With the exception of a five acre parcel in the vicinity of Knox Ranch, the entire cumulative effects area is administered by the U.S. Forest Service. Since 1950 an estimated 7,208 acres have been harvested within the cumulative effects area. Historic records indicate that since 1910 roughly 67,853 acres within the cumulative effects area have been affected by wildfire, some of which overlap with harvested acres. Although the specific effects cannot be quantified, the existing conditions disclosed above reflect the impacts of those past activities as well as any vegetative recovery that has occurred since those events. Ongoing and/or foreseeable future activities within this cumulative effects area that could add incrementally to impacts on these species are identical to those presented above for elk/mule deer. Reference **Appendix B** for additional information and maps related to the cumulative effects analyses completed for this project.

Alternative A would have no direct or indirect effects on these species or their habitats, therefore no cumulative effects would occur (P.R., Vol. 10, Species of Concern).

Alternatives B and C would not be expected to have any meaningful effects on the sagebrush shrubland, non-riverine wetland, riparian, or dry ponderosa pine/Douglas-fir/grand fir habitat types. Therefore these alternatives would not result in any cumulative effects on these priority habitats (P.R., Vol. 10, Species of Concern).

3.11 Watershed/Soils

This section of the document discusses the existing characteristics of the watershed/soil resources, as well as the effects of the alternatives on those resources. The discussions will focus on five areas; erosion and sedimentation, water yield, slope stability, soil productivity, and wetlands and floodplains. Given the complexity of these components, a variety of different analysis areas were used. A brief summary of each is provided in the discussion for each respective analysis.

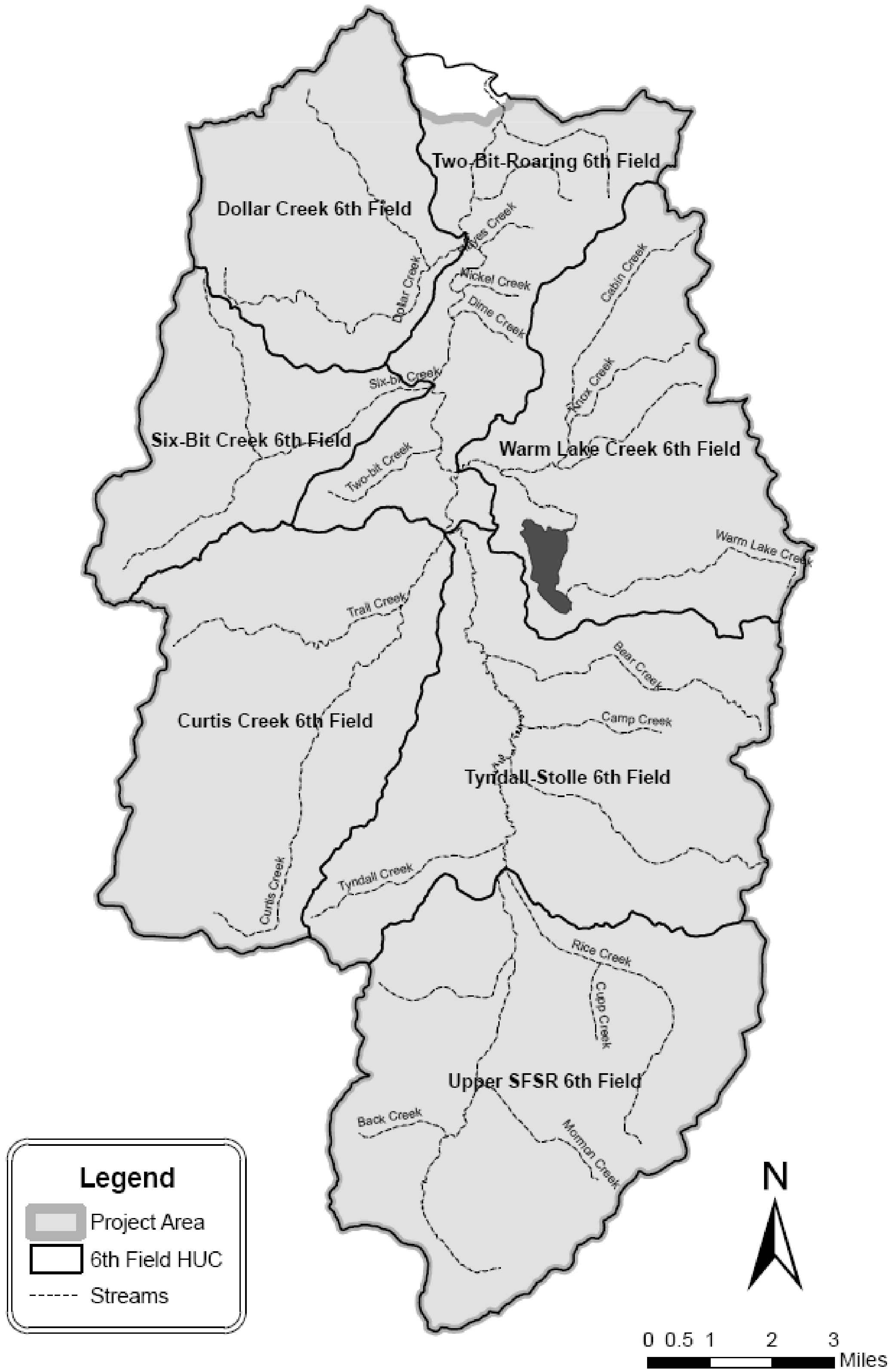
The 103,804 acre project area comprises most of two 5th field watersheds, Warm Lake (HUC 1706020810) and the Upper South Fork Salmon River (HUC 1706020811). The Warm Lake 5th field consists of four 6th field subwatersheds; Dollar Creek, Warm Lake Creek, Six-bit Creek, and Two-bit Roaring. The Upper South Fork Salmon River 5th field consists of three 6th field subwatersheds; Tyndall Stolle, Curtis Creek, and Upper South Fork Salmon River (Figure 3-16). The project area includes numerous named and unnamed tributaries to the South Fork Salmon River (Figure 3-16).

Elevations within the project area range from 5,000 feet near the mouth of Roaring Creek to 8,696 feet at the summit of Rice Peak. Annual average precipitation ranges from 20 to 60 inches, with about 65 percent falling as snow. Long duration, low intensity frontal storms are common in fall, winter, and spring and may generate considerable snow melt in addition to storm rainfall. Summers are typically hot and dry with precipitation occurring primarily during intense, short duration thunderstorms. The most significant precipitation characteristic is the fairly frequent short duration, high intensity storms that can result in extremely high, flashy runoff peaks or landslides.

3.11.1 Erosion/Sedimentation

This section of the document describes the existing conditions as well as the effects of the alternatives on erosion/sedimentation. For the purposes of this analysis the seven 6th field subwatersheds in their entireties, totaling roughly 104,431 acres, were evaluated as separate analysis areas. As displayed in Figure 3-16, a portion of the Two-bit Roaring 6th field occurs outside of the 103,804 acre project area, with the remaining 6th fields located entirely within the project area.

Figure 3-16 6[th] Field Subwatersheds



The project area lies in the central Idaho batholith, well known for its high sedimentation rates following natural and human-induced disturbances. Of particular concern in this case, are those effects related to the 2007 Cascade Complex Wildfire. Accelerated erosion caused by wildfire has been suggested as the largest productivity loss in the northern Rocky Mountains because of the large area involved (Clayton and King 1995). The most common type of surface erosion following fire is rill erosion, especially in high intensity burned areas (Megahan 1983). Sediment delivered to streams influences fish habitat and channel morphology. Increased levels of sediment can disrupt fish population viability (Goetz 1991; Horwitz 1978; Poff and Ward 1989; Schlosser 1982; Weaver and White 1985).

Using post-fire satellite images in conjunction with the Burned Area Reflectance Classification (BARC) imagery, the seven 6th field analysis areas were stratified into burn severities. Field reconnaissance completed in the fall of 2007 verified that, in general, the BARC model results accurately reflected the levels of burn severities. In contrast to the RAVG model which reflects tree mortality, BARC is intended to reflect the impacts of fire on soil and watershed conditions. Using the BARC model, acres within the various 6th fields were stratified as unburned or as one of the following burn severities:

High Severity – High soil heating, or deep ground char, occurs where the duff is completely consumed and the top of the mineral soil is visibly reddish or orange. Logs can be consumed or deeply charred, and deep ground char can occur under slash concentrations or burned logs.

Moderate Severity – Moderate soil heating, or moderate ground char, occurs where the duff is deeply charred or consumed but the mineral soil is not visibly altered. Ash is present on the surface. Woody debris is mostly consumed, except for logs, which are deeply charred.

Low Severity – Low soil heating, or light ground char, occurs where litter is scorched, charred, or consumed but the duff is left largely intact. Woody debris accumulations are partially consumed or charred. Mineral soil is not changed.

Table 3-16 summarizes the total acres burned and their severities within the seven 6th field subwatersheds and reflects not only those acres impacted by the 2007 wildfire, but also numerous other past wildfires. Although the effects on erosion and sedimentation of many of these fires have likely subsided, some of the more recent wildfires, such as the 2003 South Fork Wildfire and the 2006 Summit Wildfire, are still contributing sediment to area streams (P.R., Vol. 11, Sediment).

Table 3-16 Burn Severities by Subwatershed

Subwatershed	Total Acres	Total Burned	Burn Severity			
			High	Moderate	Low	Unburned
Curtis Creek	17,482	16%	2%	9%	5%	84%
Dollar Creek	10,590	73%	14%	36%	23%	27%
Six-bit Creek	8,248	75%	15%	35%	25%	25%
Two-bit Roaring	11,916	95%	23%	49%	23%	5%
Tyndall Stolle	19,971	84%	42%	33%	9%	16%
Upper SFSR	21,160	87%	14%	45%	28%	13%
Warm Lake Creek	15,064	70%	21%	30%	19%	30%
Totals	**104,431**	**71%**	**20%**	**33%**	**18%**	**29%**

The Boise National Forest Sediment Model (BOISED) was used to assess the existing conditions relative to sedimentation, as well as to project the percent over natural sediment yield as a result of proposed activities. BOISED predicts the percent over natural sediment yield as a result of all past and ongoing management activities, as well as the effects of past large fires. The use of BOISED along with field inventories, monitoring results from similar projects, applicable research, and professional judgment, provides a means through which to compare the effects of different management strategies to the baseline conditions. It should be stressed that the BOISED model is not intended to predict actual sediment delivery, but rather provides a tool through which to compare the relative effects of different management strategies.

BOISED is a commonly used model and generally accepted in the professional community for the purpose of assessing relative risk between various alternatives (*R1/R4 Sediment Model and Various Clones Strategy Meeting*, EPA 1997). Recent tests indicate the model tends to over-estimate sediment delivery from roads *("R1/R4" and "BOISED" Sediment Prediction Model Tests Using Forest Roads in Granitics*, Ketcheson et al 1999). However based on monitoring after the Foothills Fire, BOISED was found to underestimate sediment yield from moderate severity wildfire by a factor of two to three times, and underestimate sediment yield from high severity wildfire by a factor of five (personal communication, Terry Hardy, Boise N. F., Forest Soils Scientist, 2004). The planning record includes several sources that document the limitations, expected predictive power and accuracy, and the generally accepted appropriate use of the BOISED model. However, the use of other predictive tools, such as the Megahan/Ketcheson model (Ketcheson and Megahan 1996) using site specific data is encouraged to better refine and/or interpret the results of the BOISED model.

Table 3-17 displays the BOISED modeled percent over natural sediment yields for the seven 6th field subwatersheds in year 2006 (pre-fire) and 2007 (post-fire). Values displayed in Table 3-17 reflect the effects of all past activities including roads, timber harvest, and large fires, as well as any recovery that may have occurred since the disturbance (P.R., Vol. 11, Sediment).

Table 3-17 Pre-fire and Post-fire BOISED Modeled Sediment Yield by Subwatershed

Subwatershed	Percent Over Natural Year 2006 (Pre-fire)	Percent Over Natural Year 2007 (Post-fire)
Curtis Creek	8.6%	29.5%
Dollar Creek	2.6%	43.1%
Six-bit Creek	2.9%	56.6%
Two-bit Roaring	7.8%	78.5%
Tyndall Stolle	5.4%	96.5%
Upper SFSR	0.8%	52.0%
Warm Lake Creek	2.3%	33.3%

Based on BOISED modeling efforts and personal observations, the Tyndall Stolle 6th field experienced the most severe impacts from the 2007 wildfire. In general, the Lodgepole Creek drainage was most affected by the wildfire and has the potential to generate and deliver sediment to fish habitat. Bear Creek and Camp Creek drainages are also of concern since they are tributaries to the South Fork Salmon River (SFSR) and are immediately upstream of or adjacent to the Stolle Meadows Chinook salmon spawning reach. The small, steep face drainages west of the SFSR between its confluence with Curtis Creek and road #483 are also likely sources of post-fire sediment due to steep terrain, high fire severity, and inherently erosive soils. All of these drainages occur in the Tyndall Stolle 6th field (P.R., Vol. 11, Sediment).

Although summer storms and their high intensity raindrop impacts have a high potential of delivering sediment to streams, the initial movement of soil particles from the burned areas will occur during the snowmelt period in the spring of 2008. However, the movement of soil by individual processes does not necessarily represent sediment delivery because material may not enter any stream system. Sediment delivery of material mobilized by debris slides, for example, can vary greatly depending upon size distribution and water content of mobilized material (Megahan et al 1978) and the topography it moves over. Megahan (1981) estimated the delivery rate at 10 percent for slides in granular granitic soils during dry periods. Sediment produced in small basins (160 to 325 acres) in the Idaho batholith showed 15 percent entered stream channels and 7 percent was delivered to the basin outlet. The remainder was stored temporarily on the hillslopes (Swanson et al 1987). Once soil particles are displaced from a location as a result of disturbance, the distance of travel is influenced by the amount of energy available for sediment transport, the potential for storage on the slope, the volume of erosion, and the particle size distribution. For these reasons the existing conditions of vegetation adjacent to streams is important. Table 3-18 displays the percentages by burn severity of the streamside RCAs within the seven 6th field subwatersheds (P.R., Vol. 11, Sediment).

Table 3-18 Burn Severities in RCAs by Subwatershed

Subwatershed	Total RCA Acres	Total Burned	Burn Severity			
			High	Moderate	Low	Unburned
Curtis Creek	3,928	15%	1%	9%	5%	85%
Dollar Creek	2,634	74%	12%	38%	24%	26%
Six-bit Creek	1,932	78%	17%	36%	25%	22%
Two-bit Roaring	1,900	95%	20%	52%	23%	5%
Tyndall Stolle	3,709	89%	45%	36%	8%	11%
Upper SFSR	3,215	89%	11%	44%	34%	11%
Warm Lake Creek	2,221	72%	24%	31%	17%	28%
Totals	**19,539**	**70%**	**19%**	**33%**	**18%**	**30%**

Section 303(d) of the Clean Water Act requires states to identify waters not meeting state water quality standards (i.e. Water Quality Limited Waterbodies). The prescribed remedy for these waterbodies is for the states to determine the Total Maximum Daily Load (TMDL) for pollutants, and to develop a plan to reduce these pollutants.

The SFSR, including all 1st to 5th order tributaries, was listed as impaired (Water Quality Limited Waterbodies) in the *2002 303(d)/305(b) Integrated Report* (IDEQ 2005), with sediment identified as the pollutant of concern. Beneficial uses identified for the SFSR include domestic and agricultural water supply, cold water biota, salmonid spawning, primary and secondary contact recreation, and special resource waters.

In January of 1992, the Environmental Protection Agency (EPA) approved the 1991 TMDL for the SFSR Subbasin, which includes both the Upper South Fork Salmon River and Warm Lake 5th field watersheds. Appendix A of that document (EPA 1992, pg. A-2) states that because of the recognized problems associated with excess sediment in the South Fork, interim water quality criteria have been set by a consensus team working on the Boise and Payette National Forest Plans. The TMDL goes on to state that Standards and Guidelines for the South Fork Salmon River Drainage have been specifically identified in both the Boise and Payette National Forest Plans. The interim objective is to provide habitat sufficient to support fishable populations of naturally spawning and rearing salmon and trout by 1997. This determination is based on evaluation of fish populations, harvest of wild fish, cobble embeddedness, core sampling, photographs, and other data as may be pertinent. Although standards and guidelines identified in the 1990 Boise Forest Plan have been replaced by direction in the 2003 Forest Plan, management direction is still focused on improvement of fish spawning and rearing habitat by reducing the sediment load attributable to human activities.

The *South Fork Salmon River Subbasin Assessment* was completed by the Idaho Department of Environmental Quality (IDEQ) in May of 2002. That document states that:

“The IDEQ and USEPA will use the results of the water body assessments contained within this document to update Idaho’s 303(d) list.” (IDEQ 2002, pg. x)

“The review of the available ambient numeric water quality monitoring data shows attainment of current water quality criteria for sediment and metals. Review of the biological data and sediment impacts to aquatic habitat indicates that the historical habitat conditions within the SF Salmon Subbasin are in the process of re-establishing. These results of the SF Salmon SBA indicate that the listed water bodies currently meet the Idaho water quality standards for sediment and metals. The TMDL approved by the USEPA in 1991 included two surrogate targets for sediment, percent depth fines and cobble embeddedness. Data included in the document suggest that the watershed has attained the target and has an improving trend for cobble embeddedness, but has not attained the target for percent depth fines. Therefore, the IDEQ is removing all water bodies currently listed for sediment and metals from the Idaho 303(d) list with the exception of the main stem South Fork Salmon River.” (IDEQ 2002, pg. xi)

"This remaining uncertainty, combined with the highly valued TES beneficial uses, suggests that the 1991 TMDL should continue to be implemented. The SF Salmon Subbasin must be managed so that the existing roads and sediment sources do not cause water quality violations in the future." (IDEQ 2002, pg. xi)

"Review of the available stream data, potential management impacts to stream temperature, and riparian conditions indicate that the Idaho water quality standard for stream temperature is not violated. However, it was found that the federal bull trout temperature standards for these same streams are exceeded. Therefore, these water bodies are placed on the Idaho 303(d) list. These water bodies include: Trout Creek, Sand Creek, Rice Creek, Trail Creek, Warm Lake Creek, Johnson Creek, SF Salmon River, Tyndall Creek, Profile Creek, Buckhorn Creek, Lick Creek, Grouse Creek, and Elk Creek." (IDEQ 2002, pg. xi)

At this time the EPA has not acted on the recommendations in the *South Fork Salmon River Subbasin Assessment* (IDEQ 2002), therefore no changes to the EPA approved list of WQLW has occurred.

