Hydrology Resource Report
Kaniksu Complex Fire BAER Assessment
Colville & Idaho Panhandle National Forests
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By

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Wildfires result in increased runoff and sediment yield commensurate with burn severity. Burn Area Emergency Response (BAER) teams use burn severity to estimate runoff and sediment increases resulting from fires. These increases are calculated as adjusted design flow and sediment potential. Adjusted design flow is the flow increase expected to occur as a result of decreased infiltration and interception following a wildfire. Together with sediment potential values are utilized to evaluate the need to increase capacity for flow or drainage structures such as culverts and bridges. Values also provide an estimate of potential flooding to Forest Service values and near-by communities.

Objectives

1. Identify Values at Risk downstream and down slope from the high and moderate severity burn areas.
2. Assess watershed changes caused by the fire, particularly those that pose substantial threats to human life, property and critical natural and cultural resources.
3. Assess the potential for post-fire effects to downstream values at risk.

Initial Concerns

- Threats to human health and life within and downstream of the burned area.
- Threats to the structures, roads, trails, and other improvements within the burn area.
- Threats to roads, stream crossings, or other man-made developments or property that are downstream of the fire and are at risk of being removed or damaged from future storm events.
- Threats to water quality; Domestic uses downstream of fire such as Mill Creek and Upper West Branch Priest River

I. Resource Condition Assessment

A. Resource Setting

The Kaniksu Complex Fire burned approximately 25,933 acres (as of 11th October 2015). Three fires within the Kaniksu Complex are being assessed within this report: Tower Fire (24,702 ac), Grease Creek Fire (717 ac), and Baldy Fire (514 ac). The Tower Fire is Located 6 miles northeast of Usk, Wash., and 6 miles west of Priest Lake, Idaho on the Newport Ranger District, Colville National Forest and Priest Lake Ranger District, Idaho Panhandle National Forest. The Grease Creek Fire is located due east of Sullivan Lake on the Sullivan Lake Ranger District, Colville National Forest. The Baldy Fire is Located 6 miles north of Ione, Washington on the Sullivan Lake Ranger District, Colville National Forest. The Kaniksu Complex is within Pend Oreille County, Washington. The majority of the Tower fire perimeter includes areas within the Mill Creek, Brown's Lake, and Upper West Branch Priest River Drainages. The Grease Creek Fire burned in the headwater creeks of the Sullivan Creek drainage. The Baldy Fire burned the upper slopes between Cedar Creek and Jim Creek. Other ownerships within the fires is predominantly checkerboard with Washington State Department of Natural Resources administered lands, Stimson Lumber Company lands, Riley Creek Lumber Company, Priest River Land Company, and other private lands. Table 1 summarizes the acres burned by land ownership.

Table 1: Area Burned and Percent of Burned Area by Land Ownership

Land Ownership	*Acres*	*Percent of Burned Area*
Tower Fire Cause: Lightening Date: August 12, 2015		
USDA – Colville National Forest	5,473	22%
USDA – Idaho Panhandle National Forest	12,128	49%
Washington State Department Natural Resources	2,203	9%
Private	4,898	20%
Grease Creek Fire Cause: Lightening Date: August 14, 2015		
USDA -- Colville National Forest	717	100%
Private	0	0%
Baldy Fire Cause: Lightening Date: August 1, 2015		
USDA -- Colville National Forest	514	100%
Private	0	0%

The Kaniksu Complex Tower, Grease Creek, and Baldy Fires were ignited by lightning on August 12th, 14th, and 1st 2015 and overall containment 85% contained as of October 11th, 2015. The Grease Creek and Baldy fires burned primarily in continuous dense mixed conifer forest and heavy fuels. Fuel conditions in the Tower Fire area are variable, with checkerboard of older timber harvest units to the north and west and continuous dense mixed conifer and heavy fuels to the east.

The Tower Fire was primarily located on the slopes of North and South Baldy peaks within the Kaniksu range of the Selkirk Mountains in northeast Washington. The West Side of the range drains into the Pend Oreille River, tributary to the Columbia River. The East side of the range drains into Priest River, tributary to the Pend Oreille River in Idaho. Elevations range from about 2540' on the valley floor to 6170' on North Baldy peak. The underlying geology is a mix of glaciated belts; glaciated granitics and glacial outwash.

