class AA water quality standards require DO to exceed 9.5 mg/L. The proposed Char, Core Salmon and Trout rearing Aquatic Life uses have the same one-day minimum criterion of 9.5 mg/L. DO concentrations in Clear Creek have been measured at 9.8 and 10.3 mg/L in 1994, meeting both the Class AA and proposed Aquatic Life standards (WDOE EIM 1994). No data on DO concentrations within the Upper Clear Fork Cowlitz watershed have been recorded (USDA 1998b).

Turbidity

Turbidity is a measure of refracted light passing through a water column, and typically is indicative of the amount of sediment and other particles (i.e., total suspended solids and total dissolved solids) entrained in the streamflow. Turbidity can be caused by finely divided organic matter, colored organic compounds, plankton and microorganisms. Both the current Class AA standards, as well as the proposed Aquatic Life uses for Char and Core Salmon and Trout rearing, 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. A monitoring station (Station ID WA805S) located on Clear Creek indicates that total suspended solids averaged 1 mg/L over a two week study in 1994 (WDOE EIM website 2004). No turbidity or suspended solids data is known to exist for Millridge Creek or the Upper Clear Fork Cowlitz River.

pH

The pH of water 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, or it can precipitate these elements and other minerals and form sediments. Both the Class AA standards, as well as the proposed Char and Core Salmon and Trout rearing 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 units. Previous pH measurements in Leech Lake indicated a pH ranging from 6.5 to 7.5 (USDA 1990b; WDOE 1991), meeting both the Class AA and Aquatic Life standards. 1994 pH measurements in Clear Creek indicated a pH ranging from 6.33 to 6.99 (WDOE EIM 1994), the low end of the range being below the desired pH range for Class AA and Aquatic Life. No data on pH was available for Millridge Creek or the Upper Clear Fork Cowlitz River (USDA 1998a, 1998b).

Nutrients

Forest removal can potentially result in increases in nutrient loading (nitrogen and phosphorus) from natural decomposition of green slash and slash burning. The potential increase in nutrient loading could potentially impact streams within the White Pass Study Area. Research has shown that clearcutting may result in a fourfold increase in nitrate-nitrogen when the slash is broadcast burned, and a sixfold increase when the slash was left to decompose naturally (Harr and Fredriksen 1988). Maximum nutrient loading values followed the same pattern, with a high of 0.08 mg/L when the slash was broadcast burned and 0.27 mg/L when the slash was left to decompose naturally (Harr and Fredriksen 1988). A noticeable delay between forest removal and the observed peaks in nitrate-nitrogen levels occurs for both burning (approximately 12 to 15 months) and natural decomposition (approximately 28 months). A more recent study has documented that the total loss of nitrogen following forest removal is less than the annual inputs through precipitation (Martin and Harr 1989). Likewise, other studies have observed only a 5 percent increase in total nitrogen levels after slash burning (Antos et al. 2003). Additional research indicates that revegetation of clearcuts reduces the potential for nitrate-nitrogen to reach streams. Planted vegetation and the associated increase in nitrate-nitrogen uptake resulted in decreased soil concentrations of nitrate-nitrogen within two years of post-burn activities (Antos et al. 2003). This indicates that an initial pulse of nitrate-nitrogen that occurs soon after forest removal can be considered a short-term impact.

Lake Water Quality

Leech Lake is the largest waterbody within the White Pass Study Area, and water quality within this lake has been designated Lake Class by the WDOE (Anderson, pers. comm.). Leech Lake is located on the north side of US 12, with depths ranging from 2 to 15 feet, 6 feet being the most common depth measured (USDA 1990c). The WDOE conducted nutrient analyses on Leech Lake between June 8, 1990 and August 30, 1993. Total phosphorus measurements ranged from 0.00006 to 0.022 mg/L (refer to Table 3.3-8), total nitrogen measurements ranged from 0.06 to 3.9 mg/L, and chlorophyll-*a* ranged from 0.6 to 1.3 µg/L (WDOE 1996). A 2006 water quality study of Leech Lake reported total phosphorus levels of 0.33 mg/L, and nitrogen levels of 0.07 mg/L (Cascade Analytical 2006). WAC 173-201A-230 (WAC 2003) describes WDOE's lake nutrient criteria, approved by the EPA in 2006, and shows that ambient total phosphorus levels of 0.004-0.010 mg/L indicate oligotrophy.

A WDOE study conducted in 1991 concluded that Leech Lake is estimated as mesotrophic, even though the chlorophyll-*a* index estimated oligotrophy (0.6 - 1.1 µg/L) (WDOE 1991). Similarly, a 1995 report assessed Leech Lake as mesotrophic (WDOE 1995). According to the WDOE, mesotrophy was estimated because of abundant macrophytes in Leech Lake, algal densities that may have been inhibited due to competition from dense macrophyte growth, and fall productivity as indicated by the DO and pH increased with depth (WDOE 1991). Additionally, WDOE studies indicate that nitrogen is the limiting nutrient in Leech Lake during the spring, but during the fall, there is uncertainty as to which nutrient (nitrogen and/or phosphorus) is limiting (WDOE 1991). According to the 1991 study, emergent macrophytes covered approximately 10 percent of the lake surface, and about 98 percent of the shoreline, suggesting Leech Lake is moving toward a more eutrophic state (WDOE 1991).

Fecal coliform was measured in Leech Lake in March and June of 1989. Fecal coliform measurements ranged from 0 to 5 colonies per 100 ml (DuMond 1989). Current SWQS for Lake Class require the geometric mean of the sample to be no more than 50 colonies/100 mL, and no more than 10 percent of all samples obtained for calculating the geometric mean value may exceed 100 colonies/100 mL (WAC 1997). Leech Lake meets the Lake Class standard for fecal coliform. Additional water quality data for Leech Lake is presented below in Table 3.3-8.

Table 3.3-8:
Summary of Existing Water Quality Data for Leech Lake

Sample Date	April 18, 1989[a]	June 19, 1990[b]	September 18, 1990[b]	October 31, 2006[c]	WDOE Lake Class Standards[d,e]
Dissolved Oxygen (mg/l)	10	~10[f]	~12[f]	11.8	No measurable decrease from natural conditions
Ortho-P (mg/l)	0.3	0.004	0.009	0.07	-
Total Phosphorus (mg/l)	-	0.00006	0.022	0.33	-
pH	6.5	~7[f]	~7.5[f]	7.30	No measurable change from natural conditions
Temperature (C)	1.7	13	13.5	-	

[a] Source: USDA 1990c. Note: 1989 measurements are averages of four samples.
[b] Source: WSDOE 1991
[c] Source: Cascade Analytical 2006
[d] Also refer to Table 3.3-FEIS2 and WAC 2003.
[e] Source: WAC 173-201A-030 (WAC 1997).
[f] Approximate average measurement within upper 1 meter of water.

WEPP Modeling

A modeling study was conducted to quantify sediment production due to changes in land cover associated with the Action Alternatives (refer to Appendix L – WEPP Modeling Analysis). The US Department of Agriculture – Agricultural Research Service's Water Erosion Prediction Project (WEPP) model was used to compute sediment detachment for the various land cover types within each affected sub-watershed. As further detailed in Appendix L, a representative Hillslope WEPP/GIS analysis model was utilized to compute sediment detachment only, and did not account for routing and buffering (which reduce actual yields to the stream system). The analysis did not account for factors that can result in the removal and deposition of sediment from water before reaching a surface water body, and therefore it represents a conservative analysis (i.e., it overestimates the contribution of sediment to the Upper Clear Fork Cowlitz and Upper Tieton River sub-watersheds). 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 2000b).

The most important potential adverse affect of forest management activities on streams is often an increase in inorganic sediment. Large increases in the amount of sediment delivered to a stream channel can greatly impair or even eliminate fish and aquatic invertebrate habitat, and alter the structure and width of the stream banks and adjacent riparian zone (MacDonald 1991). The physical effects of increased fine sediment load can be equally far-reaching. The amount of sediment can affect channel shape, sinuosity, and the relative balance between pools and riffles. Changes in sediment load would affect the bed material size, altering both the quality and quantity of fish and benthic invertebrate habitat (MacDonald 1991). Road construction and maintenance have been found to be the primary sources of sediment inputs. This sediment can be eroded from the road surface, road fills, or slope failures associated with road construction and drainage (MacDonald 1991). Mitigation measures and management activities can affect suspended sediment in streams by altering erosion rates and the rate of transport into stream channels.

Table 3.3 FEIS3 presents existing conditions of soil detachment under the WEPP model. Further information is available in Appendix L – WEPP Modeling Analysis.

Table 3.3 FEIS 3:
WEPP Sediment Detachment Existing Conditions

Sub Watershed	Soil Detachment (Tons/Year)
Upper Clear Fork Cowlitz	103.1
Upper Tieton	133.6

Ground Water Quality

Ground water quality standards are set forth in WAC 173-200 (WAC 1990), which implements the Water Pollution Control Act (RCW 90.48) and the Water Resources Act of 1971 (RCW 90.54). As described in Section 040 of the Ground Water Quality Standards, the purpose of the water quality criteria is to protect a variety of beneficial uses of ground water, including drinking water. Table 1 in Section 040 (Criteria) outlines specific contaminant criteria, based on human health, that is not to be exceeded in any ground waters of the state, except as detailed in Section 050.

As of publication of this FEIS, no ground water quality information was available for the White Pass Study Area. However, well log data kept by the WDOE EIM System indicates there are several wells in the vicinity of the White Pass Study Area. WDOE stated that they do not reveal any ground water quality information, they indicate the depth of the water table and soil types only (WDOE, pers. comm.). Three wells drilled by the WSDOT are located along US 12 at an embankment failure site at milepost 148.65 - 148.71 (refer to Figure 3-11 – Upper 5th Field Watersheds for US 12 mileposts). To the east of the White Pass Ski Area, near Dog Lake (outside the White Pass Study Area), is a 500-foot deep well used by the Department of Natural Resources to monitor water temperature. Groundwater temperatures ranged from 4.96°C at 10 meters, to 11.55°C at 148 meters in depth (Blackwell 1980). The static groundwater level was measured at 52 feet deep. North of US 12 near Knuppenburg Lake, on White Pass Forest Road (milepost 150.38) are two decommissioned wells with depths of 13 and 18 feet. No water quality information is available for these two wells.

3.3.2.5 Flow Regime

As described in Section 3.1 – Climate and Snow, average annual precipitation at White Pass is 79.6 inches. The average snowpack between January and March is 37.6 inches as measured as a SWE. The snowpack at White Pass typically forms in mid-October and persists until late June or early July. Average annual snowfall within the White Pass Study Area is 350 inches (GoSki 2004). Average annual temperatures within the White Pass Study Area are 35.8°F during the period of record from 1989 through 2003. Temperatures range from an average high of 51.2°F in August to an average low of 24.2°F in February. There are no stream gauges present within the White Pass Study Area or in the immediate vicinity to provide general stream flow characteristics. The closest stream gauge to White Pass that is located on an unregulated river is Station 14226500 on the Cowlitz River near Packwood. This station is located approximately 17 river miles downstream of White Pass. Due to the distance from White Pass and the influence of downstream sub-basins, the data can not be directly used to characterize flow conditions in the streams within the White Pass Study Area.

The alpine weather cycles and associated stream flow responses that are characteristic of the hydrologic processes at White Pass are described as follows. Stream discharge increases in perennial stream channels as autumn rains fill the storage capacity of the soil. However, the greatest stream flows and most rapid increases in discharge are not controlled by rain alone, but also by rates of snow accumulation and snowmelt (i.e., rain-on-snow events). 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. The variability in the amount of stream flow begins to stabilize in the winter due to colder temperatures. Low winter flows are sustained by melt generated by ground heat, and by alternating freezing and thawing at the snowpack surface. Large and sustained peak flows occur during the spring and early summer when warm air temperatures cause the melt-off of the winter snowpack. The ephemeral stream channels in the White Pass Study Area typically go dry shortly after the spring melt is completed (refer to Figure 3-14). The intermittent stream channels in the White Pass Study Area typically go dry later in the year, as shallow groundwater storage decreases later on in the summer (refer to Figure 3-14). The stream channels located in the lower elevation portions of the White Pass Study Area are generally perennial, with larger contributing areas to sustain base flows and significant groundwater discharge from slope wetlands (refer to Figure 3-14).

Water Use

The White Pass Company has diverted, for domestic use and fire control, a small portion of source waters from Millridge Creek (refer to Section 3.13 – Utilities and Infrastructure). During the 1996-97 season (Dec. 20 to March 16), the average peak weekend and holiday water use was 9,195 gallons (5 percent of capacity) per day for 1,870 skier visits or an average 4.92 gallons per skier per day. During the highest visitor day use on record (2,949 skier visits), 12,561 gallons were used (4.26 gal/visitor/day) (refer to Section 3.13 – Utilities and Infrastructure). The dominant non-consumptive water use of Millridge Creek in the White Pass Study Area and downstream is the maintenance of cold water biota. Additional uses are for irrigation and recreation. Fish beneficial uses are discussed in Section 3.4 – Fisheries.

Flow Model

The removal of forest cover and the creation of new impervious surfaces within a watershed can increase available surface and shallow subsurface water, resulting in altering the flow regime of a watershed (Dunne and Leopold 1978; Naiman. and Bilby 1998). The change in land cover can affect surface runoff generation and stream flow conditions by increasing residual soil moisture due to the excess water that would normally be used by trees through evapo-transpiration. Increased soil moisture can cause more development of surface water during rainstorms and additional shallow subsurface flow to streams, especially in riparian areas adjacent to streams (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, thereby creating stormwater runoff that results in the increased surface flow of streams (Wright et al. 1990). To analyze whether there would be any change to the flow regime of the Upper Clear Fork Cowlitz River and the Upper Tieton River watersheds within the White Pass Study Area due to implementation of the alternatives, a flow model was used (refer to Appendix E).

The geographic scope of the analysis for the flow model run for this FEIS was larger than the White Pass Study Area because accurate flow modeling required inclusion of the entire contributing area to the streams analyzed. Therefore, the scope of this analysis included the White Pass Study Area, as well as lands to the north and east of the White Pass Study Area, extending outward to the nearest drainage divide for the streams analyzed (refer to Figure 3-12 - Flow Model Analysis Area). This geographic area will be hereafter referred to as the Flow Model Analysis Area. The Upper Clear Fork Cowlitz watershed portion of the Flow Model Analysis Area is approximately 1,460 acres in size and the Upper Tieton watershed portion of the flow model analysis area covers approximately 535 acres. The model measures changes in flows at the mouth of the model area, which is at the inlet to Leech Lake for the Upper Tieton watershed and at the mouth of an unnamed tributary to Millridge Creek above Knuppenberg Lake for the Upper Clear Fork Cowlitz watershed.

The custom flow model was developed by first performing a thorough review of published literature in order to establish relationships between the size and type of watershed treatments (e.g., clear-cutting, road construction) and the measured effects on various stream flow parameters. For the purposes of this analysis, the existing and proposed stream flow conditions were calculated and presented as average seven-day low flow (low flow) and the two-year peak flow (peak flow). These specific flow conditions were selected for analysis because, according to published literature, these are the flow conditions most likely to be affected by land cover changes from the implementation of activities such as those in the Action Alternatives (Beschta et al. 2000; Burton 1997; Keppeler 1998; Hicks et al. 1991).

Using the stream flow prediction methods described in the Flow Model Technical Report (refer to Appendix E), the existing seven-day low flow for the Upper Clear Fork Cowlitz River is 3.12 cubic feet per second (cfs) at the mouth of the Flow Model Analysis Area (refer to Table 3.3-9). The estimated seven-day low flow for the Upper Tieton River is 1.23 cfs, which is less than the Upper Clear Fork Cowlitz due to the smaller watershed area (refer to Table 3.3-9). The estimated two-year peak flows for the Upper Clear Fork Cowlitz and the Upper Tieton Rivers are 130.7 cfs and 54.4 cfs respectively.

Table 3.3-9:
Estimated Stream Flows for the Two Mainstem Rivers
in the Flow Model Analysis Area

Watershed Name	Drainage Area (acres)	Seven-Day Low Flow (cfs)	Two-Year Peak Flow (cfs)
Upper Clear Fork Cowlitz River	1460	3.12	130.7
Upper Tieton River	535	1.23	54.4

3.3.3 Environmental Consequences

3.3.3.1 Streams

Alternative 1

Under Alternative 1, no expansion is proposed, therefore no impacts to streams would occur. Impacts (i.e., existing culverts and other stream crossings) to streams from the ongoing operation and maintenance of White Pass would continue to occur under Alternative 1. As a result, the condition of the streams within the White Pass Study Area would remain unchanged.

Alternative 2

Under Alternative 2, direct impacts to stream channels within the Upper Clear Fork Cowlitz watershed would occur from ski trail grading and new crossing structures that require in-channel work (e.g., culverts). The permanent road mileage within the Upper Clear Fork Cowlitz portion of the White Pass Study Area would remain unchanged at 2.6 miles under Alternative 2, and no new culvert, bridge, or ford crossings would be constructed on perennial streams (refer to Table 3.3-10). **There would be one new culvert constructed on a non-perennial stream under Alternative 2 associated with construction of**

the bottom terminal of the proposed *Hogback Express* chairlift (refer to Figure 3-15). As described in Chapter 2, this culvert would be placed as a stream protection measure. If possible, after construction, the culvert would be removed. If protection of the stream would be better accomplished by retaining the culvert, the implementation of Mitigation Measure MM6 would minimize direct impacts to the stream during culvert installation by incorporating 100-year storm and debris flow criteria (refer to Table 2.4-2). All ski trail crossings of streams within the Hogback Basin would cross streams by using snow bridges (refer to Other Management Provision OMP9 in Table 2.4-4).

Under Alternative 2, proposed utilities would cross streams in 11 locations in the Upper Clear Fork Cowlitz watershed (refer to Table 3.3-10 and Figure 3-15). **The implementation of Mitigation Measure MM1, listed in Table 2.4-2, would require these stream crossings by utilities to be aerial structures so that there would be no direct impact to stream channels from utility installation (refer to Table 3.3-10).** The exposed aerial stream crossing (at ground surface elevation) would include a rigid, insulated conduit and rigid bracing to hold the conduit in place and to support the structure during winter snowpack conditions. All utility crossings under Alternative 2 would occur within the Upper Clear Fork Cowlitz watershed (refer to Section 3.13 – Utilities and Infrastructure).