3.11.1.1 Environmental Consequences Specific to Alternative A

This alternative would have no effect on sedimentation within the seven 6th field analysis areas (P.R., Vol. 11, Sediment).

In comparison to the pre-fire condition, soil erosion would increase under this alternative due to the loss of vegetation consumed by the 2007 wildfire and, to a lesser degree, the fire-induced hydrophobic soil conditions. Sediment delivery to streams would increase as a result of increased surface erosion, decreased surface roughness, and increased water runoff. Sediment would be stored to some degree in the tributary channels and delivered to main channels over time. The total volume of sediment stored behind obstructions would vary between subwatersheds and years in response to changes in bankfull channel widths and annual peak flow rates, respectively (Megahan 1982) (P.R., Vol. 11, Sediment).

Over time the rate of soil erosion and sedimentation would decrease as vegetation becomes established, dead trees fall to the ground, and water infiltration increases. Areas with hydrophobic soil conditions would naturally recover through the freeze/thaw process and any trampling by wildlife. Natural regeneration of conifer species would eventually occur, but is expected to be delayed in many locations due to the lack of any seed source. The time needed for these natural processes to occur will vary depending upon the characteristics of the particular site (elevation, aspect, soil type, etc.) and the severity of the burn on that site (P.R., Vol. 11, Sediment).

As displayed in Table 3-19, sediment yields for the seven 6th field subwatersheds, as modeled by BOISED, would decrease considerably over the next few years as the effects of the 2007 wildfire subside. By year 2011, modeled sediment yields will have returned to pre-fire levels in six of the 6th field subwatersheds. The Curtis Creek 6th field sediment yield is expected to remain slightly elevated into the foreseeable future due to the recently completed reconstruction work on Warm Lake Highway (P.R., Vol. 11, Sediment).

3.11.1.2 Environmental Consequences Specific to Alternative B

With five exceptions, the effects of this alternative on fire-induced sedimentation within the seven 6th field analysis areas would be identical to Alternative A. The first exception is related to the felling of fire-killed trees in the 3 to 7 inch dbh range, post-harvest, across an estimated 100 acres of harvested units along the #470 and #472 roads. These trees would be felled and retained on site with the goal of achieving a post-harvest quantity of 500 linear feet of obstructions per acre to trap erosion. Felled trees would be severed as necessary to ensure their entire lengths are in contact with the ground surface and situated perpendicular to the direction of slope (Section 2.4.3.2). In contrast, under Alternative A (No Action), the majority of the fire-induced sedimentation would occur before natural processes result in fire-killed trees falling to the ground (Section 3.2.7).

In addition, under this alternative, fire-killed and imminently dead trees greater than or equal to 8 inches dbh that are located upslope of an open authorized road and within one site potential tree height of a stream that parallels the road, would be felled and retained on site across an estimated 10 acres (Section 2.4.3.2). These trees would be felled after harvest activities have occurred and would obstruct movement of both fire-induced and harvest-induced erosion (P.R., Vol. 11, Sediment).

The third exception is related to the beneficial effects of adding effective ground cover. On the high severity, and to a lesser extent moderate severity burned areas, the soil surface litter and humus was destroyed by the fire and the exposed soil surface is highly susceptible to erosion. While the majority of the harvest-related slash would be removed from the units via whole-tree-yarding and accumulated at landings, incidental amounts of material in the form of limbs and tops of harvested trees would break off during operations, be retained on site, and provide an immediate contribution of organic material. The immediate contribution of this logging slash would increase the effective ground cover on roughly 1,661 acre. In addition to speeding the recovery of soil productivity, this slash would also increase the interception and storage of sediment on the hillslopes (P.R., Vol. 11, Sediment).

The fourth exception relates to placement of log obstructions below six existing drainage features (i.e. relief culverts and/or drive-through dips) on the #478 road (Section 2.4.3.2). These structures would capture erosion before it is delivered to the adjacent Rice Creek (P.R., Vol. 11, Sediment).

The final exception relates to the effects of ground-based skidding on fire-induced sedimentation. Although research is limited, ground disturbance associated with logging has been observed to disrupt water-repellent layers (hydrophobic conditions), which may increase water infiltration and thereby decrease overland flow and erosion from burned sites. Ice (1999) states that where water-repellent soils are created by condensation of volatilized organics in the soil, ripping and breaking-up of this layer is essential to rapidly restore infiltration. In addition, Poff (1988) argues that "…salvage logging can improve watershed condition by increasing ground cover, by removing a source of large, high energy water drops, and by breaking up hydrophobic soil layers." While an immediate benefit would not be realized, breaking up the hydrophobic soils via ground-based skidding would speed the rate of recovery (P.R., Vol. 11, Sediment).

While the five activities discussed above would minimize fire-induced sedimentation within proposed harvest units, in comparison to the pre-fire condition, soil erosion would increase due to the loss of vegetation consumed by the 2007 wildfire and, to a lesser degree, the fire-induced hydrophobic soil conditions elsewhere within the project area. Sediment delivery to streams would increase as a result of increased surface erosion, decreased surface roughness, and increased water runoff. Sediment would be stored to some degree in the tributary channels and delivered to main channels over time. The total volume of sediment stored behind obstructions would vary between subwatersheds and years in response to changes in bankfull channel widths and annual peak flow rates, respectively (Megahan 1982) (P.R., Vol. 11, Sediment).

Over time the rate of fire-induced soil erosion and sedimentation would decrease as vegetation becomes established, dead trees fall to the ground, and water infiltration increases. Areas with hydrophobic soil conditions would naturally recover through the freeze/thaw process and any trampling by wildlife. Natural regeneration of conifer species would eventually occur, but is expected to be delayed in many locations due to the lack of any seed source. The time needed for these natural processes to occur will vary depending upon the characteristics of the particular site (elevation, aspect, soil type, etc.) and the severity of the burn on that site (P.R., Vol. 11, Sediment).

As displayed in Table 3-19, sediment yields for the seven 6th field subwatersheds, as modeled by BOISED, would decrease considerably over the next few years as the effects of the 2007 wildfire subside. By year 2011, modeled sediment yields will have returned to pre-fire levels in three of the 6th field subwatersheds, with another three returning to pre-fire levels by year 2014. The Curtis Creek 6th field sediment yield is expected to remain slightly elevated into the foreseeable future due to the recently completed reconstruction work on Warm Lake Highway (P.R., Vol. 11, Sediment).

Table 3-19 BOISED Modeled Percent Over Natural Sediment Yield by Subwatershed

	Year									
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2023**
Curtis Creek										
Alternative A	8.6	29.5	13.8	9.8	9.2	9.1	9.1	9.1	9.1	9.1
Alternative B	8.6	29.5	14.3	10.0	9.4	9.2	9.1	9.1	9.1	9.1
Alternative C	8.6	29.5	14.2	10.0	9.4	9.2	9.1	9.1	9.1	9.1
Dollar Creek										
Alternative A	2.6	43.1	11.3	4.4	2.7	2.2	2.0	2.0	2.0	2.0
Alternative B	2.6	43.1	11.3	4.5	2.7	2.2	2.0	2.0	2.0	2.0
Alternative C	2.6	43.1	11.3	4.4	2.7	2.2	2.0	2.0	2.0	2.0
Six-bit Creek										
Alternative A	2.9	56.6	14.6	5.3	3.3	2.9	2.9	2.9	2.9	2.9
Alternative B	2.9	56.6	16.3	6.2	4.0	3.3	3.1	3.0	2.9	2.9
Alternative C	2.9	56.6	15.3	5.7	3.7	3.1	2.9	2.9	2.9	2.9
Two-bit Roaring										
Alternative A	7.8	78.5	23.0	10.7	8.0	7.2	7.2	7.1	7.1	7.1
Alternative B	7.8	78.5	24.5	11.5	8.6	7.6	7.4	7.2	7.1	7.1
Alternative C	7.8	78.5	23.5	10.9	8.2	7.4	7.2	7.2	7.1	7.1
Tyndall Stolle										
Alternative A	5.4	96.5	25.3	9.3	6.1	5.3	5.3	5.3	5.3	5.3
Alternative B	5.4	96.5	28.3	10.9	7.3	6.1	5.6	5.4	5.3	5.3
Alternative C	5.4	96.5	27.0	10.2	6.8	5.7	5.5	5.4	5.3	5.3
Upper SFSR										
Alternative A	0.8	52.0	12.0	3.1	1.3	0.8	0.8	0.8	0.8	0.8
Alternative B	0.8	52.0	12.2	3.3	1.4	0.9	0.8	0.8	0.8	0.8
Alternative C	0.8	52.0	12.1	3.2	1.3	0.8	0.8	0.8	0.8	0.8
Warm Lake Creek										
Alternative A	2.3	33.3	9.0	3.5	2.3	2.0	2.0	2.0	2.0	2.0
Alternative B	2.3	33.3	9.4	3.7	2.5	2.1	2.0	2.0	2.0	2.0
Alternative C	2.3	33.3	9.2	3.6	2.4	2.1	2.0	2.0	2.0	2.0

In comparison to Alternative A (No Action), management activities associated with this alternative would increase sediment delivery a maximum of 3.0 percent over natural in any given 6th field (Table 3-19). In comparison to Alternative A, the BOISED modeled percent over natural sediment delivery attributable to management activities would be a maximum increase of 0.5 percent in the Curtis Creek 6th field; 0.1 percent in the Dollar Creek 6th field; 1.7 percent in the Six-bit Creek 6th field; 1.5 percent in the Two-bit Roaring 6th field; 3.0 percent in the Tyndall Stolle 6th field; 0.2 percent in the Upper SFSR 6th field, and; 0.4 percent in the Warm Lake Creek 6th field (P.R., Vol. 11, Sediment).

Although BOISED reflects slight increases in sedimentation for up to six years as a result of proposed activities, the modeled output does not reflect the benefits of many design features incorporated into this alternative. Design features associated with proposed activities, including Best Management Practices, would minimize soil disturbance and sediment delivery during and following implementation. The effectiveness of these Best Management Practices applied to timber harvesting activities has been extensively studied (Belt et al 1992; Dissmeyer 1994; NYSEGC 1993; Seyedbagheri 1996; Gray and Megahan 1981; Cook and King 1983). Proper application of these design features would be expected to decrease the likelihood of sediment delivery to streams in quantities sufficient to impact water quality conditions (P.R., Vol. 11, Sediment).

As discussed in detail below, this alternative would not contribute additional sediment, the pollutant of concern, to water quality limited waterbodies in amounts that would prevent the attainment and maintenance of the instream objectives. This alternative would not have a measurable effect on the identified beneficial uses of domestic and agricultural water supply, cold water biota, salmonid spawning, primary and secondary contact recreation, and special resource waters (P.R., Vol. 11, Sediment; Vol. 12, Fisheries; Vol. 5, Wild and Scenic).

This alternative would comply with existing management direction including Forest Plan Standards and Guidelines and the Clean Water Act, as well as Terms and Conditions prescribed in the Biological Opinion prepared for the Forest Plan. In addition, felling of fire-killed trees in the 3 to 7 inch dbh range, post-harvest, across an estimated 100 acres; felling fire-killed trees greater than or equal to 8 inches dbh on another 10 acres; adding effective ground cover; placement of log obstructions below six existing drainage structures, and; breaking up the hydrophobic soils via ground-based skidding would be consistent with the intent of the TMDL of reducing sediment, the pollutant of concern (P.R., Vol. 11, Sediment).

Timber Harvest Activities – Perhaps the most significant design feature not reflected in BOISED modeling relates to the effectiveness of streamside buffers. Design features associated with this alternative prohibit salvage harvest (i.e. cutting and removal) of fire-killed or imminently dead trees within one site potential tree height of any waterbody. Fire-killed and imminently dead trees greater than or equal to 8 inches dbh that are located upslope of an open authorized road and within one site potential tree height of a stream that parallels the road, would be felled and retained on site on roughly 10 acres. Ground-based skidding would not be allowed within one site potential tree height of any stream unless an open authorized road parallels the stream. If a road parallels the stream and is less than one site potential tree height distance from that stream, ground-based skidding may occur upslope of the road and within one site potential tree height of the stream, but all harvest and ground-based skidding would be prohibited between the road and stream (Seciton 2.4.3.2).

Appendix B, pages B-33 to B-36 in the Forest Plan provides direction on delineating RCAs. The analysis completed for this assessment delineated these RCAs based upon site potential tree heights for the appropriate potential vegetation group (PVG). Based upon that analysis, RCAs for perennial streams and intermittent streams providing seasonal rearing and spawning habitat were defined as: 260 feet for PVG 6; 200 feet for PVG 7, and; 160 feet for PVG 10. RCAs widths for ponds, lakes, reservoirs, wetlands, and intermittent streams not providing seasonal rearing and spawning habitat were delineated as 130 feet for PVG 6; 100 feet for PVG 7, and; 80 feet for PVG 10 (P.R., Vol. 11, Sediment).

The Megahan/Ketcheson model (Ketcheson and Megahan 1996) was developed to estimate sediment delivery distances from activities in granitic geologies, specifically the Idaho batholith. Predicted sediment delivery distances are based on the 95 percent confidence level. This means that statistically, 95 percent of sediment distances under the given parameters would be shorter than the modeled delivery distance. In other words, it is 95 percent certain that sediment generated from a given source would not travel farther than the modeled distances. The Megahan/Ketcheson model is an empirical model developed through research conducted in the Silver Creek watershed on the Boise National Forest, which has similar soils, potential vegetation groups (PVGs), topography, and climate as the project area. Due to these factors, modeled sediment delivery distances should reflect potential sediment delivery distances for this project, within the modeled confidence interval. Actual sediment delivery distances would depend on unpredictable variables such as frequency and intensity of summer thunderstorms, midwinter or spring rain-on-snow events, or the timing and intensity of spring snowmelt. However, in development of the model, 22 years of rainfall intensity data which included rainfall erosivity values ranging from moderately low to the highest on record was used thus representing an excellent range in rainfall (Megahan and Ketcheson 1996). Also included in the development of the model was 30 years of streamflow data which included the second and third highest flows in the 30 year period (Megahan and Ketcheson 1996).

The Megahan/Ketcheson model was used to estimate sediment delivery distances for several different scenarios based on skidding restrictions disclosed in Chapter 2 (Section 2.4.3.2). It is also worthy to note that these modeling efforts took into account increased erosion rates expected as a result of the 2007 wildfire. For tractor skidding on unconstructed skid trails and on slopes less than 40 percent, the Megahan/Ketcheson model predicted, using on-site data, an average sediment delivery distance of 4.6 feet with a maximum delivery distance of 16.4 feet. Relative to the potential for concentration of eroded material and delivery to streams downslope of roads, the Megahan/Ketcheson model predicted, using on-site data, an average sediment delivery distance of 7.7 feet with a maximum delivery distance of 19.0 feet. The minimum distance from the road to the stream on these sites is roughly 20 feet (P.R., Vol. 11, Sediment).

Another scenario assessed with the Megahan/Ketcheson model relates to the removal of logs from slopes exceeding 40 percent. Design features (Section 2.4.3.2) prohibit the use of ground-based equipment on slopes exceeding 40 percent, instead, included material would be removed with an off-road jammer. Off-road jammers in these situations would be confined to the road prism or slopes within the unit that are less than or equal to 40 percent if above the road and the logs winched to the off-road jammer prior to being skidded to the landing. Should the slope preclude throwing the off-road jammer tongs 200 feet upslope, the depth of the unit would be reduced as necessary (i.e. <200 feet). One concern associated with this activity is the potential for logs to gouge the ground surface as being winched to the off-road jammer, thus creating furrows for the accumulation of water and transport of eroded material. However, the Megahan/Ketcheson model predicted, using on-site data, an average sediment delivery distance of 4.7 feet with a maximum delivery distance of 6.3 feet. Not reflected in these modeled delivery distances are a design feature (Section 2.4.2.5) that requires construction of cross-ditches by hand on these furrows no later than two weeks after completion of harvest within each affected unit which would further limit the travel distance of eroded material. Another important consideration in this assessment was the number of logs potentially winched over the same path, which, given the maximum unit depth of 200 feet, would not be expected to be more than a few logs prior to the off-road jammer repositioning itself (P.R., Vol. 11, Sediment).

Given the narrow (i.e. maximum of 200 feet) linear nature of proposed units, it is unlikely that skid trail construction would be necessary. Nevertheless, the Megahan/Ketcheson model predicted, using on-site data, an average sediment delivery distance of 5.9 feet with a maximum delivery distance of 14.9 feet for this activity. In order to minimize the potential for sediment delivery from constructed skid trails, design features common to all action alternatives require the District Hydrologist to review on-the-ground all requests to construct skid trails within RCAs prior to their construction. The approval or relocation of these skid trails and/or incorporation of appropriate mitigation measures would be the responsibility of the District Hydrologist (Section 2.4.2.5). Design features (Section 2.4.2.5) also require that, following completion of use, cross-ditches would be constructed at intervals of approximately 20 feet where skid trails exceed 20 percent slope (P.R., Vol. 11, Sediment).