The weather of this region is unique in that it is consistent with both maritime and continental climates. The majority of the precipitation in this region comes in winter and spring in the form of snow. The rain-snow transition elevation varies from year-to-year due to annual climate variability. Some years can produce substantial snow deposition at low-to-mid elevations followed by a mid-winter warming trend resulting in rain-on-snow (ROS) events. The rapid melting of snow under ROS conditions can result in a sharp peak in stream flow. ROS events vary between basins as well as within a basin. Typically, the upper portions of drainages have deeper snow packs. It is common for lower elevation drainages to experience greater impacts from a ROS event due to increased runoff volumes.

At the Newport Ranger Station, which is located at an elevation of 2,142 feet, the annual average temperature is 45.3°F. Extreme precipitation events in a 24 hour period were recorded in Spokane, WA June 1964 and Deer Park, WA January 2006 with 2.07 in. and 2.01 in. respectively (WRCC, 2009).

Generally, winter storms tend to be of low intensity and long duration, and cover large areas at a time, allowing precipitation to percolate down through the soil profile and recharge aquifers (WRCC 2005). During most years, snow accumulation in the upper elevations as recorded at the Bunchgrass Meadows SNOTEL site over the last 10 years has ranged from 43" (2015) to 111" (2012). As winter turns to spring, snow storms turn to rain storms, increasing runoff, typically resulting in peak flows in March through May. These systems typically generate out of the Gulf of Alaska. Rain on snow events will occur when warm jet streams pick up warm air and moisture out of the pacific and come in from a more southerly route.

The Mill Creek and Upper West Branch Priest River drainages are popular snowmobiling areas with 55.9 miles of trails.

The Tower burn area includes 8 sub-watersheds, listed in Table 2. The majority of streams in the area are perennial in nature with several intermittent tributaries that are active only during snowmelt and high intensity, short-duration precipitation events. The steep nature of stream channels and alluvial drainage morphology within the Kaniksu Range Mountains can result in extreme debris torrents, particularly where roads are located on steep slopes, stream crossing structures are undersized and following intense precipitation events. These events cause severe erosion and deliver considerable amounts of coarse and fine sediment to the stream channels.

Table 2: 6th Level Subwatersheds within the Burn Area

Subwatershed # (HUC6#)	*Subwatershed Name (HUC6 Name)*	*% of Watershed Burned*
	Tower Fire	
170102160204	Cee Cee Ah Creek	29%
170102160301	Middle Creek-Pend Oreille River	35%
170102150401	Headwaters Upper West Branch Priest River	46%
170102150402	Goose Creek	13%
170102150602	Flat Creek-Lower West Branch Priest River	4%
170102150403	Mission Falls-Upper West Branch Priest River	1%
170102160202	Skookum Creek	2%
170102160303	East Branch Le Clerc Creek	<1%
	Grease Creek Fire	
170102160401	Harvey Creek	<2%
170102160401	Headwaters Sullivan Creek	<1%
	Baldy Fire	
170200011004	North Fork Deep Creek	<1%
170102160902	Sweet Creek-Pend Oreille River	<1%

*Subwatershed of less than 5% burned area are mentioned but were not analyzed. Watersheds with this low of a % of burned area are not expected to have runoff responses outside their natural range of variability.

Within these 6th-level subwatersheds, multiple catchments (smaller watersheds) were differentially affected by the fire. Catchments were delineated to evaluate the values-at-risk at a larger scale within each of these 6th-level subwatersheds or the watershed response at the Tower and Baldy fire perimeter (no pour points were delineated for Grease Creek fire). A pour point or drainage outlet was identified at the mouth of each of these catchments, and this point was utilized to delineate the drainage area above that point. Table 3 summarizes the pour points and names for each of those catchments by subwatershed:

Table 3A: Catchments for Tower Fire

Catchment Name	*Square Miles*	*% of Catchment Burned*
Solo Creek	4.5	71.4%
Mill Creek Upper	0.7	100%
Browns Lake Bay	0.2	100%
Mill Creek**	12.7	86.4%

Table 3B: Catchments for Baldy Fire

Catchment Name	*Square Miles*	*% of Catchment Burned*
Cedar Creek**	6.3	12%

** Indicates catchments greater than 5 square miles.

Note: Catchments or pour points were developed to assess local flooding and sedimentation impact to downstream water quality, Forest Service infrastructure, Critical habitat, and cultural sites.