Table 3.3-10:
Potential Direct and Indirect Impacts to Streams in the Upper Clear Fork Cowlitz Watershed

Parameter	Alternative 2	Modified Alternative 4	Alternative 6	Alternative 9
Number of New Permanent Perennial Stream Crossings:				
Aerial Utility	0	0	0	0
Culverts	0	11	0	11
Fords	0	0	0	0
Bridges	0	0	0	0
Number of New Permanent Non-Perennial Stream Crossings:				
Aerial Utility	11	11	0	0
Culverts	1	0	4	0
Fords	0	0	0	0
Bridges	0	1	0	0
Total New Stream Crossings	**12**	**23**	**4**	**11**
Permanent Road Length by Surface:				
Paved (miles)	0.2	0.2	0.2	0.2
Unpaved (miles)	2.3	2.3	2.7	2.3
Total Road Length (miles)	2.6	2.6	2.9	2.6
Road Density (mi/mi^2)	1.5	1.5	1.7	1.5

[a]Non-perennial includes ephemeral and intermittent streams
*Note- Numbers presented in the table have been rounded in the GIS analysis. Totals may vary due to this rounding
Impacts to streams from Alternative 1 are included in Table 3.3-2.

All new ski trail crossings of streams proposed under Alternative 2 would occur within the Upper Clear Fork Cowlitz watershed portion of the White Pass Study Area. During the construction phase, as detailed by OMP9 and OMP10 (refer to Table 2.4-4), snow bridges would be utilized at the ski trail stream crossings so that culverts and bridges would not be needed and if/when the snow melts, a temporary corduroy crossing (felled tree debris) over ephemeral and intermittent streams would be utilized. A corduroy (felled tree debris) crossing would be utilized during the implementation phase and removed after the completion of the implementation phase (refer to Table 2.3.1-2). Approval for the technique (based on site-specific conditions at the time of construction) would be obtained from the USFS (USFS ID Team, pers. comm.). These crossings would occur on small, ephemeral and intermittent streams. The ephemeral and intermittent streams are typically in small channels, less than 1 foot in width. There would be no change to the channel morphology, LWD transport functions, or other stream characteristics as a result of snow bridge crossings. The use of corduroy crossings would be approved by the USFS as per OMP10 requirements, to minimize stream characteristic effects.

As described in Table 2.4-3, Management Requirements MR2 and MR3 would reduce impacts to streams due to channel modifications or construction of facilities. USFS approval is required for all channel modifications prior to construction, and construction activities within jurisdictional streams or wetlands require a Section 404 permit from the U.S. Army Corps of Engineers. All work must be in accordance with HPA specifications.

There would be no direct impact to streams within the Upper Tieton watershed under Alternative 2. The total length of roads within the watershed would continue to be 4.2 miles (refer to Table 3.3-11). The existing ten culverts and eight fords would remain in place and no new aerial utility crossings are proposed in the Upper Tieton River watershed (refer to Table 3.3-11). No new permanent ski trail crossings of streams within the Upper Tieton River would be constructed under Alternative 2. Construction of the proposed ski trails would not result in any direct grading impacts to stream channels (refer to Figure 3-15).

Table 3.3-11:
Potential Direct and Indirect Impacts to Streams in the Upper Tieton River Watershed

Parameter	Alternative 2	Modified Alternative 4	Alternative 6	Alternative 9
Number of New Permanent Perennial Stream Crossings:				
Aerial Utility	0	0	0	0
Culverts	0	0	0	0
Fords	0	0	0	0
Bridges	0	0	0	4
Number of New Permanent Non-perennial Stream Crossings:				
Aerial Utility	0	0	0	0
Culverts	0	0	0	0
Fords	0	0	0	0
Bridges	0	0	0	0
Total New Permanent Stream Crossings	0	0	0	4
Permanent Road length by Surface:				
Paved (miles)	0.3	0.3	0.3	0.3
Unpaved (miles)	3.9	3.9	3.9	3.9
Total Road Length (miles)	4.2	4.2	4.2	4.2
Road Density (mi/mi^2)	6.0	6.0	6.0	6.0

Note: Non-perennial includes ephemeral and intermittent streams. Totals may vary due to rounding.
Impacts to streams from Alternative 1 are included in Table3.3-2.

The length of streams with potentially unstable banks in the White Pass Study Area would increase from approximately 1.5 miles under existing conditions to approximately 1.6 miles (0.8 mile in each watershed) under Alternative 2, which represents approximately 10 percent of the total stream length in the White Pass Study Area (refer to Table 3.3-12). This increase of 0.1 mile of streams with potential unstable banks would result from grading for lift terminal construction and utility installation adjacent to streams (refer to Figure 3-28). The small amount of proposed tree removal and grading along these stream reaches would potentially indirectly affect the physical condition and function of these streams over the long-term by reducing bank stability, increasing adjacent hill slope erosion, altering hyporheic flow paths, reducing sediment filtration in the riparian vegetation zone, reducing stream shade, and eliminating potential LWD inputs.

Table 3.3-12:
Potential Impacts to Stream Bank Stability within the White Pass Study Area

Parameter	Alternative 2		Modified Alternative 4		Alternative 6		Alternative 9	
	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton
Streams with potentially stable banks (miles)	9.8	3.9	9.5	3.8	9.8	3.8	9.8	3.3
Streams with potentially unstable banks (miles)	0.8	0.8	1.1	0.9	0.8	0.9	0.8	1.3
Total Stream Length (miles)	**10.6**	**4.6**	**10.6**	**4.6**	**10.6**	**4.6**	**10.6**	**4.6**

Note: Totals may vary due to rounding.
Impacts to stream bank stability under Alternative 1 are included in Table 3.3-6.

The potential impacts to these stream functions would be avoided and or minimized through implementation of Mitigation Measure MM2 and Management Requirement MR1 to reduce soil erosion and sediment yield through implementation of a Stormwater Pollution Prevention Plan (SWPPP) and water quality monitoring during construction (refer to Table 2.4-2 and Table 2.4-3). Additionally, Mitigation Measures MM3 and MM7 would be implemented to reduce the loss of stream shade and LWD recruitment potential along stream channels. Based on the successful implementation of Mitigation Measures and Management Requirements, there would be no measurable long-term indirect impacts to streams under Alternative 2. However, short-term indirect impacts to these stream reaches may occur during the construction of ski trails and other facilities. Potential short-term sediment impacts from construction are further discussed in Section 3.3.5 – Water Quality and in Section 3.2 – Geology and Soils. In addition, no snow grooming would take place within riparian or key watershed areas unless there is a minimum of 3 feet of snow pack (refer to Other Management Provision OMP8 in Table 2.4-4), which is designed to reduce potential watershed impacts.

No new permanent roads would be built under Alternative 2, therefore the road density in the White Pass Study Area would remain at 2.7 mi/mi^2. **Approximately 2.5 acres of tree removal and grading would take place in moderate erosion potential areas and approximately 0.1 acre of low erosion potential areas within the RIA (refer to Table 3.3-16). There would be no tree removal or grading in high erosion potential areas under Alternative 2.** Potential sediment yields from mass wasting events that reach streams would be minimized through the implementation of Mitigation Measure MM11, Management Requirements MR1 and MR4, and Other Management Provisions OMP1, OMP2 (refer to Tables 2.4-2, 2.4-3, and 2.4-4), which would require erosion control measures to prevent sediment from reaching streams. Additional information regarding indirect impacts to streams are described in the Riparian Zone, Water Quality, and Flow Regime discussions in this section.

As discussed in Section 3.3.2 – Affected Environment, Rosgen Type A and Aa+ streams are inherently sensitive to disturbance and are natural sediment transport channels. Activities within Riparian Reserves have the potential to increase sedimentation to these channel types. Since the Proposed Action would not measurably increase peak flows in either watershed (refer to the following discussion under Flow Regime), downstream impacts from increased sediment transport would not be measurable.

Modified Alternative 4

Similar to Alternative 2, direct impacts to stream channels within the Upper Clear Fork Cowlitz watershed would occur from ski trail grading and new crossing structures that require in-channel work (e.g., culverts). The permanent road mileage within the Upper Clear Fork Cowlitz portion White Pass Study Area would remain unchanged at 2.6 miles under Modified Alternative 4, and no bridges or ford crossings would be constructed on perennial streams (refer to Table 3.3-10). **Eleven culverts would be installed on perennial streams as a result of construction of Trail 4-18 (refer to Table 3.3-10 and Figure 3-16).** The potential impacts to stream functions as a result of the construction of the proposed ski trails in the Upper Clear Fork Cowlitz watershed would be as described under Alternative 2. As described in Alternative 2, there would be no direct impacts to streams within the Upper Tieton watershed under Modified Alternative 4 (refer to Table 3.3-11).

Additionally, one new bridge would be constructed on an intermittent stream under Modified Alternative 4, due to construction of Trail 4-16 associated with the proposed *Hogback Express* chairlift (refer to Table 2.3.1-2 and Figures 2-4 and 3-16). The implementation of Mitigation Measure MM5 would minimize direct impacts to streams during bridge construction by limiting the crossing to a single span and placing the footings above the bankfull channel width to minimize the amount of in-channel work (refer to Table 2.4-2).

Under Modified Alternative 4, proposed utilities would cross streams in 11 locations (refer to Table 3.3-10 and Figure 3-16), as described in Alternative 2. However, in conjunction with the power and communication lines, a waterline would be installed to provide a water supply to the proposed mid-mountain lodge. Because of this additional utility installation and associated trenching disturbance, Modified Alternative 4 would likely effect streams more than Alternative 2. If it is determined that the proposed waterline utility would affect streams and wetlands substantially, an on-site well would be drilled to provide a water supply for the proposed mid-mountain lodge. The well would be located upslope of the mid-mountain lodge, within the 50-foot building envelope surrounding the lodge. As detailed in Table 1-3, the Yakima/Lewis Health District Code Compliance would be approached by White Pass Company to authorize public water supply use (refer to Section 3.13 - Utilities and Infrastructure for further details). The implementation of Mitigation Measure MM1, listed in Table 2.4-2, would require these stream crossings by utilities to be aerial structures so that there would be no direct impact to stream channels from utility installation. All utility crossings would occur within the Upper Clear Fork Cowlitz watershed.

As described in Table 2.4-3, Management Requirements MR2 and MR3 would reduce impacts to streams due to channel modifications or construction of facilities. USFS approval is required for all channel modifications prior to construction, and construction activities within jurisdictional streams or wetlands require a Section 404 permit from the U.S. Army Corps of Engineers. All work must be in accordance with HPA specifications.

The length of streams with potentially unstable banks in the White Pass Study Area would increase from approximately 1.5 miles under existing conditions to approximately 2.0 miles under Modified Alternative 4, which represents approximately 13 percent of the total stream length in the White Pass Study Area (refer to Table 3.3-12). This increase of 0.5 mile of streams with potential unstable banks would result from tree removal and grading for construction of lift terminals, trails, lift corridor, and utility installation adjacent to streams (refer to Figure 3-29). Additional impacts to stream bank stability would be associated with grading for Trail 4-16, Trail 4-18, and vegetation clearing for the proposed parking lot would occur adjacent to an intermittent stream. Indirect impacts to stream functions resulting from bank instability would be as described under Alternative 2.

No new permanent roads would be build under Modified Alternative 4, therefore the road density in the White Pass Study Area would remain at 2.7 mi/mi^2. **Approximately 1.0 acres of clearing and grading would take place in high erosion potential areas, 4.8 acres would take place in moderate erosion potential areas, and approximately 0.2 acre in low erosion potential areas within the RIA (refer to Table 3.3-16).** Potential sediment yields from mass wasting events that reach streams would be more than Alternative 2 due to the construction of Trail 4-16 and Trail 4-18. Potential impacts would be minimized through the implementation of Mitigation Measure MM11, Management Requirements MR1 and MR4, and Other Management Provisions OMP1, OMP2 (refer to Tables 2.4-2, 2.4-3, and 2.4-4), which would require erosion control measures to prevent sediment from reaching streams.

The proposed PCT reroute would not affect streams as it occurs on a high elevation ridgeline.

Alternative 6

Similar to Alternative 2, direct impacts to stream channels within the Upper Clear Fork Cowlitz watershed under Alternative 6 would occur from ski trail grading and new crossing structures that require in-channel work (e.g., culverts). **The permanent road mileage within the Upper Clear Fork Cowlitz watershed portion of the White Pass Study Area would increase by approximately 0.3 mile to 2.9 miles under Alternative 6 (refer to Table 3.3-10). There would be four new culverts constructed over intermittent and ephemeral streams that are associated with construction of the access road to the bottom terminal of the proposed *Basin* chairlift under Alternative 6 (refer to Figure 3-15).** No new culvert, bridge, or ford crossings would be constructed on perennial streams The implementation of Mitigation Measure MM6 would minimize direct impacts to streams during culvert installation by incorporating 100-year storm and debris flow criteria (refer to Table 2.4-2).

Under Alternative 6, all utility crossings would occur within the Upper Clear Fork Cowlitz watershed and construction of the proposed ski trails would not result in any direct grading impacts to stream channels (refer to Table 3.3-10 and Figure 3-15). Potential indirect impacts would be minimized through the implementation of Mitigation Measure MM11, Management Requirements MR1 and MR4, and Other Management Provisions OMP1 and OMP2 (refer to Tables 2.4-2, 2.4-3, and 2.4-4), which would require erosion control measures to prevent sediment from reaching streams. During construction, as detailed by Other Management Provision OMP10 (refer to Table 2.4-4), snow bridges would be utilized at the ski trail stream crossings so that culverts and bridges would not be needed. A corduroy crossing (felled tree debris) over intermittent and ephemeral streams would be utilized during the construction phase and removed after the completion of construction.

As described in Table 2.4-3, Management Requirements MR2 and MR3 would reduce impacts to streams due to channel modifications or construction of facilities. USFS approval is required for all channel modifications prior to construction, and construction activities within jurisdictional streams or wetlands require a Section 404 permit from the U.S. Army Corps of Engineers. All work must be in accordance with HPA specifications.

Under Alternative 6, there would be no direct impacts to streams within the Upper Tieton watershed as described under Alternative 2 (refer to Table 3.3-11).

The length of streams with potentially unstable banks in the Upper Clear Fork Cowlitz watershed would increase from approximately 1.5 miles under existing conditions to approximately 1.7 miles under Alternative 6, which represents approximately 11 percent of the total stream length in the White Pass Study Area (refer to Table 3.3-12). This increase of 0.2 mile of streams with potential unstable banks would result from clearing and grading for construction of the access road, trails and lift corridor where they cross streams (refer to Figure 3-28) and vegetation clearing for the proposed parking lot, which would occur adjacent to an intermittent stream. Indirect impacts to stream functions resulting from bank instability would be as described under Alternative 2.

The overall watershed risk for impacts to watershed function from road density (1.7 mi/mi^2) under Alternative 6 would be more than under the other Action Alternatives, due to the slight increase of 0.2 mile of road per square mile within the Upper Clear Fork Cowlitz watershed. The potential increase in sediment yield to streams from clearing and grading activities proposed under Alternative 6 would be the lowest of all Action Alternatives due to the reduced grading in moderate and low erosion hazard areas and in Riparian Reserves (refer to Table 3.3-16). **However, the inclusion of a permanent road in Alternative 6 would result in the highest potential for road-related impacts to streams (e.g., alteration of surface flow paths, bank instability, erosion, and sediment delivery) among the Action Alternatives.** Potential impacts would be minimized by implementing Mitigation Measure MM11, Management Requirements MR1 and MR4, and Other Management Provisions OMP1, OMP2 (refer to

Tables 2.4-2, 2.4-3, and 2.4-4). Additional information regarding indirect impacts to streams can be found in the Riparian Reserves, Water Quality, and Flow Regime discussions in this section.

Alternative 9

Similar to Alternative 2, direct impacts to stream channels within the Upper Clear Fork Cowlitz watershed would occur from ski trail grading and new crossing structures that require in-channel work (e.g., culverts). **Eleven culverts would be installed on perennial streams as a result of construction of Trail 9-6 in the *Paradise* pod (refer to Table 3.3-10 and Figure 3-17).** The road density within the Upper Clear Fork Cowlitz watershed would be as described under Alternative 2. The implementation of Mitigation Measures MM6 would minimize direct impacts to streams during culvert and bridge installation by incorporating 100-year storm and debris flow criteria and limiting the amount of in-channel work.

Under Alternative 9, direct impacts to streams would result from four new permanent bridge crossings on perennial streams within the Upper Tieton watershed as a result of ski trail construction (refer to Table 2.3.1-2, Table 3.3-11 and Figure 3-17). Installation of bridge crossings would comply with county, state and federal regulations for construction requirements. The road density within the Upper Tieton watershed would be as described under Alternative 2. Implementation of Mitigation Measure MM5 would minimize impacts by requiring bridge footings to be constructed upslope of the bankfull channel width and all crossings would be a single span.

As described in Table 2.4-3, Management Requirements MR2 and MR3 would reduce impacts to streams due to channel modifications or construction of facilities. USFS approval is required for all channel modifications prior to construction, and construction activities within jurisdictional streams or wetlands require a Section 404 permit from the U.S. Army Corps of Engineers. All work must be in accordance with HPA specifications.

Under Alternative 9, there would be approximately 2.1 miles of streams with potentially unstable banks as a result of bridge and culvert installation, which is the most of any Action Alternative (refer to Table 3.3-12 and Figure 3-30). Potential impacts to stream functions would be as described under Alternative 2. The implementation of Mitigation Measure MM11, Management Requirements MR1 and MR4, and Other Management Provisions OMP1, OMP2 (refer to Tables 2.4-2, 2.4-3, and 2.4-4) would protect bank stability and control erosion under the proposed bridges and culverts.

The potential increase in sediment yield to streams from clearing and grading activities proposed under Alternative 9 would be the most of all Action Alternatives (approximately 11.0 acres) in all erosion hazard areas within Riparian Reserves (refer to Table 3.3-16). Potential impacts would be minimized by implementing Mitigation Measure MM11, Management Requirements MR1 and MR4, and Other Management Provisions OMP1, OMP2 (refer to Tables 2.4-2, 2.4-3, and 2.4-4). Additional information regarding indirect impacts to streams can be found in the Riparian Reserves, Water Quality, and Flow Regime discussions in this section.

3.3.3.2 Wetlands

Alternative 1

Under Alternative 1, the proposed expansion of White Pass Ski Area would not occur, and no direct or indirect impacts to wetlands would occur from construction activities. Impacts to wetlands from the ongoing operation and maintenance of White Pass Ski Area would continue to occur under Alternative 1. Therefore, the condition of the wetlands within the White Pass Study Area would remain as described in Section 3.3.3.2 – Affected Environment.