One situation that could affect sediment delivery distances reflected by the Megahan/Ketcheson model would be if fire-induced sediment filled the sediment storage capacity of existing obstructions otherwise available to trap erosion generated by timber harvest activities. As explained above, modeling efforts took into account increased erosion rates expected as a result of the 2007 wildfire. Nevertheless a number of design features, previously discussed, were incorporated to address this concern. In order to minimize sedimentation from harvested units along the #470 and #472 roads, fire-killed trees in the 3 to 7 inch dbh range would be felled and retained on site with the goal of achieving a post-harvest quantity of 500 linear feet of obstructions per acre. These felled trees would be severed as necessary to ensure their entire lengths are in contact with the ground surface and situated perpendicular to the direction of slope (Section 2.4.3.2). Fire-killed and imminently dead trees greater than or equal to 8 inches dbh that are located upslope of an open authorized road and within one site potential tree height of a stream that parallels the road, would be felled and retained on site on roughly 10 acres. In addition, logs would be placed perpendicular to the direction of flow below six drainage structures on the #478 road to capture erosion prior to its delivery to Rice Creek (Section 2.4.3.2). These three activities would not only reduce the potential for delivery of management-induced sedimentation, but would also obstruct delivery of fire-induced sediment (P.R., Vol. 11, Sediment).

While the majority of the harvest-related slash would be removed from the units via whole-tree-yarding and accumulated at landings, incidental amounts of material in the form of limbs and tops of harvested trees would break off during operations and be retained on site. The immediate contribution of this logging slash would increase the number of obstructions beyond those reflected in Megahan/Ketcheson modeling efforts and increase the interception and storage of sediment on the hillslopes (P.R., Vol. 11, Sediment).

Therefore, given incorporated design features and modeled sediment delivery distances, little if any of the BOISED modeled sediment attributed to harvest activities would be delivered to streams (P.R., Vol. 11, Sediment).

Landings – Given the narrow (i.e. maximum of 200 feet) linear nature of proposed harvest units and therefore the limited number of logs accumulated at any single location, it is suspected that few landings would be constructed under this alternative and that the Purchaser would instead use unconstructed landings and/or the actual road prism. Under a worse case scenario where landings would be constructed, the Megahan/Ketcheson model predicted, using on-site data, an average sediment delivery distance of 13.4 feet with a maximum delivery distance of 57.8 feet. In order to minimize the potential for sediment delivery from this activity, design features common to all action alternatives (Section 2.4.2.5) prohibit the construction of new landings within one site potential tree height (minimum of 80 feet) of any stream. In addition, prior to construction of landings within the remaining portions of RCAs (i.e. more than one site potential tree height from a stream but within an RCA), the District Hydrologist would review on-the-ground the proposed location. The approval or relocation of such activities and/or incorporation of appropriate mitigation measures would be the responsibility of the District Hydrologist. Therefore this activity is expected to result in negligible amounts of sedimentation to any stream. Assuming under a worse case scenario that some landings are constructed, design features (Section 2.4.2.5) require that, upon completion of harvest activities, all landings constructed in association with this project would be reshaped to provide adequate drainage, scarified to a minimum depth of 18 inches, slash distributed to cover approximately 30 percent of the reshaped surfaces, and planted with a Forest Service approved seed mixture, thereby eliminating the potential for sedimentation in the future (P.R., Vol. 11, Sediment).

Road Use/Dust - A total of approximately 900 truck loads of logs would be removed under this alternative over a period of two years, with the actual haul distributed over numerous different roads. On average, a total of 5 to 10 trucks/day would be expected on any given road. Available traffic count data for the #474.2 road suggests that in excess of 100 vehicles travel along this road on a daily basis during the snow-free season, thus the sediment attributable to dust resulting from increases in logging traffic would be inconsequential (P.R., Vol. 11, Sediment).

Dust generated from unpaved roads would be minor due to slow speeds. Also, contract provisions would require dust abatement when dust is a hazard. With normal dust abatement procedures, noticeable amounts of fine sediment generated by logging traffic would not reach stream channels. Since some potential haul routes may also receive abundant use by recreational traffic during the same time period, dust abatement associated with the timber sale may actually reduce the amount of dust reaching streams that is attributable to recreational uses (P.R., Vol. 11, Sediment).

Temporary Roads - As part of the Burned Area Emergency Response (BAER) effort, the culvert at the #473 road crossing of Lodgepole Creek was removed in the fall of 2007, thus eliminating authorized motorized access to the #473 road. However, an unauthorized road prism is currently in place that connects the #474.2 road with the #473 road south of the Lodgepole Creek culvert location. This alternative would use this existing unauthorized road (0.7 miles) as a temporary road in order to access the #473 road.

This temporary road does not cross any streams, with the closest stream located roughly 150 feet to the north across flat ground. Use of this existing road prism as a haul route would not be expected to increase sediment delivery to any stream channel (P.R., Vol. 11, Sediment).

3.11.1.3 Environmental Consequences Specific to Alternative C

With three exceptions, the effects of this alternative on fire-induced sedimentation within the seven 6^{th} field analysis areas would be identical to Alternative A. The first exception relates to the felling and retention on site of fire-killed and imminently dead trees greater than or equal to 8 inches dbh within an estimated 200 feet upslope of open authorized roads and approximately 50 feet downslope of open authorized roads across 422 acres. This treatment would occur within RCAs that lie more than one site potential tree height from a stream unless an open authorized road parallels the stream. If a road parallels the stream, falling and retention of these trees on site may occur upslope of the road and within one site potential tree height of a paralleling stream, but falling of trees would be prohibited between the road and stream (Section 2.4.3.3). Felling and retention on site of these trees would increase sediment storage and interception of fire-induced sediment on the hillslopes. In contrast, under Alternative A (No Action), the majority of the fire-induced sedimentation would occur before natural processes result in fire-killed trees falling to the ground (Section 3.2.7).

The second exception is related to the beneficial effects of adding effective ground cover. On the high severity, and to a lesser extent moderate severity burned areas, the soil surface litter and humus was destroyed by the fire and the exposed soil surface is highly susceptible to erosion. While the majority of the harvest-related slash would be removed from the units via whole-tree-yarding and accumulated at landings, incidental amounts of material in the form of limbs and tops of harvested trees would break off during operations, be retained on site, and provide an immediate contribution of organic material. The immediate contribution of this logging slash would increase the effective ground cover on roughly 1,249 acre. In addition to speeding the recovery of soil productivity, this slash would also increase the interception and storage of sediment on the hillslopes (P.R., Vol. 11, Sediment).

The final exception relates to the effects of ground-based skidding on fire-induced sedimentation. Although research is limited, ground disturbance associated with logging has been observed to disrupt water-repellent layers (hydrophobic conditions), which may increase water infiltration and thereby decrease overland flow and erosion from burned sites. Ice (1999) states that where water-repellent soils are created by condensation of volatilized organics in the soil, ripping and breaking-up of this layer is essential to rapidly restore infiltration. In addition, Poff (1988) argues that "…salvage logging can improve watershed condition by increasing ground cover, by removing a source of large, high energy water drops, and by breaking up hydrophobic soil layers." While an immediate benefit would not be realized, breaking up the hydrophobic soils via ground-based skidding would speed the rate of recovery (P.R., Vol. 11, Sediment).

While the three activities discussed above would minimize fire-induced sedimentation within proposed units, in comparison to the pre-fire condition, soil erosion would increase due to the loss of vegetation consumed by the 2007 wildfire and, to a lesser degree, the fire-induced hydrophobic soil conditions elsewhere within the project area. Sediment delivery to streams would increase as a result of increased surface erosion, decreased surface roughness, and increased water runoff. Sediment would be stored to some degree in the tributary channels and delivered to main channels over time. The total volume of sediment stored behind obstructions would vary between subwatersheds and years in response to changes in bankfull channel widths and annual peak flow rates, respectively (Megahan 1982) (P.R., Vol. 11, Sediment).

Over time the rate of fire-induced soil erosion and sedimentation would decrease as vegetation becomes established, dead trees fall to the ground, and water infiltration increases. Areas with hydrophobic soil conditions would naturally recover through the freeze/thaw process and any trampling by wildlife. Natural regeneration of conifer species would eventually occur, but is expected to be delayed in many locations due to the lack of any seed source. The time needed for these natural processes to occur will vary depending upon the characteristics of the particular site (elevation, aspect, soil type, etc.) and the severity of the burn on that site (P.R., Vol. 11, Sediment).

As displayed in Table 3-19, sediment yields for the seven 6^{th} field subwatersheds, as modeled by BOISED, would decrease considerably over the next few years as the effects of the 2007 wildfire subside. By year 2011, modeled sediment yields will have returned to pre-fire levels in four of the 6^{th} field subwatersheds, with another two returning to pre-fire levels by year 2013. The Curtis Creek 6^{th} field sediment yield is expected to remain slightly elevated into the foreseeable future due to the recently completed reconstruction work on Warm Lake Highway (P.R., Vol. 11, Sediment).

In comparison to Alternative A (No Action), management activities associated with this alternative would increase sediment delivery a maximum of 1.7 percent over natural in any given 6^{th} field (Table 3-19). In comparison to Alternative A, the BOISED modeled percent over natural sediment delivery attributable to management activities would be a maximum increase of 0.4 percent in the Curtis Creek 6^{th} field; 0.7 percent in the Six-bit Creek 6^{th} field; 0.5 percent in the Two-bit Roaring 6^{th} field; 1.7 percent in the Tyndall Stolle 6^{th} field; 0.1 percent in the Upper SFSR 6^{th} field, and; 0.2 percent in the Warm Lake Creek 6^{th} field. Although this alternative does include falling and retention on site of trees in the Dollar Creek 6^{th} field, no harvest activities would occur, therefore BOISED does not model any increase in sediment delivery (P.R., Vol. 11, Sediment).

Although BOISED reflects slight increases in sedimentation for up to six years as a result of proposed activities, the modeled output does not reflect the benefits of many design features incorporated into this alternative. Design features associated with proposed activities, including Best Management Practices, would minimize soil disturbance and sediment delivery during and following implementation. The effectiveness of these Best Management Practices applied to timber harvesting activities has been extensively studied (Belt et al 1992; Dissmeyer 1994; NYSEGC 1993; Seyedbagheri 1996; Gray and Megahan 1981; Cook and King 1983). Proper application of these design features would be expected to decrease the likelihood of sediment delivery to streams in quantities sufficient to impact water quality conditions (P.R., Vol. 11, Sediment).

As discussed in detail below, this alternative would not contribute additional sediment, the pollutant of concern, to water quality limited waterbodies in amounts that would prevent the attainment and maintenance of the instream objectives. This alternative would not have a measurable effect on the identified beneficial uses of domestic and agricultural water supply, cold water biota, salmonid spawning, primary and secondary contact recreation, and special resource waters (P.R., Vol. 11, Sediment; Vol. 12, Fisheries; Vol. 5, Wild and Scenic).

Relative to water quality and fisheries, this alternative would comply with existing management direction pertaining to water quality including Forest Plan Standards and Guidelines and the Clean Water Act, as well as Terms and Conditions prescribed in the Biological Opinion prepared for the Forest Plan. In addition, felling and retention on site of fire-killed and imminently dead trees greater than or equal to 8 inches dbh across an estimated 422 acres; adding effective ground cover, and; breaking up the hydrophobic soils via ground-based skidding would be consistent with the intent of the TMDL of reducing sediment, the pollutant of concern (P.R., Vol. 11, Sediment).

Timber Harvest Activities – Perhaps the most significant design feature not reflected in BOISED modeling relates to the effectiveness of streamside buffers. Design features associated with this alternative prohibit salvage harvest (i.e. cutting and removal) or ground-based skidding within or through these RCAs. Fire-killed and imminently dead trees greater than or equal to 8 inches dbh and within RCAs, but more than one site potential tree height from a stream, would be felled and retained on site. An exception would be if an open authorized road parallels the stream. If a road parallels the stream and is less than one site potential tree height distance from that stream, falling and retention of trees on site may occur upslope of the road and within one site potential tree height of the stream, but falling of trees would be prohibited between the road and stream. Skidding through any portion of this RCA, as described below, would be prohibited. Therefore trees would also be felled and retained on site in those portions of units where the presence of an RCA above the road prevents access to the road (Section 2.4.3.3).

Appendix B, pages B-33 to B-36 in the Forest Plan provides direction on delineating RCAs. The analysis completed for this assessment delineated these RCAs based upon site potential tree heights for the appropriate potential vegetation group (PVG). Based upon that analysis, RCAs for perennial streams and intermittent streams providing seasonal rearing and spawning habitat were defined as: 260 feet for PVG 6; 200 feet for PVG 7, and; 160 feet for PVG 10. RCAs widths for ponds, lakes, reservoirs, wetlands, and intermittent streams not providing seasonal rearing and spawning habitat were delineated as 130 feet for PVG 6; 100 feet for PVG 7, and; 80 feet for PVG 10 (P.R., Vol. 11, Sediment).

The Megahan/Ketcheson model (Ketcheson and Megahan 1996) was developed to estimate sediment delivery distances from activities in granitic geologies, specifically the Idaho batholith. Predicted sediment delivery distances are based on the 95 percent confidence level. This means that statistically, 95 percent of sediment distances under the given parameters would be shorter than the modeled delivery distance. In other words, it is 95 percent certain that sediment generated from a given source would not travel farther than the modeled distances. The Megahan/Ketcheson model is an empirical model developed through research conducted in the Silver Creek watershed on the Boise National Forest, which has similar soils, potential vegetation groups (PVGs), topography, and climate as the project area. Due to these factors, modeled sediment delivery distances should reflect potential sediment delivery distances for this project, within the modeled confidence interval. Actual sediment delivery distances would depend on unpredictable variables such as frequency and intensity of summer thunderstorms, midwinter or spring rain-on-snow events, or the timing and intensity of spring snowmelt. However, in development of the model, 22 years of rainfall intensity data which included rainfall erosivity values ranging from moderately low to the highest on record was used thus representing an excellent range in rainfall (Megahan and Ketcheson 1996). Also included in the development of the model was 30 years of streamflow data which included the second and third highest flows in the 30 year period (Megahan and Ketcheson 1996).

The Megahan/Ketcheson model was used to estimate sediment delivery distances for several different scenarios based on skidding restrictions disclosed in Chapter 2 (Section 2.4.3.3). It is also worthy to note that these modeling efforts took into account increased erosion rates expected as a result of the 2007 wildfire. For tractor skidding on unconstructed skid trails and on slopes less than 40 percent, the Megahan/Ketcheson model predicted, using on-site data, an average sediment delivery distance of 4.6 feet with a maximum delivery distance of 16.4 feet. Relative to the potential for concentration of eroded material and delivery to streams downslope of roads, the Megahan/Ketcheson model predicted, using on-site data, an average sediment delivery distance of 7.7 feet with a maximum delivery distance of 19.0 feet. The minimum distance from the road to the stream on these sites is roughly 20 feet (P.R., Vol. 11, Sediment).

Another scenario assessed with the Megahan/Ketcheson model relates to the removal of logs from slopes exceeding 40 percent. Design features (Section 2.4.3.2) prohibit the use of ground-based equipment on slopes exceeding 40 percent, instead, included material would be removed with an off-road jammer. Off-road jammers in these situations would be confined to the road prism or slopes within the unit that are less than or equal to 40 percent if above the road and the logs winched to the off-road jammer prior to being skidded to the landing. Should the slope preclude throwing the off-road jammer tongs 200 feet upslope, the depth of the unit would be reduced as necessary (i.e. <200 feet). One concern associated with this activity is the potential for logs to gouge the ground surface as being winched to the off-road jammer, thus creating furrows for the accumulation of water and transport of eroded material. However, the Megahan/Ketcheson model predicted, using on-site data, an average sediment delivery distance of 4.7 feet with a maximum delivery distance of 6.3 feet. Not reflected in these modeled delivery distances are a design feature (Section 2.4.2.5) that requires construction of cross-ditches by hand on these furrows no later than two weeks after completion of harvest within each affected unit which would further limit the travel distance of eroded material. Another important consideration in this assessment was the number of logs potentially winched over the same path, which, given the maximum unit depth of 200 feet, would not be expected to be more than a few logs prior to the off-road jammer repositioning itself (P.R., Vol. 11, Sediment).

Given the narrow (i.e. maximum of 200 feet) linear nature of proposed units, it is unlikely that skid trail construction would be necessary. Nevertheless, the Megahan/Ketcheson model predicted, using on-site data, an average sediment delivery distance of 5.9 feet with a maximum delivery distance of 14.9 feet for this activity. In order to minimize the potential for sediment delivery from constructed skid trails, design features common to all action alternatives require the District Hydrologist to review on-the-ground all requests to construct skid trails within RCAs. However, the design feature prohibiting ground-based skidding within or through RCAs under this alternative (Section 2.4.3.3) would effectively eliminate the possibility of a skid trail being constructed within an RCA. Design features (Section 2.4.2.5) also require that, following completion of use, cross-ditches would be constructed at intervals of approximately 20 feet where skid trails exceed 20 percent slope (P.R., Vol. 11, Sediment).

One situation that could affect sediment delivery distances reflected by the Megahan/Ketcheson model would be if fire-induced sediment filled the sediment storage capacity of existing obstructions otherwise available to trap erosion generated by timber harvest activities. As explained above, modeling efforts took into account increased erosion rates expected as a result of the 2007 wildfire Nevertheless two design features, previously discussed, were incorporated to address this concern. Specifically, fire-killed and imminently dead trees greater than or equal to 8 inches dbh would be felled and retained on site across 422 acres of RCAs (Section 2.4.3.3). This activity would not only reduce the potential for delivery of management-induced sedimentation, but would also obstruct delivery of fire-induced sediment. In addition, design features associated with this alternative prohibit harvest or ground-based skidding within or through RCAs (Section 2.4.3.3).

While the majority of the harvest-related slash would be removed from the units via whole-tree-yarding and accumulated at landings, incidental amounts of material in the form of limbs and tops of harvested trees would break off during operations and be retained on site. The immediate contribution of this logging slash would increase the number of obstructions beyond those reflected in Megahan/Ketcheson modeling efforts and increase the interception and storage of sediment on the hillslopes (P.R., Vol. 11, Sediment).