Miles of stream type in the burn perimeter are developed from a National Hydrology Database GIS layer and listed in Table 4.

Table 4: Miles of perennial and intermittent streams within the Tower, Grease Creek, and Baldy Fires per the National Hydrology Database (NHD)

Fire	*Perennial (mi)*	*Intermittent (mi)*
Tower	35.6	134.9
Grease Creek	0.2	0.7
Baldy	0.2	0.5
Total	**36.0**	**136.1**

Most of the streams in the burn area are intermittent in nature. Some streams and their associated intermittent tributary sources display intermittent characteristics, i.e., they discharge water in the spring but dry up by mid to late summer.

B. Summary of Findings, On-the-Ground Survey

1. Identify Values at Risk

Table 5 identifies the values at risk in the primary watersheds (HUC 6) of the Kaniksu Fire Complex. The primary threat to the values at risk is flooding and in-channel sedimentation. Mobilization of woody debris and refuse within stream channels is an additional threat in areas of stream constriction where debris can build up with sediment and result in infrastructure damage or failures.

Table 5: Watershed Related Values at Risk in the watersheds of the Kaniksu Fire Complex [(a)]

6th-level Watersheds and Sub-watersheds	*Values at Risk from Flooding and Sedimentation*	*Comments*
Upper West Branch Priest River (6th-level):	***USFS values*** 1) Life and Property associated with NFS infrastructure such as FS Roads and Trails. Temporary impacts to water quality from ash and sediment. Degradation of natural and cultural resource sites. Spread of noxious weeds. Loss of soil and cover from the hill slope.	With the expected increases of sediment and runoff during large storms (post-fire) from the burned watersheds, channel sections in lower gradient stream reaches have the potential for debris deposition that could cause peak flows to overwhelm channels and flood adjacent areas and streamside terraces impacting infrastructure directly along the channel. Increased runoff and debris flows, rock and debris fall, and hazard trees could undermine or impair FS roads and trails. Increased deposition of hill slope material or scouring to the channel may result in changes to channel morphology, lowered water quality, and erosion of stream banks and associated riparian vegetation Loss of natural vegetative recovery, watershed integrity, and soil stability due to impacts from noxious weeds. Increased peak flows and sediment have the potential for failures to system infrastructure causing significant impacts to the Forest Service road system and recreational use within and between the Forests. (Roads 1090, 1137, 659 and 1089).
***Cee Cee Ah Creek (6th-level)*:**	***USFS values*** FS Road 5080. Temporary impacts to Browns Lake water quality from ash and sediment. Spread of noxious weeds. Loss of soil and cover from the hill slope.	With the expected increases of sediment and runoff during large storms (post-fire) from the burned watersheds, channel sections in lower gradient stream reaches have the potential to accumulate excess sediment and debris deposition that could cause peak flows to overwhelm channels and flood adjacent areas and streamside terraces impacting infrastructure directly along the channel. Increased runoff and debris flows, rock and debris fall, and hazard trees could

		undermine or impair FS roads and trails. Increased deposition of hill slope material or scouring to the channel may result in changes to channel morphology, lowered water quality, and erosion of stream banks and associated riparian vegetation. Loss of natural vegetative recovery, watershed integrity, and soil stability due to impacts from noxious weeds.
***Middle Creek (6th-level)*:**	*USFS values* FS Road 1200, 1920, and 1200-530. Temporary impacts to water quality from ash and sediment, affecting downstream water quality for domestic use). Spread of noxious weeds. Loss of soil and cover from the hill slope.	With the expected increases of sediment and runoff during large storms (post-fire) from the burned watersheds, channel sections in lower gradient stream reaches have the potential to accumulate excess sediment and debris deposition that could cause peak flows to overwhelm channels and flood adjacent areas and streamside terraces impacting infrastructure directly along the channel. Increased runoff and debris flows, rock and debris fall, and hazard trees could undermine or impair FS. Increased deposition of hill slope material or scouring to the channel may result in changes to channel morphology, lowered water quality, and erosion of stream banks and associated riparian vegetation. Loss of natural vegetative recovery, watershed integrity, and soil stability due to impacts from noxious weeds. Increased peak flows and sediment have the potential to overwhelm and jam infrastructure causing significant impacts to road system and recreation/commercial users.