Alternative 2

Wetlands are directly impacted by construction activities that require grading, which displaces wetland area and removes all functionality of the wetland through the placement of fill material and/or soil excavation in wetlands. Grading activities can also modify the hydrology of wetlands through the creation of more impervious surfaces in the wetland, such as buildings and parking lots, or by changing the existing drainage patterns, which can alter the hydrologic regime and cause a wetland to become impaired and/or defunct. Under Alternative 2, there would be the potential for approximately 0.03 acre of grading impacts in wetlands within the White Pass Study Area. However, with the implementation of Mitigation Measure MM1, this 0.03-acre impact would be avoided, so that there would be no long-term, direct impacts to wetlands due to grading under Alternative 2.

During the installation of the *Hogback Express* and *Basin* chairlifts and corresponding trails, 0.06 acre of clearing (refer to Table 3.3-13) would take place within wetlands in the White Pass Study Area, with all of the clearing acreage occurring within the Upper Clear Fork Cowlitz watershed, which encompasses the proposed expansion area. The prescription for the approximately 0.06 acre of proposed vegetation clearing, all of which occurs in riverine wetlands, typically consists of the trimming of shrub vegetation and removing any trees within the construction limits by cutting the tree flush to the ground (the stumps would not be removed), processing the tree by hand, and leaving all parts of the tree onsite (lop and scatter) (refer to Table 2.4-1). Potential impacts to these riverine wetlands from this clearing prescription would be minimized through implementation of Mitigation Measures MM8 and MM9 to ensure that the surface of the wetland would not be graded, the natural ground cover would be maintained, and any tree removal would not cause incidental wetland impacts (refer to Table 2.4-2). The proposed clearing under Alternative 2 within riverine wetlands would have a long-term, direct impact on some of the functions of these wetlands, such as shading, nutrient and organic carbon cycling, and wildlife habitat. Under Alternative 2, no clearing would take place in either slope or depressional wetlands (refer to Table 3.3-13).

Development activities in the uplands adjacent to wetlands can indirectly affect wetland functions. The location of the development activity with relation to the wetland and the type of development activity dictates the degree of impact and what wetland functions would be affected. Primary indirect impacts to wetlands typically occur from changes in hydrology and sediment sources. Under Alternative 2, grading would take place in the Riparian Reserves of several wetlands in the proposed expansion area. The potential for increased sediment delivery to wetlands would be increased during construction. Implementation of BMPs and Mitigation Measures such as MM3 and MM8, as well as Management Requirement MR1 would reduce the potential for these indirect impacts. The introduction of new disturbance in the Riparian Reserves, such as areas of grading activities, ski trail clearing, and utility trenching would result in increased potential for the introduction of noxious species into wetlands. Implementation of Mitigation Measures MM8 and MM9 and Management Requirement MR7 (refer to Table 2.4-2 and Table 2.4-3) would minimize the risk of the introduction of noxious species into wetlands as a result of the indirect impacts from clearing, grading, and utility trenching within the immediate vicinity of wetlands in the White Pass Study Area.

Operational and maintenance activities that indirectly impact wetlands would primarily be limited to wetlands on existing and proposed ski trails under Alternative 2. These activities include mowing vegetation, the maintenance of contour ditch lines, and snow management. Potential impacts to wetlands from operation and maintenance include increased sedimentation and the growth of noxious weeds and are usually long-term because they would cause wetlands to lose some of their functions. Wetlands within the White Pass Study Area that are in natural settings in the forest or open meadows would not be affected by the maintenance of ski area facilities.

Table 3.3-13
Potential Direct Impacts to Wetlands within the White Pass Study Area Under the Action Alternatives

Parameter	Alternative 2		Modified Alternative 4		Alternative 6		Alternative 9	
	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton
Potential Wetland Impacts from Vegetation Removal (acres):								
Slope Wetlands	0	0	0	0	0	0	0	0.02
Riverine Wetlands	0.06	0	0.06	0	0.08	0	0	0
Depressional Wetlands	0	0	0	0	0	0	0	0
Subtotal Clearing Impacts	0.06	0	0.06	0	0.08	0	0	0
Potential Wetland Impacts from Grading (acres)								
Slope Wetlands	0	0	0.04	0	0	0	0.04	0.01
Riverine Wetlands	0.03	0	0.02	0	0.02	0	0	0
Depressional Wetlands	0	0	0	0	0	0	0	0
Subtotal Potential Grading Impacts	0.03	0	0.06	0	0.02	0	0.04	0.01
Total Area of Wetland Impacts (acres)	**0.09**	**0**	**0.12**	**0**	**0.11**	**0**	**0.04**	**0.03**

Note: Totals may vary due to rounding
Impacts to wetlands from Alternative 1 are included in Table 3.3-3.

Modified Alternative 4

Under Modified Alternative 4, there would be the potential for approximately 0.06 acre of grading impacts in wetlands within the White Pass Study Area. However, with the implementation of Mitigation Measure MM1, this 0.06-acre impact would be avoided, so that there would be no long-term, direct impacts to wetlands due to grading under Modified Alternative 4.

During the installation of the *Hogback Express* and *Basin* chairlifts and corresponding trails, approximately 0.06 acre of clearing (refer to Table 3.3-13) would take place within wetlands in the White Pass Study Area, with all of the clearing occurring within the Upper Clear Fork Cowlitz watershed, which encompasses the proposed expansion area. Similar to Alternative 2, this 0.06 acre of proposed vegetation clearing would occur in riverine wetlands, and would follow the clearing prescriptions in Table 2.4-1. Potential impacts to riverine wetlands from clearing would be reduced through implementation of Mitigation Measures MM8 and MM9 outlined in Table 2.4-2. Under Modified Alternative 4, no clearing would take place in either slope or depressional wetlands (refer to Table 3.3-13).

Grading impacts to Riparian Reserves would be as described for Alternative 2.

As described in Alternative 2, operational and maintenance activities that indirectly impact wetlands would primarily be limited to wetlands on existing and proposed ski trails under Modified Alternative 4.

Alternative 6

Under Alternative 6, there would be potential for approximately 0.02 acre of grading impacts in wetlands within the White Pass Study Area. However, with the implementation of Mitigation Measure MM1, this 0.02-acre impact would be avoided so that there would be no long-term, direct impacts to wetlands due to grading under Alternative 6.

During the installation of the *Basin* chairlift and corresponding trails, approximately 0.08 acre of clearing (refer to Table 3.3-13) would take place within wetlands in the White Pass Study Area, with all of the clearing occurring within the Upper Clear Fork Cowlitz watershed, which encompasses the proposed expansion area. All 0.08 acre of proposed vegetation clearing would occur in riverine wetlands, and would follow the clearing prescriptions in Table 2.4-1. Potential impacts to riverine wetlands from clearing would be reduced through implementation of Mitigation Measures MM8 and MM9 outlined in Table 2.4-2. Under Alternative 6 no clearing would take place in either slope or depressional wetlands (refer to Table 3.3-13).

Grading impacts to Riparian Reserves would be as described for Alternative 2.

As described in Alternative 2, operational and maintenance activities that indirectly impact wetlands would primarily be limited to wetlands on existing and proposed ski trails under Alternative 6.

Alternative 9

Under Alternative 9, there would be the potential for approximately 0.05 acre of grading impacts in wetlands within the White Pass Study Area, with approximately 0.04 acre occurring in the Upper Clear Fork Cowlitz watershed and 0.01 acre of grading in the Upper Tieton watershed. However, with the implementation of Mitigation Measure MM1, these impacts would be avoided so that there would be no long-term, direct impacts to wetlands due to grading under Alternative 9.

Under Alternative 9, the infill alternative, there would be no expansion of the SUP area. The *PCT* chairlift and corresponding trails would be built in the existing SUP area. A total of approximately 0.02 acre of clearing (refer to Table 3.3-13) would take place within wetlands in the Upper Tieton River watershed portion of the White Pass Study Area. All of the 0.02 acre of proposed vegetation clearing, would occur in slope wetlands, and would follow the clearing prescriptions in Table 2.4-1. Potential impacts to slope wetlands from clearing would be minimized through implementation of Mitigation Measures MM8 and MM9 outlined in Table 2.4-2. Under Alternative 9, no clearing would take place in either riverine or depressional wetlands (refer to Table 3.3-13).

Grading impacts to Riparian Reserves would be as described for Alternative 2.

As described under Alternative 2, operational and maintenance activities that indirectly impact wetlands would primarily be limited to wetlands on existing ski trails under Alternative 9.

3.3.3.3 Riparian Zones

As discussed previously, direct impacts to Riparian Reserves and RIAs can have indirect effects on streams, wetlands, flow regime, and water quality. Since the other sections discuss the potential indirect effects from activities in Riparian Reserves and RIAs in detail, the analyses in this subsection will focus on potential direct impacts to Riparian Reserves and RIAs.

Alternative 1

Under Alternative 1, the proposed expansion of White Pass Ski Area would not occur, and no direct or indirect impacts to Riparian Reserves and RIAs would occur from construction activities. Impacts to Riparian Reserves and RIAs from the ongoing operation and maintenance of White Pass Ski Area would continue under Alternative 1. Therefore, the condition of the Riparian Reserves and RIAs within the White Pass Study Area would remain as described in Section 3.3.3.2 – Affected Environment.

Alternative 2

Riparian Reserves

Under Alternative 2, the largest proposed impact to Riparian Reserves, on the basis of intensity, would be the complete removal of riparian function through the installation of one culvert under the bottom terminal of the Hogback Express chairlift. There would be no change to the permanent road network in the White Pass Study Area under Alternative 2. As such, there would be no additional direct impacts to Riparian Reserves in the White Pass Study Area from road crossings. The proposed culvert would directly impact Riparian Reserves by constraining the stream, eliminating riparian functions, and providing sites of increased sediment recruitment and erosion concerns. The size of the proposed culvert would be determined in the Construction Plan, however as specified in Mitigation Measure MM6 (refer to Table 2.4-2), the culvert would be sized to pass the 100-year event, including debris passage. In addition to the proposed culvert, 11 low-elevation, aerial utility crossings are proposed in the SUP expansion area to provide power to the two lifts and the mid-mountain lodge. The aerial utility crossings over the channel (at ground surface elevation – refer to Illustration 2.3 FEIS4) would directly impact Riparian Reserves by eliminating riparian functions within the utility corridor, such as the loss of riparian vegetation within the crossing corridor (refer to Table 3.3-14).

Table 3.3-14:
Summary of Potential Impacts to Riparian Reserves in the White Pass Study Area

Parameter	Alt. 1	Alt. 2	Mod. Alt. 4	Alt. 6	Alt. 9
Riparian Reserve Area (acres)	632.3	No Change			
Proposed Clearing in Riparian Reserves (acre)	0.0	13.5	14.7	8.6	15.7
Proposed Grading in Riparian Reserves (acre)	0.0	4.2	11.1	4.0	8.7
Total Impacts to Riparian Reserves (acre)	**0.0**	**17.7**	**25.8**	**12.6**	**24.4**
Reduction in Average Canopy Cover	0.0%	2.8%	4.1%	2.0%	3.8%
Resulting Average Canopy Cover	48.0%	45.2%	43.9%	46.0%	44.2%

Under Alternative 2, there would be approximately 4.2 acres of grading in Riparian Reserves in the White Pass Study Area (refer to Table 3.3-14). Most of the proposed grading work would result in short-term, direct impacts to Riparian Reserves because the areas of proposed grading for utility installation and grading in the vicinity of the bottom terminal would be restored through replacement of topsoil and revegetation with native species. Following construction, these areas would be maintained as ski trails, so there would be a long-term direct impact to some riparian functions, but functions such as filtering sediment, floodwater storage, and stream bank stabilization would not be affected over the long-term because the trails would be maintained in a modified vegetative condition. Approximately 13.5 acres of Riparian Reserves in the White Pass Study Area would be cleared under Alternative 2 (refer to Table 3.3-14). These clearing impacts to Riparian Reserves would result in long-term, direct impacts to forest communities and the functions associated with upland forests within Riparian Reserves. The total impact to Riparian Reserves under Alternative 2 would be 17.7 acres, which represents approximately 2.8 percent of the Riparian Reserves in the White Pass Study Area.

The 17.7 acres of clearing and grading within Riparian Reserves under Alternative 2 would immediately reduce any LWD input that these areas currently provide to the streams, although the clearing in parkland is not anticipated to result in the loss of large wood due to the comparatively small tree size class in the parkland community (refer to Section 3.5 – Vegetation). These clearing and grading impacts would reduce the average canopy coverage in the White Pass Study Area by 2.8 percent so that the resulting average canopy cover would be 45.2 percent (refer to Table 3.3-14), thus indirectly impacting Riparian Reserves by reducing LWD recruitment within the White Pass Study Area. As stated in Section 3.3.2 – Affected Environment, LWD is not a dominant component of stream channel structure and function of Type Aa+ and Type A streams within the White Pass Study Area because of the lack of large trees within the Riparian Reserves. All of the clearing and grading under Alternative 2 would occur in the Upper Clear Fork Cowlitz watershed. However, LWD is abundant within the Lower Clear Fork Cowlitz subwatershed, with more than 80 pieces per mile (USDA 1998a). Therefore, no detrimental effects to LWD recruitment within this subwatershed are expected from implementation of Alternative 2. Implementation of Mitigation Measure MM7 (refer to Table 2.4-2) would further reduce impacts to LWD recruitment within the White Pass Study Area. The breakdown of canopy coverage reduction by watershed is shown in Table 3.3-15.

Under Alternative 2, the average canopy coverage of the White Pass Study Area would be reduced by approximately 2.8 to 45.2 percent (refer to Table 3.3-14), with a more open canopy cover occurring in Hogback Basin. The resulting canopy coverage is not expected to indirectly impact the stream temperatures within the White Pass Study Area because most of the affected streams occur in Hogback Basin and are ephemeral or intermittent. As a result, these streams are dry during the season with the highest solar exposure (i.e., summer). When they are flowing, these streams have high channel gradients with turbulent cascades, riffles, and falls, which cool the stream water regardless of the amount of canopy cover. Implementation of Mitigation Measures MM3 and MM10 would reduce the amount of indirect impacts to shading within Riparian Reserves.

The 17.7 total acres of direct impacts to Riparian Reserves under Alternative 2 would also indirectly impact the adjacent undisturbed Riparian Reserves through increasing the windthrow potential. The windthrow potential would be reduced through forest edge feathering and scalloping trail edge treatments under Alternative 2. Due to the specialized trail clearing treatments and the open nature of the forest communities in the White Pass Study Area, the amount of windthrow in Riparian Reserves is expected to remain similar to background levels. No new permanent roads would be constructed under Alternative 2, therefore increases in the transportation and establishment of noxious weeds into Riparian Reserves would be unlikely to occur. The greatest increase in noxious weed potential would continue to be at the existing 28 road crossings of streams and at the proposed new culvert. The construction of ski trails through and adjacent to Riparian Reserves may increase the potential for noxious weed establishment within the White Pass Study Area. Implementation of Mitigation Measure MM10 and Management

Requirement MR7 (refer to Table 2.4-2 and Table 2.4-3) would reduce potential indirect impacts to Riparian Reserves from noxious weeds.

Table 3.3-15:
Potential Impacts to Riparian Reserves in the Upper Clear Fork Cowlitz River Watershed and the Upper Tieton River Watershed Portions of the White Pass Study Area

Parameter	Alt. 1		Alt. 2		Mod. Alt. 4		Alt. 6		Alt. 9	
	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton
Riparian Reserve Area (acres)	395.3	237.0	No Change							
Proposed Clearing in Riparian Reserves (acre)	0.0	0.0	13.5	0.0	13.9	0.8	8.0	0.6	0.5	15.2
Proposed Grading in Riparian Reserves (acre)	0.0	0.0	4.2	0.0	8.3	2.8	2.7	1.3	3.6	5.1
Total Impacts to Riparian Reserves (acre)	**0.0**	**0.0**	**17.7**	**0.0**	**22.2**	**3.6**	**10.7**	**1.9**	**4.1**	**20.3**
Reduction in Ave. Canopy Cover	0.0%	0.0%	4.5%	0.0%	5.6%	1.5%	2.7%	0.8%	1.0%	8.6%
Resulting Ave. Canopy Cover	46.5%	49.5%	42.0%	49.5%	40.9%	47.9%	43.8%	48.7%	45.5%	40.9%

Riparian Influence Areas

A site-specific amendment to the GPNF Forest Plan would be required to allow for the construction of ski area facilities within RIAs along streams. The effects for Alternative 2, described below, take into account implementation of this amendment.

Under Alternative 2, there would be approximately 0.8 acre of grading in RIAs within the White Pass Study Area (refer to Table 3.3-16 and Figure 3-28). Grading within RIAs could result in either a short-term direct impact or a long-term direct impact depending on the construction activity. Long-term direct impacts to RIAs would result from construction activities that would eliminate all riparian function, such as the creation of impervious surfaces (buildings, lift towers and terminals, and roads) and the installation of bridges and culverts. Short-term direct impacts would result from construction activities such as the proposed grading for utility installation and grading in the vicinity of the bottom terminal, all of which would be restored through revegetation with native species. Following construction, these areas would be maintained as ski trails. Riparian functions, such as filtering sediment, floodwater storage, and stream bank stabilization, would not be affected over the long-term because the trails would be maintained in a modified vegetative condition over time.

Approximately 1.8 acres of RIAs within the White Pass Study Area would be cleared under Alternative 2 (refer to Table 3.3-16 and Figure 3-28). These clearing impacts to RIAs would result in long-term, direct impacts to forest communities and the riparian functions that they typically perform, such as nutrient and LWD inputs. The total amount of direct impacts to RIAs under Alternative 2 would be 2.6 acres, which represents approximately 1.8 percent of the RIAs within the White Pass Study Area. Implementation of BMPs and Mitigation Measures such as MM1, MM3, and MM10 (refer to Table 2.4-2) and Management Requirement MR1 (refer to Table 2.4-3) would help reduce the loss of riparian function of RIAs within the White Pass Study Area under Alternative 2.