Therefore, given incorporated design features and modeled sediment delivery distances, little if any of the BOISED modeled sediment attributed to harvest activities would be delivered to streams (P.R., Vol. 11, Sediment).

Landings – Given the narrow (i.e. maximum of 200 feet) linear nature of proposed harvest units and therefore the limited number of logs accumulated at any single location, it is suspected that few landings would be constructed under this alternative and that the Purchaser would instead use unconstructed landings and/or the actual road prism. Under a worse case scenario where landings would be constructed, the Megahan/Ketcheson model predicted, using on-site data, an average sediment delivery distance of 13.4 feet with a maximum delivery distance of 57.8 feet. In order to minimize the potential for sediment delivery, design features common to all action alternatives (Section 2.4.2.5) prohibit the construction of new landings within one site potential tree height (minimum of 80 feet) of any stream. However, the design feature prohibiting ground-based skidding within or through RCAs under this alternative (Section 2.4.3.3) would effectively eliminate the possibility of a landing being constructed within an RCA. Therefore this activity is expected to result in negligible amounts of sedimentation to any stream. Assuming under a worse case scenario that some landings are constructed, design features (Section 2.4.2.5) require that, upon completion of harvest activities, all landings constructed in association with this project would be reshaped to provide adequate drainage, scarified to a minimum depth of 18 inches, slash distributed to cover approximately 30 percent of the reshaped surfaces, and planted with a Forest Service approved seed mixture, thereby eliminating the potential for sedimentation in the future (P.R., Vol. 11, Sediment).

Road Use/Dust - A total of approximately 660 truck loads of logs would be removed under this alternative over a period of two years, with the actual haul distributed over numerous different roads. On average, a total of 5 to 10 trucks/day would be expected on any given road. Available traffic count data for the #474.2 road suggests that in excess of 100 vehicles travel along this road on a daily basis during the snow-free season, thus the sediment attributable to dust resulting from increases in logging traffic would be inconsequential (P.R., Vol. 11, Sediment).

Dust generated from unpaved roads would be minor due to slow speeds. Also, contract provisions would require dust abatement when dust is a hazard. With normal dust abatement procedures, noticeable amounts of fine sediment generated by logging traffic would not reach stream channels. Since some potential haul routes may also receive abundant use by recreational traffic during the same time period, dust abatement associated with the timber sale may actually reduce the amount of dust reaching streams that is attributable to recreational uses (P.R., Vol. 11, Sediment).

Temporary Roads - As part of the Burned Area Emergency Response (BAER) effort, the culvert at the #473 road crossing of Lodgepole Creek was removed in the fall of 2007, thus eliminating authorized motorized access to the #473 road. However, an unauthorized road prism is currently in place that connects the #474.2 road with the #473 road south of the Lodgepole Creek culvert location. This alternative would use this existing unauthorized road (0.7 miles) as a temporary road in order to access the #473 road.

This temporary road does not cross any streams, with the closest stream located roughly 150 feet to the north across flat ground. Use of this existing road prism as a haul route would not be expected to increase sediment delivery to any stream channel (P.R., Vol. 11, Sediment).

3.11.1.4 Cumulative Effects

The effects of any alternative on erosion/sedimentation would be limited to the seven 6th field analysis areas. Therefore the area used to assess cumulative effects consists of the 104,431 acre area encompassing those seven 6th field subwatersheds (Figure 3-16).

With the exception of a five acre parcel in the vicinity of Knox Ranch, the entire cumulative effects area is administered by the U.S. Forest Service. Since 1950 an estimated 7,208 acres have been harvested within the cumulative effects area. Historic records indicate that since 1910 roughly 74,147 acres within the cumulative effects area have been affected by wildfire, some of which overlap with harvested acres. Although the specific effects cannot be quantified, the existing conditions disclosed above reflect the impacts of those past activities as well as any recovery that has occurred since those events. Ongoing or foreseeable future activities within this cumulative effects area that could add incrementally to impacts on this resource are listed below. Reference **Appendix B** for additional information and maps related to the cumulative effects analyses completed for this project.

Cabin Salvage, Knox Salvage, and South Fork Houselog Salvage I Sales – These three salvage sales, all under contract to the same Purchaser, were offered following the 2003 South Fork Wildfire. At this time the majority of the included timber has already been removed. However, the Purchaser is expected to continue to remove small amounts of fire-killed and imminently dead timber in 2008. In order to present a worse case scenario, the effects of these projects relative to sedimentation were modeled as part of the existing post-fire condition.

Power Salvage Sale – This salvage sale permits the removal of downed trees only from 66 acres within sections of the right-of-way of the overhead power line in the Warm Lake Basin. This contract is projected to terminate in July of 2008. In order to present a worse case scenario, the effects of this project relative to sedimentation were modeled as part of the existing post-fire condition.

South Fork Campground Restoration Project – While still in the developmental phase, the objective of this project would be to minimize the fire-induced effects of the 2007 wildfire on the 10 acre South Fork Campground by removing hazard trees, planting conifers, and implementing other restorative activities. The environmental analysis for this project is tentatively scheduled to occur in 2008 with implementation in 2009 or 2010.

Shoreline Fuels Reduction Project – This project consists of mechanical mulching of 32 acres of sub-merchantable trees and hand thinning and piling of 77 acres of sub-merchantable trees, all in the vicinity of the Shoreline Campground. Implementation is scheduled to occur in 2008.

Tyndall Stolle Reforestation Project – This project consists of planting conifers on an estimated 4,127 acres that burned at a high or moderate intensity where competing vegetation is expected and/or where no seed source is present to facilitate natural regeneration. Planting activities are projected to occur in the spring and fall of 2008 and 2009.

SFSR Travel Management Project - While still in the developmental phase, the objective of this project would be to minimize undesirable impacts associated with poorly located dispersed campsites and authorized and unauthorized roads and/or trails causing resource damage, as well as to address under-sized culverts, fish passage barriers, and/or structures damaged by the 2007 wildfire in the South Fork Salmon River drainage. The environmental analysis for this project is tentatively scheduled to occur in 2008 with implementation in 2009 or 2010.

Warm Lake Highway Reconstruction Project – The majority of this project was completed in the summer of 2007 and included repair and resurfacing of the Warm Lake Highway (FH22) from Big Creek Summit to its crossing of the South Fork Salmon River. In order to present a worse case scenario, the effects of this project relative to sedimentation were modeled as part of the existing post-fire condition.

Road Use and Road Maintenance – In addition to the ongoing use associated with recreational activities, roads within the area would continue to receive routine maintenance and/or repair as priorities dictate and funding allows. In order to present a worse case scenario, the effects of this project relative to sedimentation were modeled as part of the existing post-fire condition.

BAER Culvert Replacements – A number of culverts removed in the fall of 2007 as part of the Cascade Complex BAER project would be reinstalled in the summer of 2008.

Alternative A would have no direct or indirect effects on erosion/sedimentation therefore no cumulative effects would occur.

As disclosed above, Alternatives B and C would result in a slight increase in sedimentation over the next six years. Given that sedimentation associated with the major ongoing projects in the area were modeled as part of the existing post-fire condition in order to present a worse case scenario, the cumulative sediment yield of all projects within the area would be very similar to the direct effects portrayed for these alternatives. The incremental effect of Alternative B or C in combination with ongoing and foreseeable future projects would be a slightly elevated risk of sediment delivery over the next five or six years (P.R., Vol. 11, Sediment).

3.11.2 Water Yield

This section of the document describes the existing conditions as well as the effects of the alternatives on water yield. For the purposes of this analysis, Equivalent Clearcut Area (ECA) was used as a means of quantifying the effects of past and proposed activities, as well as any large fires, on water yield. ECA is a method of determining the percent of a subwatershed's vegetation in a "hydrologically immature" condition. Hydrologically immature indicates forested stands in which root structures and canopy closure have not reached the level of water use and influence created by mature timber stands.

The percent ECA of an area is based on the percent tree crown cover removed by management activities or natural events and any recovery that may have occurred over time. Roads are assumed to have complete vegetation removal and remain in an unrecovered condition. The procedure used to evaluate ECA for this analysis is described in *Forest Hydrology, Hydrologic Effects of Vegetative Manipulation* (USDA 1974).

ECA desired conditions in the Forest Plan were defined at the 6th field HUC level, therefore for the purposes of this analysis, the seven 6th field subwatersheds (Figure 3-16) were analyzed as separate analysis areas.

Increased water yield and runoff within a drainage following the removal of forest canopy is well documented (USDA 1974; King 1993; Megahan et al 1996; Hibbert 1967; Stednick 1996). Research studies have shown increases in water yield can lead to increased sediment transport in stream channels and by in-channel erosion such as extension of headwater channels. As vegetation is removed, increases in water yield occur because of one or more factors: a reduction in transpiration; an increase in wind turbulence which results in redistribution of snow and greater local snow accumulations; a reduction in interception; and/or a more efficient conversion of the snow pack to stream flow. Increases in water yield become a concern when they result in the degradation of stream channels or channel adjustments and the associated increase in sediment yield and loss of fish habitat.

Increases in water yield can increase the magnitude and duration of the runoff within a drainage in both the spring and fall, thus increasing the frequency of bankfull (channel forming) flows. Summer low flows may also increase. Lower summer stream temperatures, usually a benefit to native aquatic species, can also result from increased summer low flows. The magnitude of increase in water yield is dependent upon soils and rooting depth, amount and type of vegetation removed, rainfall input compared to energy supply, and the method of vegetation removal. Both elevation and aspect influence snow accumulation and melt, mainly through their influence on radiation intensity and exposure to winds. Following the 1992 Foothills Fire on the Boise National Forest, additional sediment transport was mostly a result of decreased channel stability due to the loss of woody debris, vegetation, and channel down-cutting from increased water yield (Maloney et al 1995).

Several fires, including the 1994 Thunderbolt Wildfire, the 2003 South Fork Wildfire, and the 2007 Cascade Complex, have led to large openings in the forest canopy and as a result, ECA values generally above the desired condition of 15 percent for properly functioning watersheds (Forest Plan Appendix B, pg. B-19). Table 3-20 displays the existing post-fire ECA values for the seven analysis areas (P.R., Vol. 11, Water Yield).

As displayed below, the post-fire ECA value of nine percent in the Curtis Creek subwatershed is less that the desired condition of 15 percent, thus indicating a properly functioning watershed relative to water yield (P.R., Vol. 11, Water Yield).

Table 3-20 Post-fire Equivalent Clearcut Area (ECA) by Subwatershed

Subwatershed	Total Acres	Harvest & Burn Related ECA Acres	Road Related ECA Acres	Total ECA Acres	Percent ECA
Curtis Creek	17,482	1,482	170	1,652	9%
Dollar Creek	10,590	4,880	106	4,986	47%
Six-bit Creek	8,248	3,054	44	3,098	38%
Two-bit Roaring	11,916	5,742	153	5,895	49%
Tyndall Stolle	19,971	13,057	250	13,407	67%
Upper SFSR	21,160	9,042	92	9,134	43%
Warm Lake Creek	15,064	6,657	108	6,765	45%

Given the post-fire ECA values in the remaining six subwatersheds, some changes in stream flow conditions at the 6th field level would be expected as a result of the 2007 wildfire. The timing and magnitude of flows is also likely to change due to greater reductions in canopy and soils impacted by high fire severity. Although the specific magnitude and timing of increased flows is largely dependent upon precipitation events and therefore unpredictable, some channel degradation in streams within the analysis areas is likely to occur (P.R., Vol. 11, Water Yield).

3.11.2.1 Environmental Consequences Specific to Alternative A

As a result of the 2007 wildfire, increased water yield would be expected in the spring of 2008. However, this alternative would not result in a measurable change in the existing ECA values or water yield. The watersheds would begin to recover from the effects of the fire in the temporary time frame, and would continue to recover over the short and long terms (P.R., Vol. 11, Water Yield).

Following implementation of this alternative, ECA values in all but the Curtis Creek subwatershed would continue to exceed the Forest Plan desired condition of 15 percent for an estimated 20 to 30 years. Table 3-21 displays projected ECA values in years 2008, 2018, and 2028 (P.R., Vol. 11, Water Yield).

Table 3-21 Percent Equivalent Clearcut Area by Subwatershed

Year	Alternative A	Alternative B and C
Curtis Creek		
2008	9%	9%
2018	5%	5%
2028	4%	4%
Dollar Creek		
2008	47%	47%
2018	23%	23%
2028	16%	16%
Six-bit Creek		
2008	38%	38%
2018	18%	18%
2028	12%	12%
Two-bit Roaring		
2008	49%	49%
2018	25%	25%
2028	18%	18%
Tyndall Stolle		
2008	67%	67%
2018	32%	32%
2028	22%	22%
Upper SFSR		
2008	43%	43%
2018	21%	21%
2028	14%	14%
Warm Lake Creek		
2008	45%	45%
2018	23%	23%
2028	17%	17%

3.11.2.2 Environmental Consequences Common to Alternative B and C

As a result of the 2007 wildfire, increased water yield would be expected in the spring of 2008. However, these alternatives would not result in a measurable change in the existing ECA values or water yield. The watersheds would begin to recover from the effects of the fire in the temporary time frame, and would continue to recover over the short and long terms (P.R., Vol. 11, Water Yield).

Since only fire-killed and imminently dead trees would be felled, these alternatives would have little impact on the ability of affected acres to intercept precipitation and transpire soil moisture. As disclosed in Section 3.2.1 of this chapter, although some exceptions could occur, given the level of damage seen in those trees identified as fire-killed, there is little chance that implementation of these alternatives would result in the cutting of trees that could potentially survive the fire-induced damage (P.R., Vol. 2, Fire-killed Trees). The cutting of such an insignificant number of trees scattered across the 1,671 acres of proposed units would have a negligible impact on water yield or ECA (P.R., Vol. 11, Water Yield).

A similar scenario would be true for imminently dead trees (e.g. windthrown or successfully attacked by bark beetles). The removal of windthrown trees would have no effect on evapotranspiration since these trees would no longer have their root systems in the ground. Trees successfully attacked by bark beetles during the summer months could potentially continue to transpire moisture for several months, however any evapotranspiration will have ceased by the following spring. Similarly to fire-killed trees, there is a possibility that a few bark beetle infested trees would be felled that could actually survive the beetle infestation. Although the total number of trees falling under this scenario would be expected to be minor, the exact number is unquantifiable. Nevertheless, cutting of these trees would reduce evapotranspiration at site-specific locations. In contrast, retention of these trees on site would facilitate beetle infestations of additional live trees in future years which could also reduce evapotranspiration. Given the few trees expected to fall under this scenario, the cutting of imminently dead trees would have a negligible impact on water yield or ECA (P.R., Vol. 11, Water Yield).

Following implementation of these alternatives, ECA values in all but the Curtis Creek subwatershed would continue to exceed the Forest Plan desired condition of 15 percent for an estimated 20 to 30 years. Table 3-21 displays projected ECA values in years 2008, 2018, and 2028 (P.R., Vol. 11, Water Yield).

3.11.2.3 Cumulative Effects

The effects of any alternative on water yield/ECA would be limited to the seven 6th field analysis areas. Therefore the area used to assess cumulative effects consists of the 104,431 acre area encompassing those seven 6th field subwatersheds (Figure 3-16).

With the exception of a five acre parcel in the vicinity of Knox Ranch, the entire cumulative effects area is administered by the U.S. Forest Service. Since 1950 an estimated 7,208 acres have been harvested within the cumulative effects area. Historic records indicate that since 1910 roughly 74,147 acres within the cumulative effects area have been affected by wildfire, some of which overlap with harvested acres. Although the specific effects cannot be quantified, the existing conditions disclosed above reflect the impacts of those past activities as well as any vegetative recovery that has occurred since those events. Ongoing or foreseeable future activities within this cumulative effects area that could add incrementally to impacts on this resource are listed below. Removal of dead or dying trees through salvage sales would not result in a measurable increase in ECA or water yield and therefore are not relevant to this cumulative effects analysis. Reference **Appendix B** for additional information and maps related to the cumulative effects analyses completed for this project.

Shoreline Fuels Reduction Project – This project consists of mechanical mulching of 32 acres of sub-merchantable trees and hand thinning and piling of 77 acres of sub-merchantable trees, all in the vicinity of the Shoreline Campground. Implementation is scheduled to occur in 2008.

Tyndall Stolle Reforestation Project – This project consists of planting conifers on an estimated 4,127 acres that burned at a high or moderate intensity where competing vegetation is expected and/or where no seed source is present to facilitate natural regeneration. Planting activities are projected to occur in the spring and fall of 2008 and 2009.

As disclosed above, none of the alternatives considered in detail would have any measurable direct or indirect effects on water yield or ECA. Therefore, regardless of the effects of ongoing or foreseeable future projects, none of these alternatives would add incrementally to those effects (P.R., Vol. 11, Water Yield).

3.11.3 Slope Stability

This section of the document describes the existing conditions relative to slope stability. The analysis area used in this assessment consists of the 104,431 acre area encompassed by the seven 6th field subwatersheds (Figure 3-16). The Forest Plan requires identification and protection of landslides and landslide prone areas as Riparian Conservation Areas (RCAs).

Landslides are naturally occurring disturbances that have had, and will continue to have, an influence on the analysis area. Landslides have been documented as the dominant form of sediment delivery to streams in the Idaho batholith (Arnold 1988). The rapid delivery of high volumes of sediment can result in major negative short and long term impacts to riparian systems, water quality, and fish habitat (Helvey 1972; Maloney et al 1995; Shultz et al 1986). However, landslides also provide a critical source of rock and organic material to stream systems that is necessary to maintain the integrity of the systems and aquatic habitat.