(a) Note: For a more comprehensive list of the values at risk, see the appendix of the FS-2500-8, Burned-Area Report plus the individual specialists reports prepared to support this document. Values called out in Table 6 have varying range of risks. Further discussion of the emergency determination of each site can be found in the VARs table of the FS-2500-8.

II. Synopsis of Post –Fire Watershed Conditions of the Kaniksu Fire Complex

A limited Burned Area Reflectance Classification (BARC) image dated October 8, 2015 was acquired from the Forest Service Remote Sensing Applications Center. Based on comparisons with archived images, this image classifies the extent of the burned area into four categories: unburned, low severity burn, moderate severity burn, and high severity burn. BAER team members ground-truthed this image through field observations and observations made by helicopter for inaccessible areas. The BARC image was found to have a relatively high degree of accuracy across the fire.

The criteria for the soil burn severity map can be found in the Soil Scientists Specialist Report. On Friday and Monday, October 9th and 12th, BAER watershed team initiated a helicopter reconnaissance and mapped the burn severity on 1:24,000 scale topographic maps. The BAER Team Leader, Hydrologist Trainee, and Fisheries Trainee began the limited BAER watershed survey on October 9th by conducting an on-the-ground reconnaissance within the burn area.

Hydrophobicity tests were conducted to determine the water repellency characteristics of affected soils. An elevated hydrophobicity decreases infiltration and increases overland flow and erosion. Water was utilized

to evaluate hydrophobicity and thus infiltration rates. Soils in which a water drop infiltrated in less than 10 seconds were classified as low hydrophobicity, between 10 and 40 seconds was classified as moderate, and greater than 40 seconds was classified as high. These tests were used to further characterize the effect of the fire on post-fire hydrological response. See the Soils Scientists Specialist Report for hydrophobicity tests results.

The BAER Team assessment identified the overall soil burn severity for the Kaniksu Complex Tower Fire as 2% High, 18% Mod, 71% Low, and 9% Unburned; Baldy Fire as 8% High, 7% Mod, 59% Low, and 26% Unburned; Grease Creek Fire as 6% High, 6% Mod, 88% Low/Unburned. Watershed conditions in some of the burned watersheds in the Tower fire have changed significantly as a result of the fire. Vegetation and underlying organic matter slow runoff and protect soils from direct raindrop impact, assists with water infiltration to soil and releases runoff at slower rates. Consumption of organic material and high soil heating can promote the formation of water repellent layers, at or near the soil surface, which can result in significant amounts of soil loss. The strength and depth of water repellency varies greatly by the duration and intensity of soil heating, type of organic matter consumed by the wildfire, and soil texture and moisture content. A "buried" water repellent layer was observed beginning at the surface to as deep as 2 inches below the soil surface based on the burn intensity and duration driving the water repellent layer deeper into the soil where the gases cooled, condensed on soil particles and remained buried. As a result of the Kaniksu Complex Fire, the above described hydrologic function has been adversely affected and rates of runoff and sediment outputs are now expected to be significantly increased, particularly the first year after the fire.

Watershed Post-Fire Response

Post-fire conditions have been assessed to determine how fire-induced changes to hillslope hydrology and soil conditions will impact the values at risk. The results of a peak flow analysis show that pre-fire flows weighted by area were on average 23.73 cfs /mi^2 for a 10-year, 1-hour storm, and 292.1 cfs /mi^2 for post-fire flows. Table 6 summarizes these data along with other hydrologic design factors.

Table 4A: Tower Fire Hydrologic design factors

A. Estimated Vegetative Recovery Period	3-7 years
B. Design Chance of Success	80 %
C. Equivalent Design Recurrence Interval	10 years
D. Design Storm Duration	1 hours
E. Design Storm Magnitude	0.76 inches
F. Design Flow	23.73 cfs / mi^2
G. Estimated Reduction in Infiltration	20 %
H. Adjusted Design Flow	292 cfs / mi^2

Table 5B: Baldy Fire Hydrologic design factors

A. Estimated Vegetative Recovery Period	3-7 years
B. Design Chance of Success	90 %
C. Equivalent Design Recurrence Interval	10 years
D. Design Storm Duration	1 hours
E. Design Storm Magnitude	0.66 inches
F. Design Flow	15.8 cfs / mi^2
G. Estimated Reduction in Infiltration	15 %
H. Adjusted Design Flow	31 cfs / mi^2

Appendix A contains a detailed explanation of the runoff response from the Kaniksu Complex burn area. As previously mentioned, the post-fire flows could lead to plugged culverts, flow over road surfaces, rill and gully erosion of cut and fill slopes, erosion and deposition along road surfaces and relief ditches, loss of long-term soil productivity, and threats to human safety. Some sedimentation of the ephemeral and

intermittent channels is likely to occur at an accelerated rate until vegetation establishes itself and provides ground cover.