Table 3.3-16:
Summary of Potential Impacts to Riparian Influence Areas in the White Pass Study Area

Parameter	Alt. 1	Alt. 2	Mod Alt. 4	Alt. 6	Alt. 9
Riparian Influence Area (acres)	147.4	No Change			
Proposed Clearing in RIAs (acres):					
On High Erosion Potential Soils	N/A	0.0	0.0	0.0	0.0
On Medium Erosion Potential Soils	N/A	1.8	1.7	1.0	0.4
On Low Erosion Potential Soils	N/A	0.0	0.1	0.1	6.6
Total Clearing in RIAs (acres)	**N/A**	**1.8**	**1.8**	**1.0**	**7.0**
Proposed Grading in RIAs (acres):					
On High Erosion Potential Soils	N/A	0.0	1.0	0.0	1.0
On Medium Erosion Potential Soils	N/A	0.7	3.1	0.3	2.2
On Low Erosion Potential Soils	N/A	0.1	0.1	0.1	0.8
Total Grading in RIAs (acres)	**N/A**	**0.8**	**4.1**	**0.4**	**4.0**
Total Impacts to RIAs (acres)	**N/A**	**2.6**	**5.9**	**1.4**	**11.0**

Note: Totals may vary due to rounding

Indirect impacts resulting from clearing and grading in RIAs would be increased sediment yield to streams and wetlands within the White Pass Study Area from construction activities. **Under Alternative 2, there would be no clearing or grading on High Erosion Potential Soils within RIAs, but 0.7 acre of grading and 1.8 acres of clearing would occur on Medium Erosion Potential Soils (refer to Table 3.3-16), which has the potential to indirectly impact streams through mass wasting and other erosion occurrences.** All of these indirect clearing and grading impacts within RIAs would take place in the Upper Clear Fork Cowlitz watershed and not in the Upper Tieton watershed (refer to Table 3.3-17). These indirect impacts to RIAs would likely create elevated sediment yields to streams above existing levels because of the erosion potential of the soils that lie within RIAs. The use of BMPs and implementation of Mitigation Measures MM2, MM3, MM8, and MM10 as well as Management Requirement MR1 would help reduce the sediment yield to streams from RIAs (refer to Tables 2.4-2 and 2.4-3).

Table 3.3-17:
Potential Impacts to Riparian Influence Areas in the Upper Clear Fork Cowlitz River Watershed and the Upper Tieton River Watershed Portions of the White Pass Study Area

Parameter	Alt. 1		Alt. 2		Mod. Alt. 4		Alt. 6		Alt. 9	
	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton
Riparian Influence Area (acres)	94.5	52.9	No Change							
Proposed Clearing in RIAs (acres):										
On High Erosion Soils	N/A	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
On Medium Erosion Soils	N/A	N/A	1.8	0.0	1.7	0.0	1.0	0.0	0.0	0.4
On Low Erosion Soils	N/A	N/A	0.0	0.0	0.02	0.1	0.1	0.0	0.0	6.7
Total Clearing in RIAs (acres)	**N/A**	**N/A**	**1.8**	**0.0**	**1.7**	**0.1**	**1.0**	**0.0**	**0.0**	**7.0**
Proposed Grading in RIAs (acres):										
On High Erosion Soils	N/A	N/A	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0
On Medium Erosion Soils	N/A	N/A	0.7	0.0	2.9	0.1	0.3	0.0	2.0	0.1
On Low Erosion Soils	N/A	N/A	0.1	0.0	0.09	0.02	0.1	0.0	0.0	0.8
Total Grading in RIAs (acres)	**N/A**	**N/A**	**0.8**	**0.0**	**4.0**	**0.1**	**0.4**	**0.0**	**3.0**	**0.9**
Total Impacts to RIAs (acres)	**N/A**	**N/A**	**2.6**	**0.0**	**5.7**	**0.2**	**1.4**	**0.0**	**3.0**	**8.0**

Note: Totals may vary due to rounding

Another indirect impact as a result of clearing within RIAs under Alternative 2 would be the creation of additional lengths of streams with unstable banks. Refer to the discussion of stream bank stability under Section 3.3.3.1 – Streams.

Modified Alternative 4

Riparian Reserves

Under Modified Alternative 4, the largest proposed impact to Riparian Reserves, on the basis of intensity, would be the complete removal of riparian function through the construction of the new parking lot, which would occupy 1.58 acres of Riparian Reserves and disturb another 0.48 acre during construction. In addition, the construction of a bridge over a perennial stream for Trail 4-16 would be among the largest impacts to Riparian Reserves. Like Alternative 2, there would be no change to the permanent road network in the White Pass Study Area under Modified Alternative 4, so there would be no additional direct impacts to Riparian Reserves within the White Pass Study Area from road crossings. The parking lot, bridge and 11 culverts (for Trail 4-18) would directly impact Riparian Reserves by eliminating riparian functions and providing sites of increased sediment recruitment and erosion concerns. In addition to the proposed bridge, 11 aerial utility crossings would directly impact Riparian Reserves by eliminating riparian functions within the utility corridor, as described in Alternative 2. Impacts to Riparian Reserves due to utility line installation under Modified Alternative 4 would be greater than under Alternative 2, because a waterline would be installed in conjunction with the power and communication lines to provide a water supply to the proposed mid-mountain lodge. However, all utilities would be installed within the specified 15-foot wide utility disturbance corridor (refer to Table 2.3.1-2). If it is determined that the proposed waterline would substantially affect streams and wetlands, an on-site well would be drilled to provide a water supply for the proposed mid-mountain lodge (refer to Section 3.13- Utilities and Infrastructure). The well would be located upslope of the mid-mountain lodge, within the 50-foot disturbance corridor surrounding the lodge and would not impact Riparian Reserves.

Under Modified Alternative 4, there would be approximately 11.1 acres of grading in Riparian Reserves in the White Pass Study Area (refer to Table 3.3-14). With the exception of the parking lot, described above, the short-term and long-term direct impacts to Riparian Reserves would be similar to Alternative 2, with the addition of the construction of trails 4-16, 4-17, and 4-18. Approximately 14.7 acres of Riparian Reserves in the White Pass Study Area would be cleared under Modified Alternative 4 (refer to Table 3.3-14) and these clearing impacts to Riparian Reserves would result in long-term, direct impacts to forest communities and the functions associated with upland forests within Riparian Reserves. The total impact to Riparian Reserves under Modified Alternative 4 would be 25.8 acres, which represents approximately 4.1 percent of the Riparian Reserves within the White Pass Study Area. Within Upper Clear Fork Cowlitz River watershed, there would be 4.5 more acres of impacts to Riparian Reserves under Modified Alternative 4 than under Alternative 2 (refer to Table 3.3-15). The alignment of the lifts and trails under Modified Alternative 4 results in less clearing along the ephemeral streams in the upper Hogback Basin. Including the additional clearing and grading for Trail 4-16 (which is not a component of Alternative 2), Modified Alternative 4 would result in greater disturbance to Riparian Reserves in Pigtail and Hogback Basins. However, under Modified Alternative 4, clearing and grading within the existing SUP area would result in less disturbance to forest stands with old-growth characteristics, as compared to

Alternative 9 (refer to Section 3.5 – Vegetation). Additionally, implementation of Mitigation Measures MM3 and MM10 would reduce the amount of indirect impacts within Riparian Reserves (refer to Table 2.4-2).

The 25.8 acres of clearing and grading within Riparian Reserves under Modified Alternative 4 would immediately reduce any LWD input that these areas currently provide to the streams, although the clearing in parkland is not anticipated to result in the loss of large wood due to the comparatively small tree size class in the parkland community (refer to Section 3.5 – Vegetation). These clearing and grading impacts would reduce the average canopy coverage in the White Pass Study Area by 4.1 percent so that the resulting average canopy cover would be 43.9 percent (refer to Table 3.3-14), thus indirectly impacting Riparian Reserves as described under Alternative 2. A total of 22.2 acres of clearing and grading under Modified Alternative 4 would occur in the Upper Clear Fork Cowlitz watershed and 3.6 acres of clearing and grading would occur in the Upper Tieton watershed (refer to Table 3.3-15). Implementation of Mitigation Measure MM7 (refer to Table 2.4-2) would further reduce impacts to LWD recruitment within the White Pass Study Area.

The resulting average canopy coverage, 40.9 percent in the Upper Clear Fork Cowlitz watershed and 47.9 percent in the Upper Tieton watershed (Table 3.3-15), is not expected to indirectly impact the stream temperatures within the White Pass Study Area because most of the affected streams occur in the Hogback Basin and are ephemeral or intermittent. As a result, these streams are dry during the season with the highest solar exposure (i.e., summer). Clearing along perennial reaches, associated with Trail 4-18 would occur along perennial reaches. When they are flowing, these streams have high channel gradients with turbulent cascades, riffles, and falls, which cool the stream water regardless of the amount of canopy cover. Implementation of Mitigation Measures MM3 and MM10 would minimize the amount of indirect impacts to shading within Riparian Reserves by reducing solar exposure to streams.

Approximately, 25.8 total acres of direct impacts to Riparian Reserves under Modified Alternative 4 would also indirectly impact the adjacent undisturbed Riparian Reserves through increased windthrow potential, as described under Alternative 2. No new permanent roads would be constructed under Modified Alternative 4, therefore increases in the transportation and establishment of noxious weeds into Riparian Reserves would not occur. The greatest increase in noxious weed potential would continue to be at the existing 28 road crossings of streams. The construction of ski trails through and adjacent to Riparian Reserves may increase the potential for noxious weed establishment within the White Pass Study Area. Implementation of Mitigation Measure MM10 and Management Requirement MR7 (refer to Table 2.4-2 and Table 2.4-3) would reduce potential indirect impacts to Riparian Reserves from noxious weeds.

The PCT reroute occurs on top of a ridge, so there would be no impact to Riparian Reserves.

Riparian Influence Areas

A site-specific amendment to the GPNF Forest Plan would be required to allow for the construction of ski area facilities within RIAs along streams. The effects of Modified Alternative 4, described below, take into account implementation of this amendment.

Under Modified Alternative 4, there would be approximately 4.1 acres of grading in RIAs within the White Pass Study Area (refer to Table 3.3-16 and Figure 3-29). As described in Alternative 2, grading within RIAs could result in either a short-term direct impact or a long-term direct impact depending on the construction activity. Following construction, these areas would be maintained as ski trails. Riparian functions such as filtering sediment, floodwater storage, and stream bank stabilization would not be affected over the long-term, because the trails would be maintained in a modified vegetative condition. Approximately 1.8 acres of RIAs within the White Pass Study Area would be cleared under Modified Alternative 4 (refer to Table 3.3-16 and Figure 3-29). These clearing impacts to RIAs would result in long-term, direct impacts to forest communities as described in Alternative 2. The total amount of direct impacts to RIAs under Modified Alternative 4 would be 5.9 acres, which represents approximately 4 percent of the RIAs within the White Pass Study Area. Implementation of BMPs and Mitigation Measures such as MM1, MM3, and MM10 (refer to Table 2.4-2) and Management Requirement MR1 (refer to Table 2.4-3) would help reduce the loss of riparian function in RIAs within the White Pass Study Area under Modified Alternative 4.

Indirect impacts resulting from clearing and grading in RIAs would include increased sediment yield to streams and wetlands within the White Pass Study Area from construction activities. Under Modified Alternative 4, there would be no clearing on High Erosion Potential Soils within RIAs, however approximately 1.0 acre of grading would occur in High Erosion Potential Soils in RIAs within the White Pass Study Area. Approximately 3.1 acres of grading and 1.7 acres of clearing would occur on Medium Erosion Potential Soils (refer to Table 3.3-16 and Table 3.3-17). These activities have the potential to indirectly impact streams through mass wasting and other erosion occurrences. These indirect impacts to RIAs would likely create slightly elevated sediment yields to streams above existing levels because of the erosion potential of the soils within RIAs. The use of BMPs and implementation of Mitigation Measures MM2, MM3, MM8, and MM10 as well as Management Requirement MR1 would help reduce the sediment yield to streams from RIAs.

Another indirect impact as a result of clearing within RIAs under Modified Alternative 4 would be the creation of additional lengths of streams with unstable banks (refer to Section 3.3.3.1 – Streams).

Alternative 6

Riparian Reserves

Under Alternative 6, the largest proposed impact to Riparian Reserves, on the basis of intensity, would be the construction of the 2.5-acre parking lot, which would eliminate riparian function in approximately 1.9 acres of Riparian Reserves. In addition, the complete removal of riparian function through the installation of four culverts for the proposed road to the bottom terminal of the *Basin* chairlift would rank among the larger Riparian Reserve impacts in Alternative 6. The culverts would directly impact Riparian Reserves by constricting the stream channel, eliminating riparian functions, and providing sites of increased sediment recruitment and erosion concerns. Under Alternative 6, there would be no aerial utility crossings because the proposed lodge and *Basin* chairlift would be in a location served by a road (refer to Figure 2-7), and the utilities serving the chairlift and lodge would be buried within the road corridor, which has culverted crossings.

Under Alternative 6, there would be approximately 4.0 acres of grading in Riparian Reserves within the White Pass Study Area (refer to Table 3.3-14). Short-term and long-term direct impacts to Riparian Reserves would be similar to Alternative 2. Approximately 8.6 acres of Riparian Reserves within the White Pass Study Area would be cleared under Alternative 6 (refer to Table 3.3-14) and these clearing impacts to Riparian Reserves would result in long-term, direct impacts to forest communities and the functions associated with upland forests within Riparian Reserves. The total impact to Riparian Reserves under Alternative 6 would be 12.6 acres, which represents approximately 2.0 percent of the Riparian Reserves within the White Pass Study Area, the lowest impact among the Action Alternatives.

The 12.6 acres of clearing and grading within Riparian Reserves under Alternative 6 would immediately reduce any LWD input that these areas currently provide to the streams, although the clearing in parkland is not anticipated to result in the loss of large wood because of the comparatively smaller tree size classes that occur in parkland (refer to Section 3.4 – Vegetation). These clearing and grading impacts would reduce the average canopy coverage in the White Pass Study Area by 2.0 percent so that the resulting average canopy cover would be 46.0 percent (refer to Table 3.3-14), thus indirectly impacting Riparian Reserves, as described under Alternative 2. Approximately 10.7 acres of the clearing and grading under Alternative 6 would occur in the Upper Clear Fork Cowlitz watershed and 1.9 acres of clearing and grading would occur in the Upper Tieton watershed (refer to Table 3.3-15). Implementation of Mitigation Measure MM7 (refer to Table 2.4-2) would further reduce impacts to LWD recruitment within the White Pass Study Area.

The resulting average canopy coverage, 43.8 percent in the Upper Clear Fork Cowlitz watershed and 48.7 percent in the Upper Tieton watershed (refer to Table 3.3-15), is not expected to indirectly impact the stream temperatures within the White Pass Study Area because most of the affected streams occur in the Hogback Basin and are ephemeral or intermittent. As a result, these streams are dry during the season with the highest solar exposure (i.e., summer). When they are flowing, these streams have high channel gradients with turbulent cascades, riffles, and falls, which cool the stream water regardless of the amount of canopy cover. Implementation of Mitigation Measures MM3 and MM10 would reduce the amount of indirect impacts to shading within Riparian Reserves.

The 12.6 total acres of direct impacts to Riparian Reserves under Alternative 6 would also indirectly impact the adjacent undisturbed Riparian Reserves through increased windthrow potential, as described under Alternative 2. Under Alternative 6, one new permanent road would be constructed; therefore increases in the transportation and establishment of noxious weeds into Riparian Reserves could occur. Implementation of Mitigation Measure MM10 and Management Requirement MR7 (refer to Table 2.4-2 and Table 2.4-3) would reduce potential indirect impacts to Riparian Reserves from noxious weeds.

Riparian Influence Areas

A site-specific amendment to the GPNF Forest Plan would be required to allow for the construction of ski area facilities within RIAs along streams. The effects of Alternative 6 take into account implementation of this amendment.

Under Alternative 6, there would be approximately 0.4 acre of grading in RIAs within the White Pass Study Area (refer to Table 3.3-16 and Figure 3-28). As described in Alternative 2, grading within RIAs could result in either short-term direct impacts or long-term direct impacts, depending on the construction activity. Following construction, these areas would be maintained as ski trails. Riparian functions, such as filtering sediment, floodwater storage, and stream bank stabilization, would not be affected over the long-term, because the trails would be maintained in a modified vegetative condition. Approximately 1.0 acre of RIAs within the White Pass Study Area would be cleared under Alternative 6 (refer to Table 3.3-16 and Figure 3-28). These clearing impacts to RIAs would result in long-term, direct impacts to forest communities, as described in Alternative 2. The total amount of direct impacts to RIAs under Alternative 6 would be 1.4 acres, which represents approximately 0.9 percent of the RIAs in the White Pass Study Area. Implementation of BMPs, Mitigation Measures MM1, MM3, and MM10 (refer to Table 2.4-2), and Management Requirement MR1 (refer to Table 2.4-3) would help reduce the loss of riparian function in RIAs within the White Pass Study Area under Alternative 6.

Indirect impacts resulting from clearing and grading in RIAs would include increased sediment yield to streams and wetlands within the White Pass Study Area from construction activities. Under Alternative 6, there would be no clearing or grading on High Erosion Potential Soils within RIAs, but 0.3 acre of grading and 1.0 acre of clearing would occur on Medium Erosion Potential Soils (refer to Table 3.3-16), which has the potential to indirectly impact streams through mass wasting and other erosion occurrences. All 1.4 acres of these indirect clearing and grading impacts within RIAs would take place in the Upper Clear Fork Cowlitz watershed and none would occur in the Upper Tieton watershed (refer to Table 3.3-17). These indirect impacts to RIAs would likely create slightly elevated sediment yields to streams above existing levels, because of the erosion potential of the soils within RIAs. The use of BMPs and implementation of Mitigation Measures MM2, MM3, MM8, and MM10, as well as Management Requirement MR1, would help reduce the sediment yield to streams from RIAs.

Another indirect impact as a result of clearing within RIAs under Alternative 6 would be the creation of additional lengths of streams with unstable banks (refer to Section 3.3.3.1 – Streams).

Alternative 9

Riparian Reserves

Under Alternative 9, the largest proposed impact to Riparian Reserves, on the basis of intensity, would be the construction of the 2.5-acre parking lot, as described for Alternative 6. **In addition, the complete removal of riparian function through the installation of 11 culverts and 4 bridges over streams for ski trails would be among the largest impacts to Riparian Reserves under Alternative 9.** As described under Alternative 2, there would be no change to the permanent road network in the White Pass Study Area under Alternative 9, so there would be no additional direct impacts to Riparian Reserves within the White Pass Study Area from road crossings. The proposed culverts and bridges would directly impact Riparian Reserves by constricting the stream channel, eliminating riparian functions, and providing sites of increased sediment recruitment and erosion concerns.

Under Alternative 9, there would be approximately 8.7 acres of grading and approximately 15.7 acres of clearing in Riparian Reserves within the White Pass Study Area (refer to Table 3.3-14). These grading and clearing impacts to Riparian Reserves would result in long-term, direct impacts to forest communities and the associated functions of Riparian Reserves. A majority of clearing and grading within the existing ski area would occur in forest stands with old-growth characteristics, the most of any alternative (refer to Section 3.5 – Vegetation and Appendix G). The total impact to Riparian Reserves under Alternative 9 would be 24.4 acres, which represents approximately 3.8 percent of the Riparian Reserves within the White Pass Study Area.