The triggering event for landslides is usually a major seismic and/or climatic event, such as a rain-on-snow, intense, or long duration rainstorm. An actual landslide typically occurs when a randomly occurring rainstorm or snowmelt event generates sufficient groundwater conditions to induce instability of a slope (Sidle 1992). Although landslides are naturally occurring events, man-caused disturbances such as road construction, and to a lesser extent timber harvest, can increase the potential for and occurrence of landslides.

Landslide is a collective term that includes both deep-seated, geologic failures, and smaller localized mass erosion events such as slumps, debris torrents, and debris slides. Three principle factors influence slope stability; soil moisture, root strength, and slope gradient.

Geologic failures, which include fault blocks and earth flows, are generally deep-seated and associated with bedrock characteristics, (bedding, fracturing, etc.), faulting, contacts, and intrusions. The smaller, localized landslides include mass-failures such as slumps, debris slides, avalanches, flows and torrents, and rock fall. In general, these types of landslides are a function of slope gradient, shape and aspect, bedrock and soil characteristics (soil depth, less permeable soil horizons, etc.), and soil moisture content. Except for rock fall, the mass failures typically occur as a result of wet or saturated soil conditions resulting from storm events. Rock fall is associated with areas of bedrock outcroppings. As physical processes such as freezing and thawing weather the rock, individual rocks or masses of rock break loose and move downslope.

The debris events (slides, avalanches, flows and torrents) are the most prevalent of all types of landslides in the analysis area. These types of debris events are differentiated from each other by the water content and viscosity of the failed material. The debris flows and torrents are movements of a "liquid" mass. The debris slides and avalanches typically fail due to saturated conditions at the slip surface, however, the mass of debris that moves has a much lower water content. Slumps are rotational failures of soil masses.

The debris events and slumps tend to occur on steep, concave slopes and stream headland areas where surface and subsurface water tends to accumulate and concentrate. They often recur on the same landscape, sometimes as often as every 10 to 20 years. Due to the limited size of the point of origin, typically ¼ to ½ acre or less, and the transported material being confined in draws and drainages, the impacts to site productivity of the landscape is often minor. However, in some steep basins, debris events may be the dominant source of sediment production and downstream affects on the aquatic resources.

Vegetation utilizes and transpires soil moisture. As vegetation is lost or removed from a site, the outlet for soil water through evapotranspiration is diminished. The vegetation canopy also functions as an interception of precipitation and in the case of snow, the rate and timing of snowmelt. Without the presence of vegetation to utilize and/or intercept soil moisture, the non-cohesive soil can become saturated and lose its binding strength. Within the project area, evapotranspiration was essentially eliminated in areas that burned at a moderate or high severity.

The weight of trees, or the surcharge on a slope, can have different effects on slope stability depending upon the soil moisture content. On saturated soils the weight produces a down slope force vector and contributes to slope instability. On dry slopes the added weight can increase soil internal frictional resistance, thus increasing stability.

Roots of trees and shrubs also provide structural reinforcement and buttressing and are a critical component of slope stability. In the shallow, coarse-textured soils of the Idaho batholith, the most favorable region for roots to exploit from a moisture standpoint is the zone close to the contact between the soil and underlying fractured, disintegrated bedrock. In other words, one should expect a fairly high concentration of vertical and sinker roots across this contact (Gray and Megahan 1981). These are the roots that contribute most to sliding resistance of the soils on steep slopes. When vegetation is removed the binding strength of the root system gradually decreases as roots decompose, typically within 5 to 10 years. With the loss of vegetation in the project area, landslide activity can be expected to increase over the next 5 to 10 years as the roots of dead vegetation gradually decompose.

The SINMAP model (Stability Index Mapping; Pack et al 1998) was used as a preliminary tool to identify locations in the project area that may be landslide prone. Terrain stability mapping with SINMAP requires that broad stability classes be identified and mapped, based upon relatively coarse information, to quickly identify regions where more detailed assessments are warranted. This model uses a digital elevation model coupled with the infinite slope stability equation to identify potential landslide hazards associated with shallow surface failures (debris slides). The primary output of this modeling approach is a stability index that can be used to categorize the terrain stability. Although the SINMAP model can be calibrated using the locations of existing landslides within a particular analysis area, site-specific calibration was not done for this assessment. Instead the Forest-wide coverage developed concurrently with the Forest Plan was used in this analysis.

The selection of breakpoints for the various SINMAP stability index classes is subjective, requiring both judgment and interpretation. For the purposes of this analysis, the "stable", "moderately stable", and "quasi-stable" classes are considered stable areas and should not fail (i.e. none to low risk). The terms "lower threshold" (i.e. moderate risk), "upper threshold" and “undefended” (i.e. high risk) characterize areas where the probability of a landslide is less than or greater than 50 percent following a 100-year storm event, respectively.

Based on the SINMAP modeling effort, roughly five percent (4,909 acres) of the 104,431 acre analysis area is categorized as being in the moderate risk category (probability of instability 0 to 50 percent following a 100 year storm event), with three percent (3,104 acres) identified as being in the high risk category (probability of instability 50 to 100 percent following a 100 year storm event). Overall the analysis area has a relatively low amount of land prone to shallow landslides (P.R., Vol. 11, Slope Stability).

3.11.3.1 Environmental Consequences Specific to Alternative A

Since no additional management activities would occur, Alternative A would have no effect on the probability of a landslide occurring. The loss of vegetation, particularly trees, due to the 2007 wildfire would result in an increase in soil moisture and the progressive loss of root strength and support afforded the soils as tree roots gradually deteriorate over time. These effects would result in an increase in the occurrence of landslides over the next decade. Within the analysis area, approximately 2,570 acres burned at a high or moderate severity within areas with a moderate or high slope stability risk and are expected to have a higher probability of a landslide event (P.R., Vol. 11, Slope Stability).

The elevated risk of landslides due to the 2007 wildfire would lessen over the next two to five years as hydrophobic soils recover through freeze/thaw action and rainfall, and as vegetation recovers on the sites (USDA 2007) (P.R., Vol. 11, Slope Stability).

3.11.3.2 Environmental Consequences Common to Alternative B and C

The loss of vegetation, particularly trees, due to the 2007 wildfire would result in an increase in soil moisture and the progressive loss of root strength and support afforded the soils as tree roots gradually deteriorate over time. These effects would result in an increase in the occurrence of landslides over the next decade. Within the analysis area, approximately 2,570 acres burned at a high or moderate severity within areas with a moderate or high slope stability risk and are expected to have a higher probability of a landslide event (P.R., Vol. 11, Slope Stability).

The elevated risk of landslides due to the 2007 wildfire would lessen over the next two to five years as hydrophobic soils recover through freeze/thaw action and rainfall, and as vegetation recovers on the sites (USDA 2007) (P.R., Vol. 11, Slope Stability).

The cutting of dead trees on lands modeled by SINMAP as having a moderate or high risk to instability would not change the probability of failure (Megahan et al IN: USDA 1995). The cutting of dead trees under Alternative B or C would have no effect on the rate at which the dead roots deteriorate. Since the trees are already dead, their cutting would have no effect on evapotranspiration or the soil moisture content (P.R., Vol. 11, Slope Stability).

There is a possibility that a few trees meeting the definition of a fire-killed or imminently dead tree that would be felled could survive, however it is unlikely. As disclosed in Section 3.2.1 of this chapter, given the level of damage in trees identified as fire-killed, there is little chance that implementation of any action alternative would result in the cutting of trees that could potentially survive the fire-induced damage. Although some exceptions could occur, given the level of damage seen in those trees identified as fire-killed, there is little chance that implementation of these alternatives would result in the harvesting or felling of trees that could potentially survive the fire-induced damage (P.R., Vol. 2, Fire-killed Trees).

Under these alternatives, a maximum of 89 acres of ground-based harvest would occur on areas modeled by SINMAP as having a moderate or high risk to instability. Ground-based operations on these acres could increase the risk of mass failure on susceptible soils by modifying hillslope hydrology with skid trails and other soil disturbance. However, design features associated with these alternatives (Section 2.4.2.5) prohibit harvest or ground-based skidding of trees on any landslide prone areas. These design features require field identification and protection of these areas which should effectively mitigate any adverse effects of ground disturbance on slope stability (P.R., Vol. 11, Slope Stability).

3.11.3.3 Cumulative Effects

The effects of any alternative on slope stability would be limited to the analysis area. Therefore the area used to assess cumulative effects consists of the 104,431 acre analysis area encompassing the seven 6th field subwatersheds (Figure 3-16).

With the exception of a five acre parcel in the vicinity of Knox Ranch, the entire cumulative effects area is administered by the U.S. Forest Service. Since 1950 an estimated 7,208 acres have been harvested within the cumulative effects area. Historic records indicate that since 1910 roughly 74,147 acres within the cumulative effects area have been affected by wildfire, some of which overlap with harvested acres. Although the specific effects cannot be quantified, the existing conditions disclosed above reflect the impacts of those past activities as well as any recovery that has occurred since those events. Ongoing or foreseeable future activities within this cumulative effects area that could add incrementally to impacts on this resource are listed below. Reference **Appendix B** for additional information and maps related to the cumulative effects analyses completed for this project.

Cabin Salvage, Knox Salvage, and South Fork Houselog Salvage I Sales – These three salvage sales, all under contract to the same Purchaser, were offered following the 2003 South Fork Wildfire. At this time the majority of the included timber has already been removed. However, the Purchaser is expected to continue to remove small amounts of fire-killed and imminently dead timber in 2008.

Power Salvage Sale – This salvage sale permits the removal of downed trees only from 66 acres within sections of the right-of-way of the overhead power line in the Warm Lake Basin. This contract is projected to terminate in July of 2008.

South Fork Campground Restoration Project – While still in the developmental phase, the objective of this project would be to minimize the fire-induced effects of the 2007 wildfire on the 10 acre South Fork Campground by removing hazard trees, planting conifers, and implementing other restorative activities. The environmental analysis for this project is tentatively scheduled to occur in 2008 with implementation in 2009 or 2010.

Shoreline Fuels Reduction Project – This project consists of mechanical mulching of 32 acres of sub-merchantable trees and hand thinning and piling of 77 acres of sub-merchantable trees, all in the vicinity of the Shoreline Campground. Implementation is scheduled to occur in 2008.

Tyndall Stolle Reforestation Project – This project consists of planting conifers on an estimated 4,127 acres that burned at a high or moderate intensity where competing vegetation is expected and/or where no seed source is present to facilitate natural regeneration. Planting activities are projected to occur in the spring and fall of 2008 and 2009.

SFSR Travel Management Project - While still in the developmental phase, the objective of this project would be to minimize undesirable impacts associated with poorly located dispersed campsites and authorized and unauthorized roads and/or trails causing resource damage, as well as to address under-sized culverts, fish passage barriers, and/or structures damaged by the 2007 wildfire in the South Fork Salmon River drainage. The environmental analysis for this project is tentatively scheduled to occur in 2008 with implementation in 2009 or 2010.

Warm Lake Highway Reconstruction Project – The majority of this project was completed in the summer of 2007 and included repair and resurfacing of the Warm Lake Highway (FH22) from Big Creek Summit to its crossing of the South Fork Salmon River.

Road Use and Road Maintenance – In addition to the ongoing use associated with recreational activities, roads within the area would continue to receive routine maintenance and/or repair as priorities dictate and funding allows.

BAER Culvert Replacements – A number of culverts removed in the fall of 2007 as part of the Cascade Complex BAER project would be reinstalled in the summer of 2008.

Alternative A would have no direct or indirect effects on slope stability and therefore no cumulative effects (P.R., Vol. 11, Slope Stability).

As disclosed above, neither Alternative B nor C would be expected to have any measurable direct or indirect effects on slope stability. Therefore, regardless of the effects of ongoing or foreseeable future projects, these alternatives would not add incrementally to those effects (P.R., Vol. 11, Slope Stability).

3.11.4 Long-Term Soil Productivity

This section of the document describes the existing conditions and the effects of the alternatives on long term soil productivity, with the discussions focusing on coarse woody debris, detrimental disturbance, and total soil resource commitment within the project area. Per direction in the Forest Plan, different analysis areas have been used for each of the three components of soil productivity, with each defined in the discussions presented below.

Coarse Woody Debris – One important component of soil productivity is the presence of organic or woody material on a site. This material is particularly important following disturbance events such as wildfires. The maintenance and restoration of nutrient cycling, decomposition processes, and a nutrient supply from vegetation are important for sustaining soil productivity and dependent, in part, on having sufficient amounts of woody material on site.

Although fire has many beneficial effects on the environment, uncharacteristic wildfires have the potential for negative effects by disrupting the nutrient cycling processes. Nutrient cycling is dependent on a variety of sizes of woody material and finer organics on the soil surface and within the soil. Nutrient cycling is also influenced by the degree of decay of the material. Typically there is a full range of decay levels on the site which provide for a slow, continual release of nutrients. Woody material on site also provides for moisture retention and an environment that supports bacteria and microbes important to the nutrient cycling process, as well as surface irregularities for the interception and storage of sediment.

The Forest Plan defines coarse woody debris as pieces of woody material having a diameter of at least three inches and a length greater than six feet. Appendix A of the Forest Plan discloses desired ranges for coarse wood in decay classes I and II for individual potential vegetation groups (PVGs), and goes on to explain that those desired ranges are not meant to provide an even distribution across every acre of the forested landscape, but to provide numbers that serve as a guide to approximate an average condition for an activity area (Forest Plan, Appendix A, pg. A-8). Appendix A goes on to state that although coarse wood is managed at the activity area, it is useful to have some knowledge of the larger landscape to assist in determining the appropriate amount that falls within the desired range in order to provide context (Forest Plan, Appendix A, pg. A-10).

Pre-fire Condition – Since recent stand data for the pre-fire conditions was unavailable, coarse woody debris levels prior to the 2007 wildfire cannot be quantified. Given the limited road access within the majority of the analysis area and therefore the lack of firewood cutting, and the level of Douglas-fir beetle and mountain pine beetle activity within the last decade, it was assumed that coarse wood levels prior to the wildfire were generally near levels indicative of unmanaged ecosystems across the majority of the 103,804 acre project area. However, because of the popularity of the area for personal use firewood cutting, pre-fire coarse wood levels were likely below desired conditions on those sites 200 feet above open authorized roads, which equates to approximately 2,933 acres, or three percent of the project area (P.R., Vol. 11, Coarse Woody Debris).

Post-fire Condition – Post-fire stand data was collected at representative sites within the perimeter of the wildfire in the fall of 2007 in those PVGs where salvage activities are being considered, which in this case consists of PVGs 6, 7, and 10. Table 3-22 discloses the post-fire quantities of coarse woody debris for these PVGs and compares those values to the desired conditions portrayed in Appendix A (pg. A-9) of the Forest Plan (P.R., Vol. 11, Coarse Woody Debris). Although standing dead trees resulting from the 2007 wildfire will certainly contribute to coarse woody debris levels in the future, only that material on the ground in the fall of 2007 and in decay class I or II was considered in describing the post-fire conditions reflected in Table 3-22.

It is also important to note that while desired conditions portrayed in the Forest Plan for coarse woody debris greater than 15 inches in diameter are displayed as percentages of the total amount of coarse wood, the intent was that a range of material greater than 15 inches in diameter would be present, not a variable amount dependent upon the total amount of coarse woody debris (John Thornton, Forest

Hydrologist, and Terry Hardy, Forest Soil Scientist, Boise National Forest, personal communication March 17, 2008). For example, the Forest Plan desired condition for PVG 6 discloses that 65 percent of the coarse woody debris should exceed 15 inches in diameter. In reality, the intent was that PVG 6 should have a range of 2.6 to 9.1 tons/acre of coarse wood greater than 15 inches in diameter present regardless of the total amount of coarse wood on a site (John Thornton and Terry Hardy, personal communication March 17, 2008). The clarification of this desired condition is critical when assessing projects such as this where the total tons/acre of coarse wood could potentially greatly exceed the desired ranges.

Table 3-22 Post-fire Coarse Woody Debris within the Analysis Area

	PVG 6		PVG 7		PVG 10	
Indicator	Desired Condition	Post-fire Condition	Desired Condition	Post-fire Condition	Desired Condition	Post-fire Condition
Dry Weight*	**4 – 14**	4.0	**5 – 19**	12.2	**5 – 19**	2.0
Percent >15” (Tons/Acre >15”)	**>65% (2.6 – 9.1)**	17% (0.7)	**>50% (2.5 – 9.5)**	53% (6.5)	**>25% (1.2 – 4.7)**	0% (0)

* Dry weight in tons per acre in Decay Classes I and II. Post-fire CWD data for the remaining PVGs was not collected since no activities are being considered on those habitat types.

As displayed in Table 3-22, post-fire tons/acre of coarse woody debris are within the desired range for PVG 7, at the low end of the desired range for PVG 6, and below the desired range for PVG 10. Values disclosed in Table 3-22 also indicate a deficiency of material greater than 15 inches in diameter in PVGs 6 and 10 when compared to the desired conditions. The low levels of coarse woody debris are not surprising given the popularity of firewood cutting within the area and the fact that post-fire stand data was collected within 200 feet of open authorized roads. Whether these low quantities are a result of the 2007 wildfire or reflect low levels of coarse woody debris existing prior to the wildfire is unknown (P.R., Vol. 11, Coarse Woody Debris).

Although not reflected in Table 3-22, a significant portion of the fine organic material and duff layer was lost to the wildfire in areas of moderate and high severity burns. Low severity burns consumed some of the fine organic material on the soil surface but the productivity remains unaltered for the most part and the normal nutrient cycling processes should continue (P.R., Vol. 11, Coarse Woody Debris).

***Detrimental Soil Disturbance* –** Management activities can detrimentally alter the natural soil characteristics resulting in the immediate and/or prolonged degradation of onsite resources or biomass productivity. This impact, referred to as detrimental disturbance, is generally associated with soil puddling, compaction, and/or displacement resulting from the use of ground-based equipment. Severely burned soils, such as those that burned at a high severity, are also considered to be detrimentally disturbed due to the associated loss of soil productivity. Soils that burn at a high or moderate severity are vulnerable to high soil erosion rates. Loss of soil litter and duff layers allows for accelerated soil loss through erosional processes of rainfall, gravity, and wind. In addition, fire often volatilizes and/or modifies nutrients into forms not readily available to plants.