Due to the steepness of some drainages in the moderate and high burn severity, and the large areas now devoid of vegetation and groundcover after the fire, large runoff producing storms will likely create increased surface flow volumes and velocities that can transport available sediment from the slopes and along the channel bottoms.

The primary watershed responses of the Kaniksu Complex Fire are expected to include: 1) an initial flush of ash, 2) rill and gully erosion in drainages and on steep slopes within the burned area, 3) floods with increased peak flows and sediment deposition. These responses are expected to be greatest in initial storm events, and will become less evident as vegetation is reestablished, providing ground cover, increasing surface roughness, and stabilizing and improving the infiltration capacity of the soils.

Initial erosion of ash and surface soil during the first storm events will reduce slope roughness by filling depressions above rocks, logs, and remaining vegetation. The ability of the burned slopes to detain water and sediment will be reduced accordingly. This will increase the potential for floods and will increase the distance that eroded materials are transported. However, several factors favor a quick recovery in terms of normal hydrologic response of some hillslopes. The existence of fine roots in the low and moderate severity burn areas just below the surface will likely aid plant recovery and will serve as a seed source for natural vegetation recovery. The major concern for hydrologic recovery is development of ground cover and vegetative recovery in the limited high and extensive moderate severity burn areas.

Field observations of the slopes and drainages in the burned area show loose soil, rock and burned organic matter over large areas of the watersheds that will be available for transport when heavy rainfall occurs. In addition, on steep slopes large amounts of loose soils are presently moving off slopes as a result of gravity (dry ravel) and are accumulating within drainage channels, increasing the amount of transportable materials. The highest amounts of sediment yields from the burned watersheds are expected during the first several years after the fire.

An analysis of pre- and post-fire peak flows was completed by the BAER team. Peak flows on average are expected to be one to two times higher than normal where less than 50% of the sub-watershed burned at a moderate or high burn severity. Peak flows on average are expected to be three to five times higher than normal where more than 50% of the sub-watershed burned at a moderate or high burn severity. Regardless, the amounts of sediment and debris delivered to the lower depositional areas could be substantial.

With intense rainfall and the expected increases in runoff, the slope materials could easily move into drainages, accumulate and move downstream and increase exponentially further down the watershed. Along with sediment bulking, it is expected that burned wood and other organic materials in the watersheds will be entrained in the flows. If a sustained and intense runoff event occurs, it is likely sediment and debris bulked runoff may be substantial and large sediment/debris deposits could cause channel aggradation within the upper steep gradient reaches. If channel capacities are limited along these reaches due to channel constriction points or areas of dense in-channel vegetation and sediment deposits are large enough, peak flow runoff and debris may be able to overwhelm channel banks and flow outward onto forest system land, state, and private roadways. This may be more concentrated at the low water crossings and downstream areas possibly causing significant infrastructure damage and the potential threat to human life and safety.

Braided channels occur when a threshold level of sediment load or slope is reached. Geologically speaking, an increase in sediment load will over time decrease the slope of the channel. An increase in suspended sediment from the fire will allow for the deposition of erosion material on the inside of a curve, which accentuated the curve and in many instances caused a channel to shift. The channels and braid bars are usually highly mobile, with the systems layout often changing significantly during flood events. This change in the channel's location may cause impacts to features directly adjacent to or over the channel.

Within the major drainages, a few of the reaches have limited streamside vegetation. In lower burn severity; much of the existing vegetation that lined the channels is still intact. The limited vegetation will help to reduce floodwater energy and help to capture and slow sediment and debris during peak flow events. The channel bottoms are mostly comprised of sand with some large rocks and cobble. The cobble and large rocks should resist some channel scour and slow peak flows.

Image 1: Stream channel conditions along Browns Lake tributary on the Kaniksu Complex Fire with low to unburned burn severity in the channel.