The 24.4 acres of clearing and grading within Riparian Reserves under Alternative 9 would immediately reduce any LWD input that these areas currently provide to the streams, particularly given that the proposed clearing would remove trees that are capable of providing LWD, unlike the parkland vegetation described under Alternative 2, Modified Alternative 4, and Alternative 6. These clearing and grading impacts would reduce the average canopy coverage in the White Pass Study Area by 3.8 percent so that the resulting average canopy cover would be 44.2 percent (refer to Table 3.3-14), thus indirectly impacting Riparian Reserves as described under Alternative 2. Approximately 4.1 acres of clearing and grading under Alternative 9 would occur in the Upper Clear Fork Cowlitz watershed and 20.3 acres of clearing and grading would occur in the Upper Tieton watershed (refer to Table 3.3-15). Implementation of Mitigation Measure MM7 (refer to Table 2.4-2) would reduce impacts to LWD recruitment within the White Pass Study Area.

The resulting average canopy coverage, 45.5 percent in the Upper Clear Fork Cowlitz watershed and 40.9 percent in the Upper Tieton watershed (Table 3.3-15), has the highest potential of all Action Alternatives to increase the stream temperatures within the White Pass Study Area, because the majority of canopy removal would take place along perennial streams. These streams drain groundwater seeps and/or snowmelt when flowing, and have high channel gradients with turbulent cascades, riffles, and falls, which cool the stream water regardless of the amount of canopy cover. Implementation of Mitigation Measures MM3 and MM10 would minimize the amount of indirect impacts to shading within Riparian Reserves.

The 24.4 total acres of direct impacts to Riparian Reserves under Alternative 9 would also indirectly impact the adjacent undisturbed Riparian Reserves through increased windthrow potential. No new permanent roads would be constructed under Alternative 9, therefore increases in the transportation and establishment of noxious weeds into Riparian Reserves would not occur. The greatest increase in noxious weed potential would continue to be at the existing 28 road crossings of streams as well as the 11 new culverts and 4 new bridges that would be constructed under Alternative 9. The construction of ski trails through and adjacent to Riparian Reserves may increase the potential for noxious weed establishment within the White Pass Study Area. Implementation of Mitigation Measure MM10 and Management Requirement MR7 (refer to Table 2.4-2 and Table 2.4-3) would reduce potential indirect impacts to Riparian Reserves from noxious weeds.

Riparian Influence Areas

A site-specific amendment to the GPNF Forest Plan would be required to allow for the construction of ski area facilities within RIAs along streams. The effects of Alternative 9, described below, take into account implementation of this amendment.

Under Alternative 9, there would be approximately 4.0 acres of grading in RIAs within the White Pass Study Area (refer to Table 3.3-16 and Figure 3-30). As described in Alternative 2, grading within RIAs could result in either short-term direct impacts or long-term direct impacts, depending on the construction activity. Following construction, these areas would be maintained as ski trails. Riparian functions, such as filtering sediment, floodwater storage, and stream bank stabilization, would not be affected over the long-term because the trails would be maintained in a modified vegetative condition over time. Approximately 7.0 acres of RIAs within the White Pass Study Area would be cleared under Alternative 9 (refer to Table 3.3-16 and Figure 3-30). These clearing impacts to RIAs would result in long-term, direct impacts to forest communities similar to those described for Alternative 2. The total amount of direct impacts to RIAs under Alternative 9 would be approximately 11.0 acres, which represents approximately 7.5 percent of the RIAs within the White Pass Study Area. Implementation of BMPs, Mitigation Measures MM1, MM3, and MM10 (refer to Table 2.4-2), and Management Requirement MR1 (refer to Table 2.4-3) would help reduce the loss of riparian function in RIAs within the White Pass Study Area under Alternative 9.

Indirect impacts resulting from clearing and grading in RIAs would include increased sediment yield to streams and wetlands within the White Pass Study Area from construction activities. Under Alternative 9, there would be approximately 1.0 acre of grading on High Erosion Potential Soils within RIAs as well as approximately 2.2 acres of grading and 0.4 acre of clearing on Medium Erosion Potential Soils (refer to Table 3.3-16), which has the potential to indirectly impact streams through mass wasting and other erosion events. Approximately 3.0 acres of these indirect clearing and grading impacts within RIAs would take place in the Upper Clear Fork Cowlitz watershed and 8.0 acres would occur in the Upper Tieton watershed (refer to Table 3.3-17). These indirect impacts to RIAs would likely create slightly elevated amounts of sediment yield to streams above existing levels because of the erosion potential of the soils within RIAs. The use of BMPs and implementation of Mitigation Measures MM2, MM3, MM8, and MM10, as well as Management Requirement MR1, would help reduce the amount of sediment yield to streams from RIAs.

Another indirect impact as a result of clearing within RIAs under Alternative 9 would be the creation of additional lengths of streams with unstable banks (refer to Section 3.3.3.1 – Streams).

3.3.3.4 Water Quality

Direct impacts to water quality are impacts that would occur from new point sources, either chemical or thermal. Activities that are most likely to indirectly impact water quality within the White Pass Study Area are those that may occur within Riparian Reserves, such as clearing of riparian vegetation, construction of roads and other ski area facilities, or grading within RIAs. These activities are discussed in more detail in the Riparian Zones discussion of this section. Potential indirect impacts to water quality include the following:

- Increased sediment yield to streams and wetlands from clearing and grading,
- Increased pollutant runoff from construction equipment into streams and wetlands,
- Increased water temperatures resulting from the removal of riparian vegetation and subsequent increases in solar radiation.

Alternative 1

Under Alternative 1, the White Pass Ski Area expansion would not occur, therefore no impacts to water quality would occur from construction activities. Impacts to water quality from the ongoing operation of White Pass that result in sediment detachment and potential yield to streams would continue to occur under Alternative 1 (refer to Appendix L – WEPP Technical Report). Therefore, the condition of water quality within the White Pass Study Area and the 5th field watershed would remain as described in Section 3.3.2 – Affected Environment.

Alternative 2

There would be no new point sources of pollution (chemical or thermal) that would affect water quality within the Upper Tieton and Upper Clear Fork Cowlitz watersheds, therefore no direct impacts to water quality would occur under Alternative 2. Indirect impacts to water quality could occur from the proposed project through increased sediment yield and changes in turbidity, pH, stream temperature, and DO.

Clearing and grading for lift, trail, road, and building construction within RIAs would increase the risk of erosion and sediment yield to streams and wetlands. The major source of sediment within the Upper Clear Fork Cowlitz watershed is clearing and grading associated with construction of the bottom terminals of the chairlifts. No impacts would occur within the Upper Tieton River watershed under Alternative 2. Tree island removal would result in comparatively less impact than full clearing due to a reduced disturbance area through selective tree removal. Approximately 2.6 acres of clearing and grading would occur within RIAs under Alternative 2 (refer to Table 3.3-16).

As described in Table 3.3 FEIS4, short-term (year of construction) sediment detachment generated within the White Pass Study Area from project activities would increase by a total of approximately 23 percent. Long-term (two to five years following construction) sediment detachment is expected to increase by approximately 4 percent under Alternative 2 (refer to Appendix L – WEPP Technical Report). There would be no change to the estimated long-term soil detachment within the Upper Tieton watershed as no construction activities would occur in the watershed under Alternative 2. It is important to note that the output of the process provides an estimate of *soil detachment*, and not actual delivery to the stream system.

Table 3.3 FEIS4:
WEPP Model Estimates of Soil Detachment for the White Pass Study Area

Soil Detachment	Alternative 2		Modified Alternative 4		Alternative 6		Alternative 9	
	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton	Upper Clear Fork Cowlitz	Upper Tieton
Short-term (tons/yr)	126.5	133.7	173.1	133.8	112.7	133.8	131.8	150.8
Short-term Increase (%)	23%	0.0%	68%	0.1%	9%	0.1%	28%	12.8%
Long-term (tons/yr)	107.2	133.7	113.3	133.9	107.8	133.7	106.6	134.8
Long-term Increase (%)	4%	0.0%	10%	0.2%	5%	0.1%	3%	0.8%

Note: WEPP model estimates of soil detachment for Alternative 1 are included in Table 3.3-FEIS 3.

Research has indicated that silt fences trap 90 percent (or more) of sediment from hillslope erosion (Robichaud and Brown 2002). Revegetation of exposed hillslopes has been shown to reduce erosion by greater than 70 percent using native vegetation (Grace 2002). Sediment basins are approximately 50-70 percent effective in trapping sediment during large storm events, or during periods of minimal vegetative cover at a construction site (TDEC 2002). The use of silt fences would constitute a short-term measure during construction (silt fences are typically removed after the site stabilizes) and could reduce potential sediment yields to streams by 90 percent, although it has been estimated that actual effectiveness would be 60 to 65 percent. Furthermore, long-term reductions in sediment yield to streams would be reduced through revegetation and other BMPs (e.g., sediment basins). **Therefore, the implementation of Mitigation Measure MM2, Management Requirement MR1, and Other Management Provisions OMP1 and OMP2 would reduce potential sediment yield through the requirement of a SWPPP and other sediment control measures that minimize impacts to watershed resources (refer to Tables 2.4-2, 2.4-3, and 2.4-4).**

The fate of sediments delivered to Clear Creek and Millridge Creek are similar. Both streams flow into a lake downstream of the existing ski area, Leech Lake and Knuppenberg Lake, respectively. Both lakes act as natural sediment traps, and potential sediment yield generated by existing and proposed ski area operations not otherwise managed on-site would be retained in the lakes. Therefore, sediment impacts from the proposed project would become indistinguishable from sediment input to the watershed downstream of the lakes.

At the bottom terminal of the proposed *Basin* and *Hogback Express* chairlifts and the upper terminal of the proposed *Basin* chairlift, the potential for increased delivery of pollutants (e.g., fuel) to streams and wetlands would be increased during construction, since the terminals would be located within Riparian Reserves. Implementation of Mitigation Measures MM2, MM3, MM4, and MM9 (refer to Table 2.4-2) and Management Requirement MR1 (refer to Table 2.4-3) would minimize the potential for this short-term, indirect delivery of pollutants to streams and wetlands. Specifically, MR1 and MM3 would require implementation of a SWPPP and water quality testing before, during and after construction. The requirements of the SWPPP would ensure state water quality standards are met through the water quality monitoring program and any necessary corrective actions that would be taken on an as-needed basis.

During construction activities, the in-stream pH can be affected by concrete operations near streams because soluble cement constituents, such as lime, can raise the pH of stormwater runoff. Under Alternative 2, construction of the bottom terminals, the upper terminal of the proposed *Basin* chairlift, and the lower lift towers, including concrete footers, would take place within the Riparian Reserves. As a result, the potential for alterations of pH would be greatest under Alternative 2, as compared to the other Action Alternatives. Mitigation Measure MM2 and Management Requirement MR1 would avoid the occurrence of high pH runoff entering water bodies, thereby maintaining the existing pH regime in nearby water bodies.

At the mid-mountain lodge, operation of the re-circulating gravel filter (RGF) wastewater treatment system would provide secondary treatment for an average of 225 gallons per day (refer to Section 3.13 – Utilities and Infrastructure). No measurable change in nutrient loads or biological oxygen demand would be expected due to the low volume, high degree of treatment, and subsurface disposal of effluent.

Approximately 13.5 acres of clearing and 4.2 acres of grading (17.7 acres total) would occur in Riparian Reserves under Alternative 2, resulting in an increased potential for indirect thermal impacts to streams and wetlands (refer to Table 3.3-15). The tree island removal clearing prescription would create minimal impacts to the forest community due to the selective tree removal in subalpine parkland, compared to full clearing. The resulting canopy coverage is not expected to indirectly impact the stream temperatures within the White Pass Study Area because most of the affected streams occur in the Hogback Basin and are ephemeral or intermittent. As a result, these streams are dry during the season with the highest solar exposure (i.e., summer). When they are flowing, these streams have high channel gradients with turbulent cascades, riffles, and falls, which cool the stream water regardless of the amount of canopy cover. **The implementation of Mitigation Measure MM3 (refer to Table 2.4-2) and Other Management Provision OMP5 (refer to Table 2.4-4) would minimize this indirect impact by maintaining a minimum amount of understory shading.** Implementation of Mitigation Measures would result in an immeasurable effect on stream temperature. As a result, stream temperatures would remain well below SWQS. Because water temperature and DO are directly correlated, Alternative 2 would also maintain stream DO concentrations above minimum standards.

Modified Alternative 4

There would be no new point sources of pollution (chemical or thermal) that would affect water quality within the Upper Tieton and Upper Clear Fork Cowlitz watersheds. Therefore, no direct impacts to water quality would occur under Modified Alternative 4. Indirect impacts to water quality could occur from the proposed project through increased sediment yield and changes in turbidity, pH, stream temperature, and DO.

Under Modified Alternative 4, impacts to RIAs include 1.8 acres of clearing and 4.1 acres of grading within RIAs, for a total of 5.9 acres, which is greater than Alternative 2 (refer to Table 3.3-16). The largest grading impact in the Upper Clear Fork Cowlitz watershed would be associated with the construction of trails 4-16, 4-17 and 4-18, while in the Upper Tieton watershed construction of the 7-acre parking lot in the existing SUP area would increase the potential for sediment delivery to down-gradient streams and wetlands.

The representative WEPP model estimated that project-generated sediment detachment, which would potentially reach streams and/or wetlands, would increase by approximately 68.1 percent within the White Pass Study Area during the short-term (refer to Table 3.3 FEIS4). While during the long-term, the estimated project-generated sediment yield would increase by approximately 10.2 percent (refer to Table

3.3 FEIS4), which is the most for any Action Alternative (refer to Appendix L – WEPP Technical Report). Management Requirement MR1 would require the implementation of a SWPPP during construction and proper stabilization/treatment of construction activities. Additionally, as outlined under Alternative 2, fully implemented BMPs are predicted to be 60 to 65 percent effective (conservatively) at containing project-generated sediment. Therefore, with mitigation, sediment delivery due to the parking lot and other construction activities is expected to be negligible.

Impacts from pollutant runoff and changes in pH would be similar to Alternative 2.

As described under Alternative 2, potential impacts to stream temperatures under Modified Alternative 4 would occur from clearing within Riparian Reserves. Approximately 14.7 acres of clearing and 11.1 acres of grading (25.8 acres total) would occur in Riparian Reserves under Modified Alternative 4, which is greater than under Alternative 2. Similar to Alternative 2, the resulting canopy coverage is not expected to indirectly impact the stream temperatures within the White Pass Study Area because most of the affected streams occur in the Hogback Basin and are ephemeral or intermittent. As a result, these streams are dry during the season with the highest solar exposure (i.e., summer). However, canopy removal associated with Trail 4-18 would occur along perennial reaches. When they are flowing, these streams have high channel gradients with turbulent cascades, riffles, and falls, which cool the stream water regardless of the amount of canopy cover. Implementation of Mitigation Measure MM3 (refer to Table 2.4-2) and Other Management Provision OMP5 (refer to Table 2.4-4) would minimize this indirect impacts by maintaining a minimum amount of understory shading and all vegetation less than 3 feet in height within ski trails. Implementation of Mitigation Measures would result in an immeasurable effect on stream temperatures. As a result, stream temperatures would remain well below the SWQS. Because water temperature and DO are directly correlated, Modified Alternative 4 would also maintain stream DO concentrations above minimum standards.

At the mid-mountain lodge, operation of the RGF wastewater treatment system would provide secondary treatment for an average of 225 gallons per day (refer to Section 3.13 – Utilities and Infrastructure). No measurable change in nutrient loads or biological oxygen demand would be expected due to the low volume, high degree of treatment, and subsurface disposal of effluent.

Alternative 6

There would be no new point sources (chemical or thermal) of pollution that would affect water quality within the Upper Tieton and Upper Clear Fork Cowlitz watersheds. Therefore, no direct impacts to water quality would occur under Alternative 6. Indirect impacts to water quality could occur from the proposed project through increased sediment yield and changes in turbidity, pH, stream temperature, and DO.

Road building and road maintenance have been found to be primary sources of sediment inputs. This sediment can be eroded from the road surface, road fills, or slope failures associated with road construction and drainage (Newcombe and MacDonald 1991). Under Alternative 6, a 0.25-mile road is proposed to the bottom terminal of the *Basin* chairlift. This road would have four new culverts, all of which are potential sources of sediment to streams. The use of BMPs and implementation of Mitigation Measures MM2 and MM6 as well as Management Requirement MR1 would help reduce potential sediment impacts to these streams.

Clearing and grading within the RIA could increase sediment yield to nearby streams and wetlands. Approximately 1.0 acre of clearing and 0.4 acre of grading would occur within RIAs under Alternative 6, potentially impacting water quality (refer to Table 3.3-17). Sediment impacts related to clearing and grading would be less than Alternative 2 or Modified Alternative 4, due to the decreased amount of activity in Hogback Basin. Sediment impacts from the parking lot would be less than described under Modified Alternative 4, as a result of the reduced parking lot size.

The representative WEPP model estimated that project-generated sediment detachment, which would potentially reach streams and/or wetlands, would increase by approximately 9.1 percent within the White Pass Study Area during the short-term (Table 3.3 FEIS4). While during the long-term, the estimated project-generated sediment detachment would increase by approximately 5.1 percent (Table 3.3 FEIS 4) (refer to Appendix L – WEPP Technical Report). Implementation of Mitigation Measures MM2, MM3, MM4, and MM9 (refer to Table 2.4-2) and Management Requirement MR1 (refer to Table 2.4-3) would reduce the potential sediment yield by requiring a SWPPP and other erosion control measures to prevent sediment from entering the water. Additionally, as outlined under Alternative 2, fully implemented BMPs are predicted to be 60 to 65 percent effective (conservatively) at containing project-generated sediment. Therefore, with mitigation, sediment delivery due to project-related construction activities is expected to be negligible.

As described under Alternative 2, potential impacts to stream temperatures could occur from clearing within Riparian Reserves under Alternative 6. Approximately 8.6 acres of clearing and 4 acres of grading (12.6 acres total) would occur in Riparian Reserves under Alternative 6, resulting in an increased potential for indirect thermal impacts to streams and wetlands (refer to Table 3.3-15). The resulting canopy coverage is not expected to indirectly impact the stream temperatures within the White Pass Study Area because most of the affected streams occur in the Hogback Basin and are ephemeral or intermittent. As a result, these streams are dry during the season with the highest solar exposure (i.e., summer). When they are flowing, these streams have high channel gradients with turbulent cascades, riffles, and falls, which cool the stream water regardless of the amount of canopy cover. Implementation of Mitigation Measure MM3 (refer to Table 2.4-2) and Other Management Provision OMP5 (refer to Table 2.4-4) would maintain a minimum amount of understory shading and all vegetation less than 3 feet in height within ski trails. As a result, temperature effects under Alternative 6 would be less than the other Action Alternatives. Under Alternative 6, stream temperatures would remain well below SWQS. Because water temperature and DO are directly correlated, Alternative 6 would also maintain stream DO concentrations above minimum standards.