Another fire effect occurs when volatilized organics move downward into the soil along the abrupt temperature gradient and condense on soil particles to form a water repellent layer. This generally occurs just below the soil surface. This layer, known as the hydrophobic layer, impedes water infiltration into the soil. This water repellency generally breaks down naturally within 1 to 8 years. However, based on the relatively shallow hydrophobic conditions observed in the project area, natural recovery is estimated to occur over the next 1 to 3 years. Nevertheless, while the condition is present, runoff water can concentrate and cause severe erosion and mass-wasting. Of the acres that burned in the 2007 wildfire, an estimated 80 percent currently reflect hydrophobic conditions (*Cascade Complex: South End, Burned Area Emergency Stabilization Plan*, September 2007).

The Forest Plan stipulates that management activities that may affect detrimental disturbance shall meet the following requirements:

1) In an activity area where the existing conditions of detrimental disturbance are below 15 percent of the area, management activities shall leave the area in a condition of 15 percent or less detrimental disturbance following completion of the activities.

2) In an activity area where existing conditions of detrimental disturbance exceed 15 percent of the area, management activities shall include mitigation and restoration so that detrimental disturbance levels are moved back toward 15 percent or less following completion of the activities.

The Forest Plan (Appendix A, pg. GL-1) defines activity areas for detrimental disturbance as the specific area where proposed actions may have detrimental soil impacts, such as harvest units within a timber sale area, an individual pasture unit within a grazing allotment, or a burn block within a prescribed burn project area. Past harvest as well as past and recent wildfires may have contributed to the amount of detrimental disturbance within the project area. However, given the definition of activity area (where proposed actions may have detrimental impacts) and the fact that those activity areas will vary by alternative, it is not possible to describe the existing conditions of individual activity areas at this point. Existing detrimental soil disturbance within each activity area was however considered in calculating the post-implementation detrimental disturbance in effects analyses for the various alternatives (P.R., Vol. 11, Detrimental Disturbance).

Total Soil Resource Commitment – Total soil resource commitment (TSRC) is the conversion of a productive site to an essentially non-productive site for a period of more than 50 years. Examples include roads, landing areas, parking lots, and mining dumps. The Forest Plan stipulates that management activities that may affect TSRC shall meet the following requirements:

1) In an activity area where the existing conditions of TSRC are below 5 percent of the area, management activities shall leave the area in a condition of 5 percent or less TSRC following completion of the activities.

2) In an activity area where existing conditions of TSRC exceed 5 percent of the area, management activities shall include mitigation and restoration so that TSRC levels are moved back toward 5 percent or less following completion of the activities.

The Forest Plan (Appendix A, pg. GL-1) defines activity areas for TSRC as generally an all-inclusive activity area, like a timber sale area. Therefore for the purposes of this analysis, the 103,804 acre project area has been used as the activity area for TSRC. Currently the TSRC for the project area (i.e. activity area) is 1.2 percent, due primarily to the existing road system (P.R., Vol. 11, TSRC).

3.11.4.1 Environmental Consequences Specific to Alternative A

There is a high potential for loss of soil productivity in areas that burned at a moderate or high severity where most or all of the organic material, duff layer, and/or coarse woody debris was destroyed by the 2007 wildfire. The actual impacts of the wildfire on soil productivity vary considerably from site to site across the project area. In time, all of the sites are expected to revegetate to pre-fire levels. However, there may be a long term reduction in the rate of growth, stocking levels, and biomass production as a result of the 2007 wildfire (P.R., Vol. 11, Coarse Woody Debris).

Coarse Woody Debris – The Forest Plan defines activity area as the specific site affected by actions. Since this alternative does not propose any actions by which to delineate activity areas, for comparative purposes, the cumulative acres of each PVG within proposed units which are common to all action alternatives was assessed as a separate activity area. In the case of this alternative that equates to three different activity areas totaling roughly 1,762 acres. Post-fire coarse woody debris data for the remaining PVGs was not collected.

Implementation of this alternative would have no effect on the existing quantities or distribution of coarse woody debris within the 103,804 acre project area or the three activity areas. As displayed in Table 3-23, in year three (three years after the wildfire), total tons/acre of coarse woody debris would continue to be below or near the low end of desired ranges in PVGs 6 and 10, and within the desired range in PVG 7. Coarse wood tons/acre greater than 15 inches in diameter would continue to be well below desired conditions in PVGs 6 and 10 and within the desired condition in PVG 7 (P.R., Vol. 11, Coarse Woody Debris).

By year five snags within the project area will begin falling to the ground, with the smaller diameter trees the first to fall as they gradually succumb to the forces of nature such as wind and decay. Given the severity of crown scorch within most of the fire-killed trees (Section 3.2.1), an estimated 75 to 85 percent of the snags will have fallen by year 15 (Section 3.2.7) thus contributing additional coarse wood to affected areas.

Table 3-24 displays estimated amounts of coarse woody debris in year 15 for the various activity areas, assuming a snag fall-rate of 75 percent, and compares those values to the desired conditions portrayed in the Forest Plan. As displayed in Table 3-24, total tons/acre of coarse wood in year 15 would be well above the desired ranges for all three activity areas. Tons/acre of coarse wood greater than 15 inches in diameter would exceed desired ranges in PVGs 6 and 7 and be within the desired range in PVG 10 (P.R., Vol. 11, Coarse Woody Debris).

By year 25 the majority of the fire-induced snags in the project area will have fallen to the ground. As displayed in Table 3-25, in year 25 total tons/acre of coarse woody debris would be well above the desired ranges in all activity areas. Tons/acre of coarse wood greater than 15 inches in diameter would exceed desired ranges in PVGs 6 and 7 and be within the desired range in PVG 10 (P.R., Vol. 11, Coarse Woody Debris).

As explained in Section 3.2.7 of this chapter, snag densities would generally exceed or be within desired ranges until some time between years 25 and 35 at which time the natural fall-rate of snags would result in levels dropping below those desired in individual diameter classes. By year 35 snag densities in all diameter classes and all PVGs would average less than one snag/acre and be below desired ranges in all cases. Given the absence of large diameter live trees across the project area to replace fallen snags, snag densities would likely remain below desired ranges for 100 to 300 years, the time estimated for conifers to become established on burned sites, grow to maturity, and natural forces to begin to cause scattered mortality in large diameter trees (P.R., Vol. 2, Snags).

In comparison to the existing condition, coarse woody debris would gradually increase over the next 25 to 35 years during which time total tons/acre would greatly exceed desired ranges while tons/acre of coarse wood greater than 15 inches in diameter would exceed or be within desired conditions. Given that coarse woody debris recruited from falling snags will eventually decompose, and the fact that a shortage of snags would be expected in the future, coarse wood amounts in decay classes I and II would be expected to drop below desired conditions for a prolonged period of time starting around year 45 (P.R., Vol. 11, Coarse Woody Debris).

Detrimental Soil Disturbance - This alternative would have no effect on detrimental disturbance. Existing levels of fire-induced detrimental disturbance would continue in the temporary and short term under this alternative. Severely burned soils would recover over a period of 1 to 3 years as hydrophobic conditions break down through natural processes and ground cover and vegetation returns to these soils (USDA 2007). Soils affected by compaction, puddling, and/or displacement would recover over a longer period of time as weathering and duff development restores soil productivity (P.R., Vol. 11, Detrimental Disturbance).

Total Soil Resource Commitment – This alternative would have no effect on total soil resource commitment (TSRC). Alternative A would maintain the existing TSRC of 1.2 percent (P.R., Vol. 11, TSRC).

3.11.4.2 Environmental Consequences Specific to Alternative B

There is a high potential for loss of soil productivity in areas that burned at a moderate or high severity where most or all of the organic material, duff layer, and/or coarse woody debris was destroyed by the 2007 wildfire. The actual impacts of the wildfire on soil productivity vary considerably from site to site across the project area. In time, all of the sites are expected to revegetate to pre-fire levels. However, there may be a long term reduction in the rate of growth, stocking levels, and biomass production as a result of the 2007 wildfire (P.R., Vol. 11, Coarse Woody Debris).

***Coarse Woody Debris* –** For the purposes of this analysis the cumulative acres of each PVG within proposed units was assessed as a separate activity area. In the case of this alternative that equates to three different activity areas totaling roughly 1,762 acres, including 91 acres of RCAs intermixed within the units where no treatments would occur, and another 10 acres of RCAs within the units where trees would be felled and retained on site. Several reasons were considered in delineation of these activity areas. The majority of acres proposed for treatment in any single PVG had similar stand characteristics prior to the wildfire and burned at a similar intensity. Therefore the current level of coarse woody debris on these acres would be similar. In addition, with the exception of portions of RCAs, the same trees (i.e. fire-killed and imminently dead) would be felled across each PVG. Therefore post-implementation conditions would be similar across any individual activity area. Finally, since the desired ranges for coarse wood identified in the Forest Plan are presented by individual PVG, it seems logical to delineate activity areas by PVG in order to provide a meaningful comparison.

Implementation of this alternative would have no effect on the existing quantities, distribution, or future recruitment of coarse woody debris on roughly 98 percent of the 103,804 acre project area. The effects of this alternative on these untreated acres, including 91 acres of RCAs intermixed within the units where no treatments would occur, would be identical to those of Alternative A (P.R., Vol. 11, Coarse Woody Debris).

With two exceptions, Alternative B would not result in the removal of down material within proposed harvest units and therefore would not decrease existing quantities of coarse wood. The first exception would be those merchantable trees that may be windthrown (i.e. imminently dead) prior to completion of harvest activities. Although merchantable trees that are blown over may be removed under this alternative, these trees are not currently on the ground and therefore are not reflected in the existing post-fire conditions portrayed in Table 3-22. The second exception would be those trees felled during fire suppression activities in the fall of 2007 which may be removed under this alternative if still merchantable at the time of harvest. However, the number of trees likely to be removed under this scenario would be incidental and have little influence on the overall level of coarse woody debris in any single activity area (P.R., Vol. 11, Coarse Woody Debris).

Dead sub-merchantable trees (i.e. less than 8” dbh) as well as dead trees greater than or equal to 8 inches dbh that are unmerchantable, such as older snags, would be retained on site and provide sources of coarse woody debris in the future. In addition, under this alternative, fire-killed trees greater than or equal to 8 inches dbh would be felled and retained on site on an estimated 10 acres thus providing an immediate contribution of coarse woody debris (P.R., Vol. 11, Coarse Woody Debris). Further, within those harvested units along the #470 and #472 roads, some fire-killed trees in the 3 to 7 inch dbh range would be felled after harvest and retained on site, thus providing another immediate but minor contribution (0.3 tons/acre) of coarse woody debris (P.R., Vol. 2, Fuel Loads and Fire Risk; P.R., Vol. 11, Coarse Woody Debris).

As displayed in Table 3-23, in year three (three years after the wildfire), total tons/acre of coarse woody debris would continue to be below or near the low end of desired ranges in PVGs 6 and 10, and within the desired range in PVG 7. Coarse wood tons/acre greater than 15 inches in diameter would continue to be well below desired conditions in PVGs 6 and 10 and within the desired condition in PVG 7 (P.R., Vol. 11, Coarse Woody Debris).

Table 3-23 Coarse Woody Debris in Year 3

Indicator	Desired Condition	Alt. A Activity Area	Alt. B Activity Area	Alt. C Activity Area
PVG 6				
		(935 ac.)	(935 ac.)	(935 ac.)
Dry Weight*	**4 – 14**	4.0	4.2	10.3
Percent >15" (Tons/Acre >15")	**>65% (2.6 – 9.1)**	17% (0.7)	19% (0.8)	50% (5.2)
PVG 7				
		(340 ac.)	(340 ac.)	(340 ac.)
Dry Weight*	**5 – 19**	12.2	12.3	19.3
Percent >15" (Tons/Acre >15")	**>50% (2.5 – 9.5)**	53% (6.5)	54% (6.6)	49% (9.5)
PVG 10				
		(487 ac.)	(487 ac.)	(487 ac.)
Dry Weight*	**5 – 19**	2.0	2.0	4.8
Percent >15" (Tons/Acre >15")	**>25% (1.2 – 4.7)**	0% (0)	0% (0)	12% (0.6)

* Dry weight in tons/acre in Decay Classes I and II. Post-fire CWD data for the remaining PVGs was not collected.

By year five retained snags within the project area will begin falling to the ground, with the smaller diameter trees the first to fall as they gradually succumb to the forces of nature such as wind and decay. Given the severity of crown scorch within most of the fire-killed trees (Section 3.2.1), an estimated 75 to 85 percent of the snags will have fallen by year 15 (Section 3.2.7) thus contributing additional coarse wood to affected areas. Table 3-24 displays estimated amounts of coarse woody debris in year 15 for the various activity areas, assuming a snag fall-rate of 75 percent, and compares those values to the desired conditions portrayed in the Forest Plan. As displayed in Table 3-24, total tons/acre of coarse wood in year 15 would be within the desired ranges for all three activity areas. Tons/acre of coarse wood greater than 15 inches in diameter would be below desired ranges in PVGs 6 and 10 and within the desired range in PVG 7 (P.R., Vol. 11, Coarse Woody Debris).

Table 3-24 Coarse Woody Debris in Year 15

Indicator	Desired Condition	Alt. A Activity Area	Alt. B Activity Area	Alt. C Activity Area
PVG 6				
		(935 ac.)	(935 ac.)	(935 ac.)
Dry Weight*	**4 – 14**	26.6	7.2	13.2
Percent >15" (Tons/Acre >15")	**>65% (2.6 – 9.1)**	60% (15.9)	26% (1.9)	47% (6.2)
PVG 7				
		(340 ac.)	(340 ac.)	(340 ac.)
Dry Weight*	**5 – 19**	28.1	17.8	24.5
Percent >15" (Tons/Acre >15")	**>50% (2.5 – 9.5)**	41% (11.6)	40% (7.1)	41% (10.0)
PVG 10				
		(487 ac.)	(487 ac.)	(487 ac.)
Dry Weight*	**5 – 19**	25.5	10.7	13.5
Percent >15" (Tons/Acre >15")	**>25% (1.2 – 4.7)**	12% (3.2)	1% (0.1)	5% (0.7)

* Dry weight in tons/acre in Decay Classes I and II. Post-fire CWD data for the remaining PVGs was not collected.

By year 25 the majority of the fire-induced snags in the project area will have fallen to the ground. As displayed in Table 3-25, in year 25 total tons/acre of coarse woody debris would be within or slightly above the desired ranges in all activity areas. Tons/acre of coarse wood greater than 15 inches in diameter would be below desired ranges in PVGs 6 and 10 and within the desired range in PVG 7 (P.R., Vol. 11, Coarse Woody Debris).

As explained in Section 3.2.7 of this chapter, proposed activities would immediately reduce snag densities on an estimated 1,671 acres. By year 25 snag densities in all diameter classes and all activity areas would be below desired ranges where proposed treatments occur. Snag densities on these managed areas (1,671 acres) would likely remain below desired ranges for 100 to 300 years, the time estimated for conifers to become established, grow to maturity, and natural forces to begin to cause scattered mortality in large diameter trees. Snag densities on the remaining 102,133 acres not affected by this alternative would be identical to those disclosed for Alternative A (No Action) (P.R., Vol. 2, Snags).

Table 3-25 Coarse Woody Debris in Year 25

PVG 6				
Indicator	**Desired Condition**	**Alt. A** **Activity Area** (935 ac.)	**Alt. B** **Activity Area** (935 ac.)	**Alt. C** **Activity Area** (935 ac.)
Dry Weight*	**4 – 14**	32.2	7.9	13.9
Percent >15" (Tons/Acre >15")	**>65%** **(2.6 – 9.1)**	61% (19.6)	28% (2.2)	47% (6.5)
PVG 7				
Indicator	**Desired Condition**	**Alt. A** **Activity Area** (340 ac.)	**Alt. B** **Activity Area** (340 ac.)	**Alt. C** **Activity Area** (340 ac.)
Dry Weight*	**5 – 19**	32.2	19.2	25.8
Percent >15" (Tons/Acre >15")	**>50%** **(2.5 – 9.5)**	40% (12.9)	37% (7.2)	39% (10.1)
PVG 10				
Indicator	**Desired Condition**	**Alt. A** **Activity Area** (487 ac.)	**Alt. B** **Activity Area** (487 ac.)	**Alt. C** **Activity Area** (487 ac.)
Dry Weight*	**5 – 19**	31.3	12.9	15.7
Percent >15" (Tons/Acre >15")	**>25%** **(1.2 – 4.7)**	13% (4.0)	1% (0.1)	4% (0.7)

* Dry weight in tons/acre in Decay Classes I and II. Post-fire CWD data for the remaining PVGs was not collected.

In comparison to the existing condition, coarse woody debris would gradually increase over the next 25 years during which time total tons/acre would remain within or slightly above desired ranges while tons/acre of coarse wood greater than 15 inches in diameter would be within or below desired conditions. Given that coarse woody debris recruited from falling snags will eventually decompose, and the fact that a shortage of snags would be expected in the future, coarse wood amounts in decay classes I and II would be expected to drop below desired conditions for a prolonged period of time starting around year 35 on harvested acres, and around year 45 on unharvested acres (P.R., Vol. 11, Coarse Woody Debris).

Although not reflected in the preceding discussions or Tables 3-23 through 3-25, given the narrow linear nature of proposed salvage units (i.e. 200 feet in width) and the abundance of fire-killed trees immediately upslope of proposed units, a substantial amount of coarse woody debris would be recruited from adjacent untreated acres over the next 25 years and contribute to both the total tons/acre of coarse wood and the tons/acre of material greater than 15 inches in diameter (P.R., Vol. 11, Coarse Woody Debris).