Alternative 9

There would be no new point sources (chemical or thermal) of pollution that would affect water quality within the Upper Tieton and Upper Clear Fork Cowlitz watersheds. Therefore, no direct impacts to water quality would occur under Alternative 9. Indirect impacts to water quality would occur through increased sediment yield and changes in turbidity, pH, stream temperature, and DO.

Clearing and grading within the RIA could increase sediment yield to nearby streams and wetlands. Approximately 7.0 acres of clearing and approximately 4.0 acres of grading would occur within the RIA under Alternative 9, potentially impacting water quality (refer to Table 3.3-17). Sediment impacts related to clearing and grading would be the greatest of all Action Alternatives due to denser canopy coverage within the existing SUP area. Sediment impacts from the parking lot would be as described under Alternative 6.

The representative WEPP model estimated that project-generated sediment detachment, which would potentially reach water resources, would increase by approximately 40.8 percent within the White Pass Study Area during the short-term (Table 3.3 FEIS 4). While during the long-term, the estimated project-generated sediment detachment would increase by approximately 3.8 percent (Table 3.3 FEIS 4). Implementation of Mitigation Measures MM2, MM3, MM4, and MM9 (refer to Table 2.4-2) and Management Requirement MR1 (refer to Table 2.4-3) would reduce the potential sediment yield by requiring a SWPPP and other erosion control measures to prevent sediment from entering the water. Additionally, as outlined under Alternative 2, fully implemented BMPs are predicted to be 60 to 65 percent effective (conservatively) at containing project-generated sediment. Therefore, with mitigation, sediment delivery due to project-related construction activities is expected to be negligible.

Potential impacts to stream temperatures could occur from clearing within Riparian Reserves. Approximately 15.7 acres of clearing and 8.7 acres of grading (24.4 acres total) would occur in Riparian Reserves under Alternative 9, resulting in an increased potential for indirect thermal impacts to streams and wetlands (refer to Table 3.3-15). Clearing impacts under Alternative 9 would be greater than all other Action Alternatives due to the full clearing prescription, and the increased total clearing area. In addition, the majority of the canopy removal under Alternative 9 would occur along perennial streams, which would be more susceptible to thermal impacts than ephemeral or intermittent streams because they are flowing during the summer. Full clearing would not leave any trees remaining within the Riparian Reserves in the eastern portion of the existing SUP area, as compared to tree island removal prescription applied to parkland under Alternatives 2, 6 and Modified Alternative 4. Implementation of Mitigation Measure MM3 (refer to Table 2.4-2) and Other Management Provision OMP5 (refer to Table 2.4-4) would maintain a minimum amount of understory shading and all vegetation less than 3 feet in height within ski trails. Due to the comparatively intense removal of forest canopy under Alternative 9, temperature effects would be greater than under the other Action Alternatives. However, under Alternative 9, stream temperatures would remain well below the SWQS. Because water temperature and DO are directly correlated, Alternative 9 would also maintain stream DO concentrations above minimum standards.

3.3.3.5 Flow Regime

Alternative 1

Water Use

Under Alternative 1, no expansion of the White Pass Ski Area is proposed, therefore there would be no new impacts to the current water use at White Pass and conditions would remain as described in Section 3.3.2 – Affected Environment.

Flow Regime

Under Alternative 1, no expansion of the White Pass Ski Area is proposed, therefore no impacts to the flow regimes of the Upper Clear Fork Cowlitz River and Upper Tieton River watersheds would occur. The flow regimes of the streams within the White Pass Study Area would remain as described in Section 3.3.2 – Affected Environment.

Alternative 2

Water Use

Under Alternative 2, the source of domestic water for the White Pass Ski Area would continue to be from a surface water diversion on Millridge Creek located in the Upper Clear Fork Cowlitz watershed. Due to the proposed increase in the CCC under Alternative 2, the peak water demand during the ski season would increase from 12,561 gallons/day to 23,001 gallons/day (as described in Section 3.13 – Utilities and Infrastructure).

This conservative estimate is based on assumed full utilization of the ski area capacity and facilities and an average water demand of 4.92 gallons/guest/day (refer to Section 3.3.2.5). The projected increase in water demand (based on measured peak demand values) would decrease the daily streamflow in Millridge Creek by approximately 0.016 cfs during the ski season. The projected decrease of 0.016 cfs in Millridge Creek under Alternative 2 was not included in the flow model below because this amount would not be measurable with current monitoring technology and the flow model estimates stream flow impacts for the summer low flow period and the two-year peak flow event when water withdrawals are unlikely by the ski area.

Flow Regime

Under Alternative 2, approximately 19.8 acres of clearing, grading, and construction of impervious surfaces would occur during the construction of the *Hogback Express* and *Basin* chairlifts and associated trails**. The proposed development would result in an estimated 1.4 percent (0.05 cfs) increase in seven-day low flow in the Upper Clear Fork Cowlitz River at the mouth of the Flow Model Analysis Area (refer to Table 3.3-18 and Figure 3-12).** Based on the relatively small projected increase in low flow and the typical amount of instrumentation error associated with measuring discharge rates, it is expected that the estimated increase in seven-day low flow in the Upper Clear Fork Cowlitz River would not be measurable at the mouth of the flow model analysis area with current monitoring technology (refer to Figure 3-12).

The flow model results estimate that the two-year peak flow discharge rate would increase by approximately 0.3 percent (0.5 cfs) over existing conditions in the Upper Clear Fork Cowlitz River as a result of the 19.8 acres of clearing, grading, and new impervious surfaces proposed in Alternative 2 (refer to Table 3.3-18). The relatively small projected increase in two-year peak flow combined with the typical amount of instrumentation error associated with measuring discharge rates suggests that the estimated increase in two-year peak flow in the Upper Clear Fork Cowlitz River would not be measurable at the mouth of the Flow Model Analysis Area with current monitoring technology.

There would be no forest clearing or new impervious surfaces in the Upper Tieton River watershed under Alternative 2, therefore, there would be no changes to the seven-day low flow discharge or to the two-year peak flow discharge of the Upper Tieton River from this project (refer to Table 3.3-18).

Table 3.3-18:
Changes to Flow in the Upper Clear Fork Cowlitz River and Upper Tieton River Watersheds due to Proposed Development in the Flow Model Analysis Area

Watershed	Alt. 1	Alt. 2		Mod. Alt. 4		Alt. 6		Alt. 9	
	Existing Flow	Increase in Flow		Increase in Flow		Increase in Flow		Increase in Flow	
	(cfs)	Percent	cfs	Percent	cfs	Percent	cfs	Percent	cfs
Seven-Day Low Flow									
Upper Clear Fork Cowlitz	3.12	1.4 %	0.05	1.6 %	0.05	0.8 %	0.02	0.7 %	0.02
Upper Tieton	1.23	0.0 %	0.00	2.1 %	0.03	0.7 %	0.01	4.6 %	0.06
Two-Year Peak Flow									
Upper Clear Fork Cowlitz	130.7	0.3 %	0.5	0.4 %	0.5	0.2 %	0.2	0.2 %	0.2
Upper Tieton	54.4	0.0 %	0.0	0.5 %	0.3	0.2 %	0.1	1.1 %	0.6

Note: Calculations of the existing flows have a standard error of 57 percent according to the model. The percentage increase in flows has approximately a 49 percent standard of error.

Due to the comparatively small size of the Flow Model Analysis Area within each modified 5th field watershed and the finding that changes in flow would not be measurable at the mouth on the Flow Model Analysis Area, the nominal changes in flow would not be detected at the modified 5th field scale.

Modified Alternative 4

Water Use

Under Modified Alternative 4, the source of domestic water for the White Pass Ski Area would continue to be from a surface water diversion on Millridge Creek located in the Upper Clear Fork Cowlitz watershed. Due to the proposed increase in the CCC under Modified Alternative 4, the peak water demand during the ski season would increase from approximately 12,561 gallons/day to 20,566 gallons/day, including approximately 225 gallons per day conveyed to the mid-mountain lodge through a pipe (refer to Section 3.13 – Utilities and Infrastructure). This conservative estimate is based on assumed full utilization of the ski area capacity and facilities and an average water demand of 4.92 gallons/day. The projected increase in water demand (based on measured peak demand values) would decrease the daily streamflow in Millridge Creek by approximately 0.013 cfs during the ski season. The projected decrease of 0.013 cfs in Millridge Creek under Modified Alternative 4 was not included in the flow model because this amount would not be measurable with current monitoring technology and the flow model estimates stream flow impacts for the summer low flow period and the two-year peak flow event when water withdrawals by the ski area are unlikely.

If the utility trenching for the waterline to the mid-mountain lodge under Modified Alternative 4 was determined to be infeasible for economic or environmental reasons, a shallow groundwater well would be constructed in the vicinity of the proposed mid-mountain lodge to provide domestic water (refer to Section 3.13 – Utilities and Infrastructure). If the well was to be built, the overall projected water demand for Modified Alternative 4 would be the same as under the trenched waterline, but the domestic water demand for the mid-mountain lodge would come from the groundwater well. The groundwater withdrawn would be approximately 225 gallons/day for potable use by the guests of the mid-mountain lodge. The localized soil moisture and flow regime impacts from the proposed groundwater withdrawal are not expected to be measurable due to the low volume of the withdrawal and surface disposal of grey water through a RGF drainfield.

Flow Regime

Under Modified Alternative 4, impacts to the flow regime in the Upper Clear Fork Cowlitz River and Upper Tieton River watersheds would be similar to, but slightly higher than the impacts described under Alternative 2. **Under Modified Alternative 4, additional clearing and grading would be required for construction of Trail 4-16, compared to Alternative 2. Approximately 44.4 acres of clearing, grading and construction of impervious surfaces would occur due to the construction of the two chairlifts, associated trails under Modified Alternative 4. However, low flow in the Upper Clear Fork Cowlitz River would increase by approximately 1.6 percent over existing conditions, which is slightly more than under Alternative 2 and more than any other Action Alternative. This projected increase in low flow under Modified Alternative 4 would result in an estimated increase in discharge of approximately 0.05 cfs to approximately 3.17 cfs (refer to Table 3.3-18). Similarly, the two-year peak flow in the Upper Clear Fork Cowlitz River would increase by approximately 0.4 percent under Modified Alternative 4, which is also the largest estimated increase as compared to the other Action Alternatives. Relating the estimated increase in two-year peak flow under Modified Alternative 4 to calculated discharge rates would result in an increase from 130.7 cfs under existing conditions to 131.2 cfs under Modified Alternative 4 (refer to Table 3.3-18).** The relatively small projected increase in low flow and two-year peak flow combined with the typical amount of instrumentation error associated with measuring discharge rates indicates that the estimated increase in stream flow in the Upper Clear Fork Cowlitz River would not be measurable at the mouth of the Flow Model Analysis Area with current monitoring technology.

Implementation of Modified Alternative 4 would result in an increase in low flow in the Upper Tieton River by approximately 2.1 percent over existing conditions due to proposed forest clearing and construction of new impervious surfaces. This projected increase in low flow would result in an estimated increase of approximately 0.03 cfs during a low flow event. Likewise, the estimated two-year peak flows in the Upper Tieton River would increase by approximately 0.5 percent over existing conditions under Modified Alternative 4 resulting in an increase of approximately 0.3 cfs in

discharge. The relatively small projected increase in low flow and two-year peak flow combined with the typical amount of instrumentation error associated with measuring discharge rates indicates that the estimated increase in stream flow in the Upper Tieton River would not be measurable at the mouth of the Flow Model Analysis Area with current monitoring technology.

Alternative 6

Water Use

Under Alternative 6, the source of domestic water for the White Pass Ski Area would continue to be from the surface water diversion on Millridge Creek located in the Upper Clear Fork Cowlitz River watershed. Due to the proposed increase in the CCC under Alternative 6, the peak water demand during the ski season would increase from 12,561 gallons/day to 19,700 gallons/day (refer to Section 3.13 – Utilities and Infrastructure). This conservative estimate is based on assumed full utilization of the ski area capacity and facilities and an average water demand of 4.92 gallons/guest/day. The projected increase in water demand (based on measured peak demand values) would decrease the daily streamflow in Millridge Creek by approximately 0.011 cfs during the ski season. The projected decrease of 0.011 cfs in Millridge Creek under Alternative 6 was not included in the flow model because this amount would not be measurable with current monitoring technology and the flow model estimates stream flow impacts for the summer low flow period and the two-year peak flow event when water withdrawals by the ski area are unlikely.

Flow Regime

Under Alternative 6, approximately 15.3 acres of clearing, grading and construction of impervious surfaces would occur due to the construction of the *Basin* chairlift and associated trails. Impacts to low flow in the Upper Clear Fork Cowlitz River under Alternative 6 would be less than under Alternative 2 and Modified Alternative 4, with an increase of approximately 0.8 percent due to the elimination of the *Hogback Express* chairlift and trails from Alternative 6. The projected increase in low flow under Alternative 6 would result in an estimated increase in discharge of approximately 0.02 cfs over the calculated existing discharge of 3.12 cfs (refer to Table 3.3-18). Similarly, the two-year peak flow in the Upper Clear Fork Cowlitz would increase by approximately 0.2 percent under Alternative 6, which is lower than under Alternative 2 and Modified Alternative 4. The proposed forest clearing and construction of new impervious surfaces would increase peak flow discharge by approximately 0.2 cfs (refer to Table 3.3-18). The relatively small projected increase in low flow and two-year peak flow combined with the typical amount of instrumentation error associated with measuring discharge rates indicates that the estimated increases in stream flow in the Upper Clear Fork Cowlitz River would not be measurable at the mouth of the Flow Model Analysis Area with current monitoring technology.

Implementation of Alternative 6 would result in an increase in low flow in the Upper Tieton River by approximately 0.7 percent over existing conditions due to proposed forest clearing and construction of new impervious surfaces. This projected increase in low flow would result in an estimated increase of approximately 0.01 cfs during a low flow event. Likewise, the estimated two-year peak flows in the Upper Tieton River would increase by approximately 0.2 percent over existing conditions under Alternative 6 resulting in an increase of approximately 0.1 cfs in discharge. The relatively small projected increase in low flow and two-year peak flow combined with the typical amount of instrumentation error associated with measuring discharge rates indicates that the estimated increase in stream flow in the Upper Tieton River would not be measurable at the mouth of the Flow Model Analysis Area with current monitoring technology.

Alternative 9

Water Use

Under Alternative 9, the source of domestic water for the White Pass Ski Area would continue to be from the surface water diversion on Millridge Creek located in the Upper Clear Fork Cowlitz River watershed. Due to the proposed increase in the CCC under Alternative 9, the peak water demand during the ski season would increase from 12,561 gallons/day to 17,751 gallons/day (refer to Section 3.13 – Utilities and Infrastructure). This conservative estimate is based on assumed full utilization of the ski area capacity and facilities and an average water demand of 4.92 gallons/guest/day. The projected increase in water demand (based on measured peak demand values) would decrease the daily streamflow in Millridge Creek by approximately 0.008 cfs during the ski season. The projected decrease of 0.008 cfs in Millridge Creek under Alternative 9 was not included in the flow model because this amount would not be measurable with current monitoring technology and the flow model estimates stream flow impacts for the summer low flow period and the two-year peak flow event when water withdrawals by the ski area are unlikely.

Flow Regime

Implementation of Alternative 9 would result in projected increases in low flow in the Upper Clear Fork Cowlitz River that would be very similar to those projected under Alternative 6 even though the distribution of the proposed impacts would be very different**. According to the results of the model, Alternative 9 would result in an increase in low flow of approximately 0.7 percent (0.02 cfs) over existing conditions in the Upper Clear Fork Cowlitz River, which is less than any other Action Alternative (refer to Table 3.3-18). Similarly, the two-year peak flow in the Upper Clear Fork Cowlitz would increase by approximately 0.2 percent under Alternative 9, which is less than Alternative 2 and Modified Alternative 4, and equal to Alternative 6.** The relatively small projected increase in low flow and two-year peak flow combined with the typical amount of instrumentation error associated with measuring discharge rates indicates that the estimated increase in stream flow in the Upper Clear Fork Cowlitz River would not be measurable at the mouth of the Flow Model Analysis Area with current monitoring technology.

The activities under Alternative 9 would result in the largest increases in low flow and peak flow in the Upper Tieton River as compared to the other Action Alternatives due to the forest clearing proposed for the *PCT* **chairlift and associated trails. Under Alternative 9, approximately 38.9 acres of forest clearing, grading and construction of new impervious surfaces would occur in the Upper Tieton River watershed, resulting in an approximately 4.6 percent (0.06 cfs) increase in low flow (refer to Table 3.3-18). Similarly, two-year peak flows in the Upper Tieton River would increase by approximately 1.1 percent over existing conditions under Alternative 9 resulting in an increase of approximately 0.6 cfs in discharge (refer to Table 3.3-18).** Even though these projected stream flow increases are the largest out of all of the Action Alternatives, these estimated discharge values are still within the typical amount of instrumentation error associated with measuring discharge rates, and therefore, these estimated increases in stream flow in the Upper Tieton River would not be measurable at the mouth of the Flow Model Analysis Area with current monitoring technology.

3.3.4 Cumulative Effects

A cumulative effects analysis was performed for each watershed at the site scale (White Pass Study Area) and 5th field watershed scale. Past, present and reasonably foreseeable projects with effects that overlap in space and time with the Action Alternatives are included in the analysis. Information on project descriptions can be found in Tables 3.0-FEIS1 and 3.0-FEIS2.

Projects and construction activities occurring within Riparian Reserves have the potential to alter plant communities and functional processes of the riparian zone. These processes include sediment filtration, stream bank stabilization, floodwater storage (duration and timing of flow), LWD recruitment, and stream channel shading (refer to Section 3.3.2.3). While Riparian Reserve widths typically encompass an area greater than the functional riparian zone, construction activities within the Riparian Reserve occur in closer proximity to watershed resources. Therefore, there is a higher potential for projects occurring within Riparian Reserves to impact watershed resources compared to projects occurring outside. As such, impacts to Riparian Reserves can be used as a surrogate measure for long-term cumulative impacts to Watershed Resources. Therefore, this analysis considers all past, present, and reasonably foreseeable future projects with effects occurring within Riparian Reserves.

Short-term cumulative impacts to Watershed Resources can occur when multiple projects overlap in space and time. For purposes of this analysis, short-term impacts are considered with regard to water quality. Impacts to water quality are most likely to result from increased sedimentation and contaminants such as equipment oil, grease, or fuel spills. Since the use of BMPs is typically required at the site scale to minimize erosion, short-term water quality impacts are not expected to be measurable at large scales (i.e. 5th field watershed). For purposes of this analysis, all projects with effects occurring within Riparian Reserves are assumed to have the potential for short-term cumulative impacts to water quality.

3.3.4.1 Upper Clear Fork Cowlitz Watershed

A summary of the projects occurring in the Upper Clear Fork Cowlitz watershed and the impacts to watershed resources can be found in Table 3.3-19. Additional information on project descriptions can be found in Table 3.0-FEIS1.

Table 3.3-19:
Cumulative Effects of Past, Present, and Reasonably Foreseeable Projects in the Upper Clear Fork Cowlitz Watershed on Watershed Resources

Project Number	Project Name	Cumulative Effects
UCFC-2	Forest Road 4600 Stabilization	Approximately 0.1 acre of short-term sediment deposition/turbidity effects to streams occurred through the placement of riprap around the culvert. The detrimental effects of this project had no temporal overlap with the White Pass expansion as the project site has stabilized. Spatially this project does not overlap with the White Pass Study Area, but occurred within the 5th field watershed. Combined with the other stabilization projects identified in this table, in the long-term, this project contributed to a cumulative reduction in sediment mobilization from unstable slopes at the 5th field watershed scale.
UCFC-3a	Palisades Scenic Viewpoint Project	Long-term direct impacts to watershed resources occurred through the creation of less than 0.5 acre of impervious surfaces within the existing disturbed area. There is no spatial overlap with the White Pass Study Area. Long-term project effects would temporally overlap with the effects of the White Pass expansion. In the long-term, this project contributed to a cumulative reduction in soil permeability at the 5th field watershed scale due to the displacement of soil by impervious surface. This project occurred outside of Riparian Reserves and the associated increase in surface runoff associated with the additional 0.5 acre of impervious surface is not measurable at the 5th field scale.
UCFC-3b	Palisades Scenic Viewpoint Project Vegetation Mgmt	Approximately 1 acre of trees will be felled and left onsite as woody material. Spatially this project does not overlap with the White Pass Study Area. Project effects would overlap in time with the effects of the White Pass expansion and cumulatively add to ground disturbance within the Upper Clear Fork Cowlitz watershed. Any localized decrease in soil permeability or increases in detrimental sediment mobilization from this project (i.e., the ground surface immediately under any felled tree) would not be measurable at the 5th field watershed scale.
UCFC-4	Mt Rainier/Goat Rocks Scenic Viewpoint	Installation of fence posts will result in small (several square feet each) areas of ground disturbance in the short-term during construction. This project would not overlap in space with the White Pass expansion. Project effects would overlap in time with the effects of the White Pass expansion. This project occurs outside of Riparian Reserves, and no measurable impacts to Watershed Resources are expected at the 5th field watershed scale.

Table 3.3-19:
Cumulative Effects of Past, Present, and Reasonably Foreseeable Projects in the Upper Clear Fork Cowlitz Watershed on Watershed Resources

Project Number	Project Name	Cumulative Effects
UCFC-5	White Pass Wildfire	The wildfire burned approximately 204 acres within the Upper Clear Fork Cowlitz watershed. Indirect impacts to water quality, loss of LWD recruitment potential, increased sedimentation, increased nutrient loading and changes in flow likely resulted from the burn. In the eight years following the fire, it is expected that some natural regeneration and stabilization of soils has occurred. This project did not overlap in space with the White Pass Study Area. Partial natural regeneration of the vegetation has occurred since the fire. In the long-term, the effects of the fire, coupled with the effects of the White Pass expansion and other project effects listed in this table, will contribute to a cumulative reduction in soil productivity at the 5th field watershed scale. With continued revegetation, the potential for long-term effects of this fire will be eliminated.
UCFC-6	Knuppenberg Lake Bridge Removal	Beneficial, long-term direct impact to watershed resources occurred through the removal of 0.24 acre of impervious surface associated with the bridge footings. Long-term project effects would temporally overlap with the White Pass expansion. Spatially, there is no overlap with the White Pass Study Area. Coupled with projects UCFC-12, UCFC-14 and UCFC-15, the removal of the bridge would improve vegetative cover and the sediment regime at the 5th field watershed scale. These projects will partially offset the cumulative effects to watershed resources associated with the White Pass expansion or other projects listed in this table.
UCFC-7	Wilderness Trail Maintenance	Approximately 20.5 miles of trail are maintained every other year, which would directly affect watershed resources over the short-term through periodic sediment mobilization associated with treating sites along the corridor (i.e., removing downed logs and maintenance of drainage structures) with hand tools. A portion of this project would overlap spatially with the White Pass Study Area (i.e., PCNST in Hogback Basin). Temporally, the effects of annual maintenance work will overlap with the effects of the White Pass expansion. Maintenance would result in an increase in short-term erosion and sediment mobilization along the trail, on a maximum of 7.5 acres. Over the long-term, treatment areas along the trail edge will naturally revegetate. Any increase in erosion/sedimentation from this project would not be measurable at the 5th field watershed scale due to the dispersed nature of the effects, compared to other projects in this table that cumulatively effect water quality.

**Table 3.3-19:
Cumulative Effects of Past, Present, and Reasonably Foreseeable Projects
in the Upper Clear Fork Cowlitz Watershed on Watershed Resources**

Project Number	Project Name	Cumulative Effects
UCFC-8	Ongoing Road Maintenance	Approximately 9 miles of road surface maintenance occurs every five years. Grading associated with road maintenance would indirectly affect watershed resources over the short-term by creating erodible surfaces that provide sediment to the aquatic environment, particularly Riparian Reserves along the edge of the road surface. This project would not overlap spatially with the White Pass Study Area. Ongoing maintenance activities in the 5th field watershed would overlap in time with the effects of the White Pass expansion, resulting in an increase in short-term erosion/sedimentation at the 5th field watershed scale on up to 46.3 acres. Regular maintenance and revegetation along the road prism will reduce the potential for long-term sediment deposition in streams. Any short-term increase in sediment from this project would not be measurable at the 5th field watershed scale and would be offset by the long-term benefit of the maintenance.
UCFC-10	Clear Fork Trail Puncheon Installation	The installation of puncheon along 0.1 mile (0.07 acre) of braided trail (an existing sediment source) directly affected watershed resources by eliminating user trails and reducing the potential for sediment mobilization. Spatially, this project did not overlap with the White Pass Study Area. Coupled with project UCFC-6, the puncheon would improve sediment conditions at the 5th field watershed scale. These projects will partially offset the cumulative effects to watershed resources associated with the White Pass expansion.
UCFC-11	Air Quality Monitoring Building	The creation of 0.02 acre of impervious surfaces for a building directly impacted soil permeability over the long-term. Project effects would temporally and spatially overlap with the effects of the White Pass expansion. In the long-term, this project and the other projects resulting in impervious surfaces (i.e., increase in runoff) listed in this table, contributed to a cumulative reduction in soil permeability at the 5th field watershed scale.
UCFC-12	Rockfall Mitigation (between mileposts 143 and 149)	The stabilization of 2.5 acres of unstable talus slopes directly impacted watershed resources over the short-term by affecting water quality due to erosion and sedimentation until the slopes were stabilized. Spatially, this project did not overlap with the White Pass Study Area. Temporally, the short-term project effects, contributed to a loss of soil productivity at the 5th field watershed scale. In the long- term, slope stabilization associated with this project and other slope stabilization/rockfall mitigation projects in this table will improve the sediment regime in the 5th field watershed. This project occurred outside of Riparian Reserves, and no other measurable impacts to watershed resources occurred within the White Pass Study Area or at the 5th field watershed scale.

Table 3.3-19: Cumulative Effects of Past, Present, and Reasonably Foreseeable Projects in the Upper Clear Fork Cowlitz Watershed on Watershed Resources

Project Number	Project Name	Cumulative Effects
UCFC-14	Unstable Slope Repair Projects (between mileposts 145.61 and 145.77)	The repair of 1 acre of unstable slopes will directly impact watershed resources over the short-term by affecting water quality due to erosion and sedimentation until the slopes are stabilized. Spatially, this project will not overlap with the White Pass Study Area. Temporally, the short-term project effects will contribute to a loss of soil productivity at the 5th field watershed scale. In the long-term, slope stabilization associated with this project and other slope stabilization/rockfall mitigation projects in this table will improve the sediment regime in the 5th field watershed. This project will occur outside of Riparian Reserves, and no other measurable impacts to watershed resources are expected to occur within the White Pass Study Area or at the 5th field watershed scale.
UCFC-15	Unstable Slope Repair Projects (between mileposts 141.8 and 144.4)	The repair of 4.5 acres of unstable slopes will directly affect watershed resources over the short-term by affecting water quality due to erosion and sedimentation until the slopes are stabilized. Spatially, this project will not overlap with the White Pass Study Area. Temporally, the short-term project effects will contribute to a loss of soil productivity at the 5th field watershed scale. In the long- term, slope stabilization associated with this project and other slope stabilization/rockfall mitigation projects in this table will improve the sediment regime in the 5th field watershed. This project will occur outside of Riparian Reserves, and no other measurable impacts to watershed resources occurred within the White Pass Study Area or at the 5th field watershed scale.
UCFC-16	Highway 12 Hazard Tree Removal	The periodic removal of occasional hazard trees within this 545-acre, 15-mile long corridor will directly impact soils and watershed functions. Hazard tree removal will spatially overlap with the White Pass Study Area and the 5th field watershed outside of the White Pass Study Area. Temporally, the effects of the hazard tree removal will overlap with the effects of the White Pass expansion. Short-term soil compaction and associated increase in surface runoff will occur in areas immediately under and adjacent to the felled trees, where the use of heavy equipment is required outside of the road surface. No long-term impacts to watershed resources are expected.
UCFC-17	White Pass Ski Area Yurt Construction	Long-term, direct impact to soils resulted from approximately 0.01 acre of new impervious surfaces from construction of the yurt. Spatially, the effects of this project overlap with the effects of the White Pass expansion. Temporally, the effects of the yurt will overlap with the effects of the White Pass expansion. In the long-term, this project and the other projects resulting in impervious surfaces, listed in this table, contribute to a cumulative increase in runoff at the 5th field watershed scale due to the decrease in soil permeability.

Table 3.3-19:
Cumulative Effects of Past, Present, and Reasonably Foreseeable Projects in the Upper Clear Fork Cowlitz Watershed on Watershed Resources

Project Number	Project Name	Cumulative Effects
UCFC-20	Benton Rural Electric Association (REA) Power Line Maintenance	The periodic power line right-of-way maintenance within this 28-acre, 1-mile long corridor will directly impact soil permeability and percolation of surface waster into the soil. The operation of equipment along the corridor could result in fuel or oil contamination, thereby affecting water quality. Power line maintenance will spatially overlap with the White Pass Study Area and the 5th field watershed outside of the White Pass Study Area. Temporally, the effects of the power line maintenance will overlap with the effects of the White Pass expansion. Short-term soil compaction and reduced permeability will occur in areas immediately under and adjacent to fallen trees and where the use of heavy equipment is required for maintenance. In the long-term, water quality impacts associated with fuel and oil would overlap with the effects of the White Pass expansion, and other projects in this table that have the potential to introduce fuel or oil into the watershed.
UCFC-21	White Pass Ski Area Day Lodge Remodel	Grading of 0.25 acre of previously disturbed ground resulted in short-term increase in sediment mobilization. In addition, the lodge increased the impervious surface associated with the lodge by 0.05 acre, increasing localized runoff. Temporally, the effects of the grading have been stabilized and do not overlap with the effects of the White Pass expansion. Spatially, the effect of the building construction overlaps with the effects of the White Pass expansion. In the long-term, the effects of the impervious surface, in conjunction with the other projects that include impervious surface, contributed to a cumulative reduction in soil permeability at the 5th field watershed scale.

As described in Table 3.3-19, numerous projects would contribute to short-term potential for increases in sediment delivery to streams. The cumulative effects on sediment delivery from these projects are not expected to be measurable as sediment mobilization and delivery would be localized to specific areas within the larger White Pass Study Area and to varying timeframes in the short-term. Table 3.3-18 shows that two-year peak flows leaving the White Pass Study Area would be increased by a maximum of 0.4 percent under the Action Alternatives. At the site scale, projects from Table 3.3-19 with effects to flow would not result in measurable changes in volume, timing or distribution of flows due to their dispersed distribution within the White Pass Study Area, compared to the modeled results in Table 3.3-18.

As described in Section 3.2 – Geology and Soils, the construction of impervious surfaces leads to decreased soil permeability and increased surface water runoff. This in turn has the potential to affect flow regimes downstream in the watershed. As described in Table 3.3-19, projects occurring outside of Riparian Reserves are not expected to have measurable cumulative effects at the 5th field scale. While projects occurring within Riparian Reserves would result in localized decreases in soil permeability, these projects are dispersed throughout the approximate 70,700 acre 5th field watershed and encompass less than two percent of the total Riparian Reserves within the Upper Clear Fork Cowlitz watershed (refer to Table 3.3-20). As a result, cumulative impacts to the timing, magnitude, duration, and spatial distribution of peak, high, and low flows due to implementation of any of the Action Alternatives are not expected to be measurable when added to the projects that overlap in space and time with the White Pass expansion at the 5th field scale.

Likewise, the increase in detrimental soil conditions described in Section 3.2 – Geology and Soils, has the potential to affect the sediment regime (sediment mobilization and delivery to streams) within the watershed. As described in Table 3.3-19, projects occurring outside of Riparian Reserves are not expected to have measurable effects on the sediment regime within the 5th field scale. Projects occurring within Riparian Reserves may result in short-term sediment delivery to streams. However, as projects stabilize over time, sediment delivery will decrease and long-term cumulative impacts are not expected. As described in the Clear Fork Cowlitz Watershed Condition Assessment, sediment introduced into streams within the watershed from management related events is slightly above background levels, but well within range of natural variability (USDA 1998a). Therefore, when combined with the implementation of the White Pass expansion, cumulative impacts to the sediment regime and delivery to streams are not expected to be measurable at the 5th field scale.

Table 3.3-20 summarizes the cumulative impacts of White Pass projects and projects not associated with the White Pass expansion within the Upper Clear Fork Cowlitz watershed at the site scale and 5th field scale.

Table 3.3-20
Cumulative Effects of Past, Present, and Reasonably Foreseeable Projects in the Upper Clear Fork Cowlitz River Watershed on Watershed Resources

Impact Type[a]	Alt. 1		Alt. 2		Mod. Alt. 4		Alt. 6		Alt. 9	
	Area (ac.)	Percent of Scale (%)[b]	Area (ac.)	Percent of Scale (%)[b]	Area (ac.)	Percent of Scale (%)[b]	Area (ac.)	Percent of Scale (%)[b]	Area (ac.)	Percent of Scale (%)[b]
White Pass Study Area Scale										
White Pass Projects	0.00	0.00	17.70	4.48	22.22	5.62	10.70	2.71	4.10	1.04
Projects Not Associated with the White Pass Expansion	0.25	0.06	0.25	0.06	0.25	0.06	0.25	0.06	0.25	0.06
Cumulative Impacts	**0.25**	**0.06**	**17.95**	**4.54**	**22.47**	**5.68**	**10.95**	**2.77**	**4.35**	**1.10**
Fifth Field Scale										
White Pass Projects	0.00	0.00	17.70	0.07	22.22	0.08	10.70	0.04	4.10	0.02
Projects Not Associated with the White Pass Expansion	300.76	1.13	300.76	1.13	300.76	1.13	300.76	1.13	300.76	1.13
Cumulative Impacts	**300.76**	**1.13**	**318.46**	**1.19**	**322.98**	**1.21**	**311.46**	**1.17**	**304.86**	**1.14**

[a] Only impacts that occur within Riparian Reserves are counted in this analysis. They include clearing and grading, new impervious surfaces, and utility trenching. Projects that occur within Riparian Reserves are more likely to impact streams, wetlands, water quality and flow regime because of the proximity of the actions to the watershed resources in comparison to activities that have no relation to waters.
[b] Percent of Scale is the percentage of Riparian Reserves impacted in the White Pass Study Area and in the fifth field watershed. The total Riparian Reserves area within the White Pass Study Area is 395.3 acres, and 26,715 acres in the 5th field.

3.3.4.2 Upper Tieton River Watershed

A list of all projects occurring within the Upper Tieton River watershed and the impact to watershed resources is located in Table 3.3-21.

Table 3.3-21:
Cumulative Effects of Past, Present, and Reasonably Foreseeable Projects in the Upper Tieton Watershed on Watershed Resources

Project Number	Project Name	Cumulative Effects
UT-2	White Pass Ski Area Sewer Line Replacement	Approximately 0.73 acre of grading will occur, associated with the excavation of the trench and resulting in potential for erosion/sediment deposition in the short-term. Project implementation and effects are expected to overlap in time and space with the effects of the White Pass expansion. No long-term effects to watershed resources are expected because the disturbed soil areas will be immediately stabilized after construction. Combined with other projects identified in this table, this project would add to an increase in short-term erosion/sediment deposition potential within and outside of the White Pass Study Area within the 5th field watershed.
UT-3	White Pass Ski Area Generator Shed and Propane Tank	The installation of 0.004 acre of impervious surfaces to build the shed and install the tank directly impacted soil permeability over the long-term. Spatially the project effects occurred within the White Pass Study Area. The impervious surfaces and associated increase in runoff overlap temporally with the expansion. The increase in impervious surfaces will result in long-term increased runoff. In the long-term, this project and the other projects resulting in impervious surfaces, listed in this table, contributed to a cumulative increase in runoff at the 5th field watershed scale due to decreased soil permeability.
UT-4	White Pass Ski Area Relocation of Chair 3 and Platter Lift	Approximately 0.5 acre of grading occurred for new lift towers and terminals, directly impacting soils and converting 0.01 acre to impervious surface. Temporally, the grading impacts (i.e., increased erosion potential) did not overlap with the White Pass expansion, but the impervious surfaces and associated increase in runoff overlap with the effects of the White Pass expansion. Spatially this project occurred within the White Pass Study Area. The grading increased short-term erosion potential but has since stabilized. In the long-term, this project and the other projects resulting in impervious surfaces, listed in this table, contributed to a cumulative increase in runoff at the 5th field watershed scale due to decreased soil permeability.
UT-5	US Cellular Tower	The installation of 0.004 acre of impervious surfaces (tower footing) to build a cell tower directly impacted soil permeability over the long-term. Spatially the effects of this project occurred within the White Pass Study Area. Temporally, the long-term loss of soil permeability will overlap with the effects of the White Pass expansion. In the long-term, this project and the other projects resulting in impervious surfaces, listed in this table, contributed to a cumulative increase in runoff at the 5th field watershed scale due to decreased soil permeability.