Detrimental Disturbance – Given the definition of activity area provided in the Forest Plan (i.e. the specific area where proposed actions may have detrimental soil impacts), each individual harvest unit associated with this alternative has been assessed as a separate activity area.

As previously discussed, detrimental disturbance is usually associated with ground disturbance (compaction, puddling, or displacement) or acres that burned at a high severity. Recovery from the effects of compaction and rutting associated with previous harvest activities include the shrinking and swelling caused by periodic freeze-thaw and wet-dry cycles (Arnup 1998). Studies on the recovery of natural soil bulk density after timber harvest demonstrate that recovery rates range from 0 to 21 years depending on soil texture, level of compaction, climate, amount of organic material in the soil, and soil drainage (Arnup 1998). Well-drained soils often recover more quickly than poorly drained soils, while clay soils may recover more quickly than sandy soils (Arnup 1998). Studies on the effects of soil puddling and displacement are more limited, but one study on organic soils indicated rut cover decreased rapidly following logging due to re-establishment of vegetation (Arnup 1998). Therefore, based on the studies reviewed in Arnup (1998), only those activity areas affected by harvest activities within the last 21 years were considered to have existing levels of detrimental disturbance. Based on the available literature, any detrimental disturbance predating that period of time should now be recovered (P.R., Vol. 11, Detrimental Disturbance).

A review of the activity areas associated with Alternative B indicates that, with the exception of Post and Pole Sales where the material was removed by hand, all other past harvest within the activity areas occurred more than 21 years ago (1954 through 1967). Therefore any detrimental disturbance that may have resulted from past timber harvest within these activity areas would be considered recovered today. However a number of the proposed harvest units do reflect existing levels of detrimental disturbance because of the 2007 wildfire. (P.R., Vol. 11, Detrimental Disturbance).

Table 3-26 lists the individual activity areas associated with this alternative, the existing acres of detrimental disturbance attributed to past activities, and the existing percent of each activity area in a detrimentally disturbed condition. As displayed in Table 3-26, detrimental disturbance currently exceeds 15 percent in many of the units because of high severity burns in the activity areas. Given the narrow (i.e. 200 feet) linear nature of proposed units, numerous trips on the same skid trail would not be necessary or expected. Therefore this alternative would not be expected to increase detrimental disturbance within any activity area. Post-implementation monitoring in 2007 of similarly shaped units on the Airline Timber Sale concluded that skidding practices resulted in little or no detrimental disturbance (Terry Hardy, Forest Soil Scientist, Boise National Forest, personal communication March 17, 2008). Nevertheless, in order to avoid increasing detrimental disturbance (i.e. compaction) and comply with direction in the Forest Plan, an additional design feature (Section 2.4.2.7) would be applied to all proposed units. Specifically, to prevent undesirable levels of soil compaction, use of ground-based equipment off of designated skid trails would be limited to a maximum of three roundtrips on any undesignated skid trail. Incorporation of this design feature would result in maintenance of the existing levels of detrimental disturbance within proposed units (P.R., Vol. 11, Detrimental Disturbance).

Table 3-26 Detrimental Disturbance (DD)

Activity Area (Unit)	Total Acres	Yarding System	Existing DD (Acres)			Existing Percent DD
			High Severity Burn	Past Harvest	Total Existing	
1	141	Trac.	11	0	11	8%
2	142	Trac.	84	0	84	59%
3	20	Trac.	3	0	3	15%
4	102	Trac.	56	0	56	55%
5	89	Trac.	24	0	24	27%
6	149	Trac.	23	0	23	15%
7	52	Trac.	22	0	22	42%
8	32	Trac.	1	0	1	3%
9	385	Trac.	100	0	100	26%
10	55	Trac.	9	0	9	16%
11	73	Trac.	9	0	9	12%
12	17	Trac.	0	0	0	0%
13	18	Trac.	0	0	0	0%
14	180	Trac.	6	0	6	3%
15	126	Trac.	46	0	46	36%
16	84	Trac.	16	0	16	19%
17	97	Trac.	8	0	8	8%

Given the direction in the Forest Plan to move these units back toward 15 percent, the question to be asked is what actions can be taken to mitigate the effects of high severity burns (i.e. soil humus loss, structural changes, hydrophobic characteristics, and/or sterilization, loss of effective ground cover, obstructions). Although research is limited, ground disturbance associated with logging has been observed to disrupt water-repellent layers (hydrophobic conditions), which may increase water infiltration and thereby decrease overland flow and erosion from burned sites. Ice (1999) states that where water-repellent soils are created by condensation of volatilized organics in the soil, ripping and breaking-up of this layer is essential to rapidly restore infiltration. In addition, Poff (1988) argues that "…salvage logging can improve watershed condition by increasing ground cover, by removing a source of large, high energy water drops, and by breaking up hydrophobic soil layers." The majority of the harvest-created slash would be removed from the units via whole-tree-yarding and accumulated at landings. Nevertheless, incidental amounts of material in the form of limbs and tops of harvested trees would break off during operations, be retained on site, and provide an immediate contribution of organic material. In addition, within harvested units along the #470 and #472 roads, some fire-killed trees in the 3 to 7 inch dbh range would be felled and retained on site across an estimated 100 acres. Further, fire-killed and imminently dead trees greater than or equal to 8 inches dbh would be felled and retained on site across another 10 acres. While an immediate benefit would not be realized, breaking up the hydrophobic soils via ground-based skidding and adding slash to the sites would speed the rate of recovery. Although unquantifiable, these actions would move detrimental disturbance in the units of concern toward the 15 percent threshold identified in the Forest Plan (P.R., Vol. 11, Detrimental Disturbance).

Total Soil Resource Commitment – No road construction would occur under this alternative. Alternative B proposes to use an existing unauthorized road (0.7 miles) to access the #473 road. However this unauthorized road, which is currently passable, was reflected in the existing condition. Therefore this activity would not contribute additional TSRC (P.R., Vol. 11, TSRC).

Under a worse case scenario, designated/dedicated skid trails associated with ground-based skidding would result in an additional 83 acres in a TSRC condition. While it is suspected that few landings would be constructed under this alternative and that the Purchaser would instead use unconstructed landings and/or the actual road prism, in order to present a worse case scenario new landing construction contributing toward TSRC was assumed to be 17 acres (P.R., Vol. 11, TSRC).

Following implementation, TSRC for the 103,804 acre activity area would be 1.3 percent. The Forest Plan standard for TSRC would be met (P.R., Vol. 11, TSRC).

3.11.4.3 Environmental Consequences Specific to Alternative C

There is a high potential for loss of soil productivity in areas that burned at a moderate or high severity where most or all of the organic material, duff layer, and/or coarse woody debris was destroyed by the 2007 wildfire. The actual impacts of the wildfire on soil productivity vary considerably from site to site across the project area. In time, all of the sites are expected to revegetate to pre-fire levels. However, there may be a long term reduction in the rate of growth, stocking levels, and biomass production as a result of the 2007 wildfire (P.R., Vol. 11, Coarse Woody Debris).

***Coarse Woody Debris* –** For the purposes of this analysis the cumulative acres of each PVG within proposed units was assessed as a separate activity area. In the case of this alternative that equates to three different activity areas totaling roughly 1,762 acres, including 91 acres of RCAs intermixed within the units where no treatments would occur, and another 422 acres of RCAs within the units where trees would be felled and retained on site. Several reasons were considered in delineation of these activity areas. The majority of acres proposed for treatment in any single PVG had similar stand characteristics prior to the wildfire and burned at a similar intensity. Therefore the current level of coarse woody debris on these acres would be similar. In addition, with the exception of portions of RCAs, the same trees (i.e. fire-killed and imminently dead) would be felled across each PVG. Therefore post-implementation conditions would be similar across any individual activity area. Finally, since the desired ranges for coarse wood identified in the Forest Plan are presented by individual PVG, it seems logical to delineate activity areas by PVG in order to provide a meaningful comparison.

Implementation of this alternative would have no effect on the existing quantities, distribution, or future recruitment of coarse woody debris on roughly 98 percent of the 103,804 acre project area. The effects of this alternative on these untreated acres, including 91 acres of RCAs intermixed within the units where no treatments would occur, would be identical to those of Alternative A (P.R., Vol. 11, Coarse Woody Debris).

With two exceptions, Alternative C would not result in the removal of down material within proposed harvest units and therefore would not decrease existing quantities of coarse wood. The first exception would be those merchantable trees that may be windthrown (i.e. imminently dead) prior to completion of harvest activities. Although merchantable trees that are blown over may be removed under this alternative, these trees are not currently on the ground and therefore are not reflected in the existing, post-fire conditions portrayed in Table 3-22. The second exception would be those trees felled during fire suppression activities in the fall of 2007 which may be removed under this alternative if still merchantable at the time of harvest. However, the number of trees likely to be removed under this scenario would be incidental and have little influence on the overall level of coarse woody debris in any single activity area (P.R., Vol. 11, Coarse Woody Debris).

Dead sub-merchantable trees (i.e. less than 8” dbh) as well as dead trees greater than or equal to 8 inches dbh that are unmerchantable, such as older snags, would be retained on site and provide sources of coarse woody debris in the future. In addition, under this alternative, fire-killed trees greater than or equal to 8 inches dbh would be felled and retained on site across 422 acres thus providing an immediate contribution of coarse woody debris (P.R., Vol. 2, Fuel Loads and Fire Risk; P.R., Vol. 11, Coarse Woody Debris).

As displayed in Table 3-23, as a result of falling and retaining trees across 422 acres, in year three (three years after the wildfire), total tons/acre of coarse woody debris would be within the desired range in PVG 6, above the desired range in PVG 7, and below the desired range in PVG 10. Coarse wood tons/acre greater than 15 inches in diameter would continue to be well below desired conditions in PVG 10 and within the desired ranges in PVGs 6 and 7 (P.R., Vol. 11, Coarse Woody Debris).

By year five retained snags within the project area will begin falling to the ground, with the smaller diameter trees the first to fall as they gradually succumb to the forces of nature such as wind and decay. Given the severity of crown scorch within most of the fire-killed trees (Section 3.2.1), an estimated 75 to 85 percent of the snags will have fallen by year 15 (Section 3.2.7) thus contributing additional coarse wood to affected areas. Table 3-24 displays estimated amounts of coarse woody debris in year 15 for the various activity areas, assuming a snag fall-rate of 75 percent, and compares those values to the desired conditions portrayed in the Forest Plan. As displayed in Table 3-24, total tons/acre of coarse wood in year 15 would be within or exceed the desired ranges for all three activity areas. Tons/acre of coarse wood greater than 15 inches in diameter would be within the desired range in PVGs 6, exceed the desired range in PVG 7, and be below the desired range in PVG 10 (P.R., Vol. 11, Coarse Woody Debris).

By year 25 the majority of the fire-induced snags in the project area will have fallen to the ground. As displayed in Table 3-25, in year 25 total tons/acre of coarse woody debris would be within or above the desired ranges in all activity areas. Tons/acre of coarse wood greater than 15 inches in diameter would be within the desired range in PVGs 6, exceed the desired range in PVG 7, and be below the desired range in PVG 10 (P.R., Vol. 11, Coarse Woody Debris).

As explained in Section 3.2.7 of this chapter, proposed activities would immediately reduce snag densities on an estimated 1,671 acres. By year 25 snag densities in all diameter classes and all activity areas would be below desired ranges where proposed treatments occur. Snag densities on these managed areas (1,671 acres) would likely remain below desired ranges for 100 to 300 years, the time estimated for conifers to become established, grow to maturity, and natural forces to begin to cause scattered mortality in large diameter trees. Snag densities on the remaining 102,133 acres <u>not</u> affected by this alternative would be identical to those disclosed for Alternative A (No Action) (P.R., Vol. 2, Snags).

In comparison to the existing condition, coarse woody debris would gradually increase over the next 25 years during which time total tons/acre would remain within or above desired ranges while tons/acre of coarse wood greater than 15 inches in diameter would be within, above, or below desired conditions. Given that coarse woody debris recruited from falling snags will eventually decompose, and the fact that a shortage of snags would be expected in the future, coarse wood amounts in decay classes I and II would be expected to drop below desired conditions for a prolonged period of time starting around year 35 on treated acres, and around year 45 on untreated acres (P.R., Vol. 11, Coarse Woody Debris).

Although not reflected in the preceding discussions or Tables 3-23 through 3-25, given the narrow linear nature of proposed treatment units (i.e. 200 feet in width) and the abundance of fire-killed trees immediately upslope of proposed units, a substantial amount of coarse woody debris would be recruited from adjacent untreated acres over the next 25 years and contribute to both the total tons/acre of coarse wood and the tons/acre of material greater than 15 inches in diameter (P.R., Vol. 11, Coarse Woody Debris).

***Detrimental Disturbance* –** Given the definition of activity area provided in the Forest Plan (i.e. the specific area where proposed actions may have detrimental soil impacts), each individual treatment unit associated with this alternative has been assessed as a separate activity area.

As previously discussed, detrimental disturbance is usually associated with ground disturbance (compaction, puddling, or displacement) or acres that burned at a high severity. Recovery from the effects of compaction and rutting associated with previous harvest activities include the shrinking and swelling caused by periodic freeze-thaw and wet-dry cycles (Arnup 1998). Studies on the recovery of natural soil bulk density after timber harvest demonstrate that recovery rates range from 0 to 21 years depending on soil texture, level of compaction, climate, amount of organic material in the soil, and soil drainage (Arnup 1998). Well-drained soils often recover more quickly than poorly drained soils, while clay soils may recover more quickly than sandy soils (Arnup 1998). Studies on the effects of soil puddling and displacement are more limited, but one study on organic soils indicated rut cover decreased rapidly following logging due to re-establishment of vegetation (Arnup 1998). Therefore, based on the studies reviewed in Arnup (1998), only those activity areas affected by harvest activities within the last 21 years were considered to have existing levels of detrimental disturbance. Based on the available literature, any detrimental disturbance predating that period of time should now be recovered (P.R., Vol. 11, Detrimental Disturbance).

A review of the activity areas associated with Alternative C indicates that, with the exception of Post and Pole Sales where the material was removed by hand, all other past harvest within the activity areas occurred more than 21 years ago (1954 through 1967). Therefore any detrimental disturbance that may have resulted from past timber harvest within these activity areas would be considered recovered today. However a number of the proposed treatment units do reflect existing levels of detrimental disturbance because of the 2007 wildfire. (P.R., Vol. 11, Detrimental Disturbance).

Table 3-26 lists the individual activity areas associated with this alternative, the existing acres of detrimental disturbance attributed to past activities, and the existing percent of each activity area in a detrimentally disturbed condition. As displayed in Table 3-26, detrimental disturbance currently exceeds 15 percent in many of the units because of high severity burns in the activity areas. Given the narrow (i.e. 200 feet) linear nature of proposed units, numerous trips on the same skid trail would not be necessary or expected. Therefore this alternative would not be expected to increase detrimental disturbance within any activity area. Post-implementation monitoring in 2007 of similarly shaped units on the Airline Timber Sale concluded that skidding practices resulted in little or no detrimental disturbance (Terry Hardy, Forest Soil Scientist, Boise National Forest, personal communication March 17, 2008). Nevertheless, in order to avoid increasing detrimental disturbance (i.e. compaction) and comply with direction in the Forest Plan, an additional design feature (Section 2.4.2.7) would be applied to all proposed units. Specifically, to prevent undesirable levels of soil compaction, use of ground-based equipment off of designated skid trails would be limited to a maximum of three roundtrips on any undesignated skid trail. Incorporation of this design feature would result in maintenance of the existing levels of detrimental disturbance within proposed units (P.R., Vol. 11, Detrimental Disturbance).

Given the direction in the Forest Plan to move these units back toward 15 percent, the question to be asked is what actions can be taken to mitigate the effects of high severity burns (i.e. soil humus loss, structural changes, hydrophobic characteristics, and/or sterilization, loss of effective ground cover, obstructions). Although research is limited, ground disturbance associated with logging has been observed to disrupt water-repellent layers (hydrophobic conditions), which may increase water infiltration and thereby decrease overland flow and erosion from burned sites. Ice (1999) states that where water-repellent soils are created by condensation of volatilized organics in the soil, ripping and breaking-up of this layer is essential to rapidly restore infiltration. In addition, Poff (1988) argues that "…salvage logging can improve watershed condition by increasing ground cover, by removing a source of large, high energy water drops, and by breaking up hydrophobic soil layers." The majority of the harvest-created slash would be removed from the units via whole-tree-yarding and accumulated at landings. Nevertheless, incidental amounts of material in the form of limbs and tops of harvested trees would break off during operations, be retained on site, and provide an immediate contribution of organic material. In addition, fire-killed and imminently dead trees greater than or equal to 8 inches dbh would be felled and retained on site across an estimated 422 acres. While an immediate benefit would not be realized, breaking up the hydrophobic soils via ground-based skidding and adding slash to the sites would speed the rate of recovery. Although unquantifiable, these actions would move detrimental disturbance in the units of concern toward the 15 percent threshold identified in the Forest Plan (P.R., Vol. 11, Detrimental Disturbance).

Total Soil Resource Commitment – No road construction would occur under this alternative. Alternative C proposes to use an existing unauthorized road (0.7 miles) to access the #473 road. However this unauthorized road, which is currently passable, was reflected in the existing condition. Therefore this activity would not contribute additional TSRC (P.R., Vol. 11, TSRC).

Under a worse case scenario, designated/dedicated skid trails associated with ground-based skidding would result in an additional 62 acres in a TSRC condition. While it is suspected that few landings would be constructed under this alternative and that the Purchaser would instead use unconstructed landings and/or the actual road prism, in order to present a worse case scenario new landing construction contributing toward TSRC was assumed to be 12 acres (P.R., Vol. 11, TSRC).

Following implementation, TSRC for the 103,804 acre activity area would be 1.3 percent. The Forest Plan standard for TSRC would be met (P.R., Vol. 11, TSRC).