Table 3.3-21:
Cumulative Effects of Past, Present, and Reasonably Foreseeable Projects in the Upper Tieton Watershed on Watershed Resources

Project Number	Project Name	Cumulative Effects
UT-6	White Pass Ski Area Restaurant/Condo Conversion	A restaurant building that occupied 0.25 acre was demolished and a new building was constructed on the original building site, including additional sidewalks, resulting in an increase of 0.01 acre of impervious surface. Spatially and temporally, the effects of the building overlap with the effects of the White Pass expansion. In the long-term, this project and the other projects resulting in impervious surfaces, listed in this table, contributed to a cumulative increase in runoff at the 5th field watershed scale due to decreased soil permeability.
UT-7	White Pass Ski Area Cross Country Yurt	Approximately 0.25 acre of grading took place in a previously disturbed area (parking lot) resulting in approximately 0.02 acre of new impervious surfaces from the yurt and infrastructure. Spatially, the effects of this project overlap with the effects of the White Pass expansion. Temporally, the effects of the yurt will overlap with the effects of the White Pass expansion. In the short-term, the disturbed soil and associated erosion/sediment deposition potential has been stabilized and returned to use as a parking lot. In the long-term, this project and the other projects resulting in impervious surfaces, listed in this table, contribute to a cumulative increase in runoff at the 5th field watershed scale due to the decrease in soil permeability.
UT-8	White Pass Ski Area Manager's Cabin	Approximately 0.25 acre of ground was cleared and graded resulting in short-term potential for erosion/sediment deposition. The construction of the cabin resulted in 0.04 acre of impervious surfaces. The graded areas have been stabilized. Spatially, the effects of this project occurred within the White Pass Study Area. Temporally, the short-term erosion/sediment deposition potential has been stabilized and therefore does not overlap with the effects of the White Pass expansion. The long-term loss of soil permeability will overlap with the effects of the White Pass expansion in the White Pass Study Area. In the long-term, this project and the other projects resulting in impervious surfaces, listed in this table, contribute to a cumulative increase in runoff at the 5th field watershed scale due to the decrease in soil permeability.
UT-9	White Pass Ski Area Manager's Office	Approximately 0.25 acre of previously disturbed ground was graded, creating short-term potential for erosion/sediment deposition. The creation of 0.03 acre of impervious surfaces directly impacted soil permeability over the long-term. Spatially, the effects of this project occurred within the White Pass Study Area. Temporally, the short-term erosion/sediment deposition potential has been stabilized and therefore does not overlap with the effects of the White Pass expansion. The long-term effect of the impervious surface on runoff will overlap with the effects of the White Pass expansion in the White Pass Study Area. In the long-term, this project and the other projects resulting in impervious surfaces, listed in this table, contribute to a cumulative increase in runoff at the 5th field watershed scale due to the decrease in soil permeability.

**Table 3.3-21:
Cumulative Effects of Past, Present, and Reasonably Foreseeable Projects in the Upper Tieton Watershed on Watershed Resources**

Project Number	Project Name	Cumulative Effects
UT-10	Dog Lake Campground/Four Trailhead Reconstruction	The reconstruction of the Dog Lake Campground and four trailheads directly impacted previously disturbed soils due to approximately 5 acres of grading, resulting in the potential for soil erosion/sediment deposition. This project does not overlap spatially with the White Pass Study Area. It is expected that the site will be stabilized immediately, but that the short-term erosion/sediment deposition effects will overlap with the effects of the White Pass expansion and other projects in this table that include the potential for erosion, as the site becomes revegetated and stable. No long-term effects are anticipated. The project includes traffic control and areas of revegetation which would aid in decreasing erosion and sediment deposition in Riparian Reserves that are currently present at the site.
UT-11	Clear Creek Overlook Reconstruction	The reconstruction of the Clear Creek Overlook will directly impact soils over the short-term due to approximately 1 acre of grading on previously disturbed soils. Creation of 0.1 acre of additional impervious surface will directly impact soils over the long-term. There is no spatial overlap with the White Pass Study Area. The short-term erosion/sediment deposition effects associated with grading are expected to be stabilized immediately. Long-term project effects associated with the new impervious surfaces (i.e., increased runoff) will temporally overlap with the effects of the White Pass expansion. In the long-term, this project will contribute to a cumulative increase in runoff at the 5th field watershed scale due to the increase in impervious surface.
UT-16	Trail 1106 Water Crossing	Re-construction or rerouting of the crossing (with hand tools) would likely result in a short-term increase in erosion/sediment deposition potential on up to 0.1 acre in Riparian Reserve. Any abandoned trail segment would be disguised and allowed to revegetate, thereby reducing erosion potential as the abandoned trail revegetates. This project does not overlap spatially with the White Pass Study Area. It is expected that the site will be stabilized immediately, but that the short-term erosion effects will overlap with the effects of the White Pass expansion and other projects in this table that include increased erosion/sediment deposition potential, as the site becomes revegetated and stable. No long-term effects are anticipated.
UT-18	Benton Rural Electric Association (REA) Power line Maintenance	The periodic power line right-of-way maintenance within this 223-acre, 8-mile long corridor will directly impact soil permeability and percolation of surface waster into the soil. The operation of equipment along the corridor could result in fuel or oil contamination, thereby affecting water quality. Power line maintenance will spatially overlap with the White Pass Study Area and the 5^{th} field watershed outside of the White Pass Study Area. Temporally, the effects of the power line maintenance will overlap with the effects of the White Pass expansion. Short-term soil compaction and reduced permeability will occur in areas immediately under and adjacent to fallen trees and where the use of heavy equipment is required for maintenance. In the long-term, water quality impacts associated with fuel and oil would overlap with the effects of the White Pass expansion and other projects in this table that have the potential to introduce fuel or oil into the White Pass Study Area and the 5th field watershed.

**Table 3.3-21:
Cumulative Effects of Past, Present, and Reasonably Foreseeable Projects in the Upper Tieton Watershed on Watershed Resources**

Project Number	Project Name	Cumulative Effects
UT-19	Highway 12 Hazard Tree Removal	The periodic removal of occasional hazard trees within this 509-acre, 14-mile long corridor will directly impact soils and watershed functions. Hazard tree removal will spatially overlap with the White Pass Study Area and the 5th field watershed outside of the White Pass Study Area. Temporally, the effects of the hazard tree removal will overlap with the effects of the White Pass expansion. Short-term soil compaction and associated increase in surface runoff will occur in areas immediately under and adjacent to the felled trees, where the use of heavy equipment is required outside of the road surface. No long-term impacts to soils are expected.
UT-20	Clear Lake Recreation Projects	Construction of the access road and other site improvements over approximately 2 acres would directly impact watershed functions. Short-term erosion/sedimentation potential will occur during construction. Spatially, this project occurs outside the White Pass Study Area. Temporally, the long-term increase in surface runoff associated with remaining impervious surfaces will overlap with the effects of the White Pass expansion. In the long-term, this project will contribute to a cumulative increase in runoff at the 5th field watershed scale due to the increase in impervious surface.
UT-21	Fish Hawk/Spillway Campground Improvements	Construction of CXT toilet and access road directly impacted approximately 1 acre of soils. Short-term erosion and sediment effects occurred during construction, but the site has since stabilized, eliminating the short-term effect. Spatially, this project occurred outside the White Pass Study Area. Temporally, the long-term loss of soil permeability associated with remaining impervious surfaces associated with the toilet (less than 500 square feet) will overlap with the effects of the White Pass expansion. Combined with the other projects identified in this table, in the long-term, this project contributed to a cumulative increase in runoff volume at the 5th field watershed scale due to the displacement of soil by impervious surfaces.
UT-23	System Trail Maintenance	Approximately 48.5 miles of trail are maintained every other year, which would directly affect watershed resources over the short-term through periodic sediment mobilization associated with treating sites along the corridor (i.e., removing downed logs and maintenance of drainage structures) with hand tools. A portion of this project would overlap spatially with the White Pass Study Area (i.e., PCNST at White Pass). Temporally, the effects of annual maintenance work will overlap with the effects of the White Pass expansion. Maintenance would result in an increase in short-term erosion and sediment mobilization along the trail, on a maximum of 36 acres. Over the long-term, treatment areas along the trail edge will naturally revegetate. Any increase in erosion/sedimentation from this project would not be measurable at the 5th field watershed scale due to the dispersed nature of the effects, compared to other projects in this table that cumulatively affect water quality.

Table 3.3-21:
Cumulative Effects of Past, Present, and Reasonably Foreseeable Projects in the Upper Tieton Watershed on Watershed Resources

Project Number	Project Name	Cumulative Effects
UT-24	Snoqueen Mine	Over the past decade, active operations have been confined to a limited season during the summer. Mining operations would result in short- and long-term impacts to soils due to grading, which is not stabilized (i.e., reclaimed). Spatially, the mine does not overlap with the White Pass Study Area. Temporally, increased erosion/sedimentation effects have overlapped and will continue to overlap in time, In the short-and long-term, the erosion and sedimentation effects will overlap with the effects of the White Pass expansion and other projects in this table that include detrimental soil conditions. The effects of this mine are not expected to be measurable at the 5th field scale because the mine is located outside Riparian Reserves.
UT-26	Highway 12 Rock Stabilization (at Mile Post 155)	The stabilization of 1 acre of unstable talus slopes will directly affect watershed resources over the short-term by providing potential for erosion and sedimentation until the slopes are stabilized. Spatially, this project does not overlap with the White Pass Study Area. Temporally, the short-term project effects will contribute to increased sediment mobilization at the 5th field watershed scale. In the long-term, slope stabilization associated with this project and other slope stabilization/rockfall mitigation projects in this table will improve the erosion and sediment regime in the 5^{th} field watershed.
UT-27	Highway 12 Rock Stabilization (at Mile Post 155)	The stabilization of 0.5 acre of unstable talus slopes in 2002 directly impacted watershed resources over the short-term by affecting water quality due to erosion and sedimentation until the slopes were stabilized. Spatially, this project did not overlap with the White Pass Study Area. Temporally, the short-term project effects contributed to a loss of soil productivity at the 5th field watershed scale. In the long-term, slope stabilization associated with this project and other slope stabilization/rockfall mitigation projects in this table will improve the sediment regime in the 5th field watershed. This project occurred outside of Riparian Reserves, and no other measurable impacts to watershed resources occurred within the White Pass Study Area or at the 5th field watershed scale.
UT-28	Camp Prime Time Accessible Trail, Wagon Ride Route and Tree House	Construction of the trail, wagon ride route, and tree house will result in short-term potential for erosion and sediment mobilization on up to 3 acres. Depending on the surfacing used for the trail, it could create additional impervious surfaces, resulting in increased runoff. Spatially, this project does not overlap with the White Pass Study Area. Temporally, the short-term erosion/sediment effects associated with the project are expected to overlap with the White Pass expansion. The long-term increase in runoff will overlap with the effects of the White Pass expansion in the White Pass Study Area. In the long-term, this project and the other projects resulting in impervious surfaces, listed in this table, contribute to a cumulative increase in runoff at the 5th field watershed scale due to the displacement of soil (i.e., loss of productivity) by the impervious surfaces.

Table 3.3-21:
Cumulative Effects of Past, Present, and Reasonably Foreseeable Projects in the Upper Tieton Watershed on Watershed Resources

Project Number	Project Name	Cumulative Effects
UT-29	Clear Lake Boat Launch Heavy Maintenance	Maintenance of the boat launch will result in short-term water quality effects associated with sediment mobilization on less than 1 acre during placement of more secure foundations for the access dock. Spatially, this project does not overlap with the White Pass Study Area. Temporally, the short-term sediment effects are expected to be immediately stabilized, and therefore not to overlap with the White Pass expansion.
UT-31	Cellular Phone Carrier Improvements at White Pass Communication Site	The replacement of an existing cell tower and building addition will result in a short-term increase in local sediment mobilization during construction on up to 0.3 acre. Spatially, this project overlaps with the White Pass Study Area. Temporally, the short-term sediment mobilization associated with the project will overlap with the White Pass expansion and other projects in this table that cause detrimental soil conditions. The long-term loss of soil permeability (i.e., increased surface runoff) will result from 0.1 acre of impervious surface associated with the cell tower and building addition. The runoff effects will overlap with the effects of the White Pass expansion in the White Pass Study Area. In the long-term, this project and the other projects resulting in impervious surfaces, listed in this table, contribute to a cumulative increase in runoff at the 5th field watershed scale due to the displacement of soil (i.e., loss of productivity) by the impervious surfaces.
UT-32	Camp Site Maintenance	The periodic removal of occasional hazard trees within developed sites will directly impact soils and watershed functions. Hazard tree removal will spatially overlap with the White Pass Study Area and the 5th field watershed outside of the White Pass Study Area. Temporally, the effects of the hazard tree removal will overlap with the effects of the White Pass expansion. Short-term soil compaction and associated increase in surface runoff will occur in areas immediately under the felled trees. No long-term impacts to soils are expected from hazard tree removal. Other maintenance activities are not expected to result in effects to watershed resources.
UT-34	Unstable Slope Repair Projects (between Mile Posts 156.32 and 156.56)	The stabilization of approximately 4 acres of unstable talus slopes directly affected watershed resources over the short-term by creating erosion and sediment mobilization until the slopes were stabilized. Spatially, this project did not overlap with the White Pass Study Area. Temporally, the short-term project effects contributed to increased runoff (due to hardened surfaces) at the 5th field watershed scale. In the long-term, slope stabilization associated with this project and other slope stabilization/rockfall mitigation projects in this table will improve the sediment regime in the 5th field watershed.
UT-35	Unstable Slope Repair Projects (between Mile Posts 161.93 and 165.02)	The stabilization of approximately 0.53 acre of unstable talus slopes directly affected watershed resources over the short-term by creating erosion and sediment mobilization until the slopes were stabilized. Spatially, this project did not overlap with the White Pass Study Area. Temporally, the short-term project effects contributed to increased runoff (due to hardened surfaces) at the 5th field watershed scale. In the long-term, slope stabilization associated with this project and other slope stabilization/rockfall mitigation projects in this table will improve the sediment regime in the 5th field watershed.

As described in Table 3.3-21, numerous projects would contribute to short-term potential for increases in sediment delivery to streams. The cumulative effects on sediment delivery from these projects are not expected to be measurable as sediment mobilization and delivery would be localized to specific areas within the larger White Pass Study Area and to varying timeframes in the short-term. Table 3.3-18 shows that two-year peak flows leaving the White Pass Study Area would be increased by a maximum of 1.1 percent under the Action Alternatives. At the site scale, projects from Table 3.3-21 with effects to flow would not result in measurable changes in volume, timing or distribution of flows due to their dispersed distribution within the White Pass Study Area, compared to the modeled results in Table 3.3-18.

As described previously, the construction of impervious surfaces leads to decreased soil permeability and ultimately the potential to affect flow regimes downstream in the watershed. As described in Table 3.3-21, projects occurring outside of Riparian Reserves are not expected to have measurable cumulative effects at the 5th field scale. While projects occurring within Riparian Reserves would result in localized decreases in soil permeability, these projects are dispersed throughout the approximate 118,000 acre 5th field watershed, less than 2 percent of the Riparian Reserve area in the Upper Tieton River watershed would experience cumulative impacts from any Action Alternative (refer to Table 3.3-22). According to the Upper Tieton Watershed Analysis, hydrologic patterns at the watershed level have not been changed significantly as a result of forest management activities (USDA 1998b). Therefore, cumulative impacts to the timing, magnitude, duration, and spatial distribution of peak, high, and low flows due to implementation of any of the Action Alternatives are not expected to be measurable when added to the projects that overlap in space and time with the White Pass expansion at the 5th field scale.

The increase in detrimental soil conditions described in Section 3.2 – Geology and Soils, has the potential to affect the sediment regime (sediment mobilization and delivery to streams) within the watershed. As described in Table 3.3-19, projects occurring outside of Riparian Reserves are not expected to have measurable effects on the sediment regime within the 5th field scale. Projects occurring within Riparian Reserves may result in short-term sediment delivery to streams. However, as projects stabilize over time sediment delivery will decrease and long-term cumulative impacts are not expected. As described in the Upper Tieton Watershed Condition Assessment, sediment introduced into streams within the watershed from management related events is slightly above background levels, but within range of natural variability (USDA 1998b). Therefore, when combined with the implementation of the White Pass expansion, cumulative impacts to the sediment regime and delivery to streams are not expected to be measurable at the 5th field scale.

Table 3.3-22 summarizes the cumulative impacts of White Pass projects and projects not associated with the White Pass expansion within the Upper Tieton watershed at the site scale and 5th field scale.

Table 3.3-22
Cumulative Effects of Past, Present, and Reasonably Foreseeable Projects in the Upper Tieton River Watershed on Watershed Resources

Impact Type[a]	Alt. 1		Alt. 2		Mod. Alt. 4		Alt. 6		Alt. 9	
	Area (ac.)	Percent of Scale (%)[b]	Area (ac.)	Percent of Scale (%)[b]	Area (ac.)	Percent of Scale (%)[b]	Area (ac.)	Percent of Scale (%)[b]	Area (ac.)	Percent of Scale (%)[b]
White Pass Study Area Scale										
White Pass Projects	0.00	0.00	0.00	0.00	3.60	1.52	1.90	0.80	20.30	8.57
Projects Not Associated with the White Pass Expansion	20.13	8.49	20.13	8.49	20.13	8.49	20.13	8.49	20.13	8.49
Cumulative Impacts	**20.13**	**8.49**	**20.13**	**8.49**	**23.73**	**10.01**	**22.03**	**9.30**	**40.43**	**17.06**
Fifth Field Scale										
White Pass Projects	0.00	0.00	0.00	0.00	3.60	0.02	1.90	0.01	20.30	0.11
Projects Not Associated with the White Pass Expansion	322.01	1.80	322.01	1.80	322.01	1.80	322.01	1.80	322.01	1.80
Cumulative Impacts	**322.01**	**1.80**	**322.01**	**1.80**	**325.61**	**1.82**	**323.91**	**1.82**	**342.31**	**1.92**

[a] Only impacts that occur within Riparian Reserves are counted in this analysis. They include clearing and grading, new impervious surfaces, and utility trenching. Projects that occur within Riparian Reserves are more likely to impact streams, wetlands, water quality and flow regime because of the proximity of the actions to the watershed resources in comparison to activities that have no relation to waters.
[b] Percent of Scale is the percentage of Riparian Reserves impacted in the White Pass Study Area and in the fifth field watershed.