3.11.4.4 Cumulative Effects

Coarse Woody Debris - The effects of any alternative on coarse woody debris would be limited to the project area. Therefore the area used to assess cumulative effects consists of the 103,804 acre analysis area (Figure 3-1).

With the exception of a five acre parcel in the vicinity of Knox Ranch, the entire cumulative effects area is administered by the U.S. Forest Service. Since 1950 an estimated 7,208 acres have been harvested within the cumulative effects area. Historic records indicate that since 1910 roughly 67,853 acres within the cumulative effects area have been affected by wildfire, some of which overlap with harvested acres. Although the specific effects cannot be quantified, the existing conditions disclosed above reflect the impacts of those past activities as well as any recovery that has occurred since those events. Ongoing or foreseeable future activities within this cumulative effects area that could add incrementally to impacts on this resource are listed below. Reference **Appendix B** for additional information and maps related to the cumulative effects analyses completed for this project.

Personal Use Firewood - Personal use firewood cutting is expected to continue into the foreseeable future and would likely reduce the quantity of fire-damaged trees within 100 to 200 feet of open roads.

Cabin Salvage, Knox Salvage, and South Fork Houselog Salvage I Sales – These three salvage sales, all under contract to the same Purchaser, were offered following the 2003 South Fork Wildfire. At this time the majority of the included timber has already been removed. However, the Purchaser is expected to continue to remove small amounts of fire-killed and imminently dead timber in 2008.

Power Salvage Sale – This salvage sale permits the removal of downed trees only from 66 acres within sections of the right-of-way of the overhead power line in the Warm Lake Basin. This contract is projected to terminate in July of 2008.

South Fork Campground Restoration Project – While still in the developmental phase, the objective of this project would be to minimize the fire-induced effects of the 2007 wildfire on the 10 acre South Fork Campground by removing hazard trees, planting conifers, and implementing other restorative activities. The environmental analysis for this project is tentatively scheduled to occur in 2008 with implementation in 2009 or 2010.

Shoreline Fuels Reduction Project – This project consists of mechanical mulching of 32 acres of sub-merchantable trees and hand thinning and piling of 77 acres of sub-merchantable trees, all in the vicinity of the Shoreline Campground. Implementation is scheduled to occur in 2008.

Alternative A would have no direct or indirect effects on coarse woody debris, therefore no incremental or cumulative effects would occur as a result of this alternative (Vol. 11, Coarse Woody Debris).

The cumulative effect of Alternative B or C in combination with ongoing and/or foreseeable future activities would be a decrease in snag densities and therefore reduced sources of coarse woody debris recruitment within the cumulative effects area. Relative to acres affected by these alternatives, personal use firewood cutting is the only foreseeable future activity that would add cumulatively to effects on the same 1,671 acres. It should be noted that the eventual decomposition of these trees/logs and the projected shortage of snags in the future would eventually result in similar effects on both treated and untreated acres (P.R., Vol. 2, Snags; Vol. 11, Coarse Woody Debris).

Detrimental Disturbance - The effects of any alternative on detrimental disturbance would be limited to the project area. Therefore the area used to assess cumulative effects consists of the 103,804 acre analysis area (Figure 3-1).

With the exception of a five acre parcel in the vicinity of Knox Ranch, the entire cumulative effects area is administered by the U.S. Forest Service. Since 1950 an estimated 7,208 acres have been harvested within the cumulative effects area. Historic records indicate that since 1910 roughly 67,853 acres within the cumulative effects area have been affected by wildfire, some of which overlap with harvested acres. Although the specific effects cannot be quantified, the existing conditions disclosed above reflect the impacts of those past activities as well as any recovery that has occurred since those events. Ongoing or foreseeable future activities within this cumulative effects area that could add incrementally to impacts on this resource are listed below. Reference **Appendix B** for additional information and maps related to the cumulative effects analyses completed for this project.

Cabin Salvage, Knox Salvage, and South Fork Houselog Salvage I Sales – These three salvage sales, all under contract to the same Purchaser, were offered following the 2003 South Fork Wildfire. At this time the majority of the included timber has already been removed. However, the Purchaser is expected to continue to remove small amounts of fire-killed and imminently dead timber in 2008.

Power Salvage Sale – This salvage sale permits the removal of downed trees only from 66 acres within sections of the right-of-way of the overhead power line in the Warm Lake Basin. This contract is projected to terminate in July of 2008.

South Fork Campground Restoration Project – While still in the developmental phase, the objective of this project would be to minimize the fire-induced effects of the 2007 wildfire on the 10 acre South Fork Campground by removing hazard trees, planting conifers, and implementing other restorative activities. The environmental analysis for this project is tentatively scheduled to occur in 2008 with implementation in 2009 or 2010.

Shoreline Fuels Reduction Project – This project consists of mechanical mulching of 32 acres of sub-merchantable trees and hand thinning and piling of 77 acres of sub-merchantable trees, all in the vicinity of the Shoreline Campground. Implementation is scheduled to occur in 2008.

Alternative A would have no direct, indirect, or cumulative effects on detrimental disturbance.

As disclosed above, Alternative B or C would move detrimental disturbance in the units of concern toward the 15 percent threshold identified in the Forest Plan. Given the lack of any ongoing or foreseeable future actions within the same activity areas, Alternative B or C would result in a slight incremental reduction of detrimental disturbance within those activity areas and within the analysis area as-a-whole (P.R., Vol. 11, Detrimental Disturbance).

Total Soil Resource Commitment – The effects of any alternative on TSRC would be limited to the project area. Therefore the area used to assess cumulative effects consists of the 103,804 acre analysis area (Figure 3-1).

With the exception of a five acre parcel in the vicinity of Knox Ranch, the entire cumulative effects area is administered by the U.S. Forest Service. Since 1950 an estimated 7,208 acres have been harvested within the cumulative effects area. Historic records indicate that since 1910 roughly 67,853 acres within the cumulative effects area have been affected by wildfire, some of which overlap with harvested acres. Although the specific effects cannot be quantified, the existing conditions disclosed above reflect the impacts of those past activities as well as any recovery that has occurred since those events. Ongoing or foreseeable future activities within this cumulative effects area that could add incrementally to impacts on this resource are listed below. Reference **Appendix B** for additional information and maps related to the cumulative effects analyses completed for this project.

Cabin Salvage, Knox Salvage, and South Fork Houselog Salvage I Sales – These three salvage sales, all under contract to the same Purchaser, were offered following the 2003 South Fork Wildfire. At this time the majority of the included timber has already been removed. However, the Purchaser is expected to continue to remove small amounts of fire-killed and imminently dead timber in 2008.

Power Salvage Sale – This salvage sale permits the removal of downed trees only from 66 acres within sections of the right-of-way of the overhead power line in the Warm Lake Basin. This contract is projected to terminate in July of 2008.

South Fork Campground Restoration Project – While still in the developmental phase, the objective of this project would be to minimize the fire-induced effects of the 2007 wildfire on the 10 acre South Fork Campground by removing hazard trees, planting conifers, and implementing other restorative activities. The environmental analysis for this project is tentatively scheduled to occur in 2008 with implementation in 2009 or 2010.

SFSR Travel Management Project - While still in the developmental phase, the objective of this project would be to minimize undesirable impacts associated with poorly located dispersed campsites and authorized and unauthorized roads and/or trails causing resource damage, as well as to address under-sized culverts, fish passage barriers, and/or structures damaged by the 2007 wildfire in the South Fork Salmon River drainage. The environmental analysis for this project is tentatively scheduled to occur in 2008 with implementation in 2009 or 2010.

Alternative A would have no direct, indirect, or cumulative effects on TSRC (P.R., Vol. 11, TSRC).

Alternative B or C, in combination with ongoing and foreseeable future activities, would result in a cumulative TSRC percentage within the cumulative effects analysis area of less than two percent. The Forest Plan standard would be met (P.R., Vol. 11, TSRC).

3.11.5 Wetlands and Floodplains

This section of the document describes the existing conditions of wetlands and floodplains as well as the effects of the alternatives on those resources. Since potential impacts on wetlands and floodplains would be limited to those associated with proposed harvest activities, the analysis area consists of the 103,804 acre project area (Figure 3-1).

Wetland communities support a unique variety of vegetation that provide food and cover for many mammals, birds, and amphibians, and have an important influence on aquatic habitat conditions. Protection of these areas is required by direction in the Forest Plan, as well as Executive Orders 11988 and 11990.

The goal of Executive Order 11988 is that the proposed activities must not increase flood hazards and must preserve the resource benefit of floodplains (i.e. their ability to dissipate flood flows and moderate peak flows). The goal of Executive Order 11990 is that the proposed activities must preserve the resource benefits of wetlands (i.e. their ability to produce abundant diverse biota, buffer water quality, and recharge groundwater) (USDA 1994).

Three main types of wetlands are present within the 103,804 acre analysis area: riverine, palustrine and lacustrine (USDI-FWS 1979).

The riverine, upper perennial wetland types occur adjacent to rock bottom or bedrock streams that are permanently flooded with water. These wetlands are typically composed of shrubs and conifer tree species with forb understories. The riverine type wetlands occur throughout the analysis area and generally follow streams or glacial outwash floodplains (P.R., Vol. 11, Wetlands and Floodplains).

The palustrine wetland types are emergent, scrub-shrub, forested persistent wetlands that are seasonally and intermittently saturated with water or forested, and may be isolated or adjacent to streams. These wetlands can also occur as persistent wetlands where small springs or seeps provide continual saturation (P.R., Vol. 11, Wetlands and Floodplains).

Topographic depressions associated with lakes or old lakebeds form the lacustrine wetland type. These wetlands are classified as littoral (aquatic bed, emergent, or shore) and limnetic (bottom) and are represented in the project area by several small named and unnamed lakes, such as Tule Lake (P.R., Vol. 11, Wetlands and Floodplains).

The impacts of the 2007 wildfire on the narrow wetlands associated with the numerous streams range from no impact (i.e. unburned) to major impacts where all overstory and understory was consumed. Section 3.11.1 of this chapter characterizes the post-fire condition of RCAs which includes wetlands. As disclosed in Section 3.11.1, roughly 19 percent of the RCAs within the analysis area burned at a high severity; 33 percent at a moderate severity; 18 percent at a low severity, and; the remaining 30 percent were unburned (P.R., Vol. 11, Sediment; P.R., Vol. 11, Wetlands and Floodplains).

Some riverine/palustrine wetlands and floodplains have been impacted by previous management activities at road crossings. Although the initial disturbance was temporary, the presence of the culvert still affects the value and function of the wetlands (P.R., Vol. 11, Wetlands and Floodplains).

Existing culverts have also impacted floodplain connectivity within the analysis area. As part of the Burned Area Emergency Response effort, culverts identified as inadequate to accommodate post-fire projected flows were addressed. Nevertheless other culverts in the area likely continue to impact floodplain connectivity to some degree (P.R., Vol. 11, Wetlands and Floodplains).

3.11.5.1 Environmental Consequences Specific to Alternative A

Although understory vegetation (i.e. grasses, forbs, and shrubs) common in wetlands that was consumed by the wildfire would be expected to reestablish within the next few years, it will likely take many decades before the conifer component of the overstory approaches pre-fire conditions (P.R., Vol. 11, Wetlands and Floodplains).

This alternative does not propose any new activities that would directly or indirectly affect wetlands or floodplains. The authorized and unauthorized use of existing roads and trails would continue to delivery sediment to area streams, some of which would impair the function and value of wetlands and floodplains to some degree (P.R., Vol. 11, Wetlands and Floodplains).

Under-sized culverts in the area would continue to be at risk of failure. Failure of these culverts would likely result in adverse impacts to downstream wetlands and floodplains (P.R., Vol. 11, Wetlands and Floodplains).

3.11.5.2 Environmental Consequences Common to Alternative B and C

Although understory vegetation (i.e. grasses, forbs, and shrubs) common in wetlands that was consumed by the wildfire would be expected to reestablish within the next few years, it will likely take many decades before the conifer component of the overstory approaches pre-fire conditions (P.R., Vol. 11, Wetlands and Floodplains).

These alternatives are not expected to negatively change the functions or values of wetlands and floodplains as they relate to protection of human health, safety, and welfare; preventing the loss of property values, and; maintaining natural systems. Design features associated with these alternatives include delineation of RCAs around all wetlands and streams (floodplains). No harvest, ground-based skidding, or felling of trees would occur within one site potential tree height of these areas unless located upslope of a road. Those areas within one site potential tree height of a wetland or stream and upslope of a road where activities may occur total approximately 10 acres of non-riparian habitats. Therefore none of the activities associated with these alternatives would occur in wetlands or affect floodplains. The function and value of wetlands and floodplains would be maintained (P.R., Vol. 11, Wetlands and Floodplains).

Landslides can impact wetlands by inundating them with debris and potentially changing the water available to wetlands by modifying hillslope hydrology. However, design features (Section 2.4.2.5) associated with these alternatives prohibit harvest or ground-based skidding within field-identified landslide prone areas (P.R., Vol. 11, Wetlands and Floodplains).

The authorized and unauthorized use of existing roads and trails would continue to delivery sediment to area streams, some of which would impair the function and value of wetlands and floodplains to some degree. Under-sized culverts in the area would continue to be at risk of failure. Failure of these culverts would likely result in adverse impacts to downstream wetlands and floodplains (P.R., Vol. 11, Wetlands and Floodplains).

3.11.5.3 Cumulative Effects

Since potential effects relative to wetlands and floodplains would be restricted to within the project area, the area used to assess cumulative effects consists of the 103,804 acre project area (Figure 3-1).

With the exception of a five acre parcel in the vicinity of Knox Ranch, the entire cumulative effects area is administered by the U.S. Forest Service. Since 1950 an estimated 7,208 acres have been harvested within the cumulative effects area. Historic records indicate that since 1910 roughly 67,853 acres within the cumulative effects area have been affected by wildfire, some of which overlap with harvested acres. Although the specific effects cannot be quantified, the existing conditions disclosed above reflect the impacts of those past activities as well as any recovery that has occurred since those events. Ongoing or foreseeable future activities within this cumulative effects area that could add incrementally to impacts on this resource are listed below. Reference **Appendix B** for additional information and maps related to the cumulative effects analyses completed for this project.

Cabin Salvage, Knox Salvage, and South Fork Houselog Salvage I Sales – These three salvage sales, all under contract to the same Purchaser, were offered following the 2003 South Fork Wildfire. At this time the majority of the included timber has already been removed. However, the Purchaser is expected to continue to remove small amounts of fire-killed and imminently dead timber in 2008.

Power Salvage Sale – This salvage sale permits the removal of downed trees only from 66 acres within sections of the right-of-way of the overhead power line in the Warm Lake Basin. This contract is projected to terminate in July of 2008.

South Fork Campground Restoration Project – While still in the developmental phase, the objective of this project would be to minimize the fire-induced effects of the 2007 wildfire on the 10 acre South Fork Campground by removing hazard trees, planting conifers, and implementing other restorative activities. The environmental analysis for this project is tentatively scheduled to occur in 2008 with implementation in 2009 or 2010.

Shoreline Fuels Reduction Project – This project consists of mechanical mulching of 32 acres of sub-merchantable trees and hand thinning and piling of 77 acres of sub-merchantable trees, all in the vicinity of the Shoreline Campground. Implementation is scheduled to occur in 2008.

Tyndall Stolle Reforestation Project – This project consists of planting conifers on an estimated 4,127 acres that burned at a high or moderate intensity where competing vegetation is expected and/or where no seed source is present to facilitate natural regeneration. Planting activities are projected to occur in the spring and fall of 2008 and 2009.

Miscellaneous Recreational Activities – Numerous recreation-related uses in the area, such as church camps, hunting, camping, firewood cutting, and sightseeing, are expected to continue in the future.

SFSR Travel Management Project - While still in the developmental phase, the objective of this project would be to minimize undesirable impacts associated with poorly located dispersed campsites and authorized and unauthorized roads and/or trails causing resource damage, as well as to address under-sized culverts, fish passage barriers, and/or structures damaged by the 2007 wildfire in the South Fork Salmon River drainage. The environmental analysis for this project is tentatively scheduled to occur in 2008 with implementation in 2009 or 2010.

Warm Lake Highway Reconstruction Project – The majority of this project was completed in the summer of 2007 and included repair and resurfacing of the Warm Lake Highway (FH22) from Big Creek Summit to its crossing of the South Fork Salmon River.

Road Use and Road Maintenance – In addition to the ongoing use associated with recreational activities, roads within the area would continue to receive routine maintenance and/or repair as priorities dictate and funding allows.

BAER Culvert Replacements – A number of culverts removed in the fall of 2007 as part of the Cascade Complex BAER project would be reinstalled in the summer of 2008.

Alternative A would have no direct or indirect effects on wetlands or floodplains within the analysis area, therefore no cumulative effects would occur (P.R., Vol. 11, Wetlands and Floodplains).

Alternatives B and C would have no direct or indirect effects on wetlands or floodplains within the analysis area. Therefore, regardless of the potential effects associated with ongoing or foreseeable future projects, these alternatives would not add incrementally to those effects (P.R., Vol. 11, Wetlands and Floodplains).

3.12 Fisheries

This section of the document discusses the existing characteristics of the fisheries and fish habitat, as well as the effects of the alternatives on those resources. The 103,804 acre project area lies within seven 6th field subwatersheds: Curtis Creek (170602081103), Dollar Creek (1702081004), Six-bit Creek (170602081003), Two-bit Roaring (HUC 170602081001), Tyndall Stolle (170602081101), Upper SFSR (170602081102), and Warm Lake Creek (HUC 170602081002). For the purposes of this analysis the seven 6th field subwatersheds in their entireties, totaling roughly 104,431 acres, were evaluated as separate analysis areas. As displayed in Figure 3-17, a portion of the Two-bit Roaring 6th field occurs outside of the 103,804 acre project area, with the remaining 6th fields located entirely within the project area.