Image 2: Kaniksu Complex Fire unnamed catchment drainage with high burn severity slopes. These areas as seen in the above photo and in similar areas of the other burned watersheds are typically subject to high precipitation rates and intensity during large storms that could trigger large volumes of sudden runoff.

III. Emergency Determination

1. Threats to Human Life, Property and Infrastructure

- Roads within and below the fire area that have low-water crossings may be flooded and covered in debris and could be a safety hazard to motorists and could restrict critical access to forest visitors and private landowners. Roads, culverts and bridge infrastructure could be damaged or destroyed. There is a possibility if flood water moves onto the roadways, flooding could occur preventing the ingress and egress of forest areas.

- Large peak flows and sediment/debris have the potential to flood across and/or through Forest Service infrastructure and private land adjacent to main drainages in the Kaniksu Complex fire which may cause a possible threat to property. Nuisance overland flooding may occur to infrastructure with burnt hill slopes above them.

- Trails and existing roads in the National Forest areas of the fire could be subject to excessive erosion and degradation during large runoff producing storm events with the possibility of sections of trail tread and roads being destroyed or made partially impassable. Travelers on trails and roads could be subject to injury or death during a large storm event from flooding, hazard trees, or rock fall.

The above threats will be the most acute during the first few years of post-fire rain season from early March through end of August with a lower level of hazard during the following years until burn areas experience new vegetative growth and become more stabilized. Research indicates that the post-fire watershed threat normally is reduced measurably after seven to ten years with favorable precipitation.

2. Threats to Water Quality

Surface waters in the fire area will be bulked by ash, debris and other floatable and transportable material during storm events. It is likely that stream flows from the post-fire runoff producing rain events will see high concentrations of ash and fine sediment that will cause considerable turbidity and degradation of water quality and the beneficial uses of water. Beneficial uses of water are identified and protected by the CWA (The Federal Water Pollution Control Act, 1972-Clean Water Act). Beneficial uses are: municipal water supply, agriculture, groundwater re-charge, contact and non-contact recreation, wildlife habitat, warm and cold water aquatic habitat, wetland habitat, rare species habitat, and spawning.

Water Quality

- The most noticeable effects on water quality will be increased sediment and ash from the burned area into the Mill Creek (CNF), Browns Lake (CNF), and likely Solo Creek (IPNF). During storm events, this will increase turbidity and contribute to pool filling and channel scouring.

The above threats will be the most acute during the first post-fire rain season from early March through end of August with a lower level of hazard during the following winter seasons until burn areas experience new vegetative growth and become more stabilized. Research indicates that the post-fire watershed threat normally is reduced significantly after seven to ten years with favorable precipitation.

IV. Treatments to Mitigate the Emergency

1) Treatment Type – The primary treatment recommended for implementation in the Tower Fire is Culvert removals at Mill Creek crossing of 1920 CCA road and culvert storm proofing on CNF FS roads 5080, 1920-306, and IPNF roads 312, 659, 1089, 1090, and 1137.

Treatment Objective:

i) The treatment objectives focus on the potential runoff into 1st-order and larger channels. This will lessen the overall threat to downstream life and property from increased flows.
ii) If additional point source protection occurs in the burn areas as well, a decrease in flows and sediment can be expected.

This treatment's primary benefit is for the protection of life, FS employees and visitors, with secondary benefits to protect FS infrastructure and natural and cultural resources.

2) Treatment Type – Administrative Closure for those areas determined to qualify as needing Emergency Closure intended to prevent human access, activities, and/or occupancy during the burn area recovery period.

a) Treatment Objective:
   i) Develop an Emergency Closure Plan with established trigger points to determine if and when a facility/burn area needs to be closed and for what duration.
   ii) Recommended Closure Sites:
      (1) FS Roads
      (2) FS Trails

This treatment's primary benefit is for the protection of life, FS employees and visitors, with secondary benefits to protect FS infrastructure and natural and cultural resources. See the BAER Recreation and Engineering Report for a further and more detailed description.

b) Treatment Description: The prescribed treatment is developing an Emergency Closure Plan. This could include: gates and closure/warning signs should be placed at trailheads, campgrounds, picnic areas, trail, and road locations adjacent and within the fire perimeter. Site specific location such as Forest roads and trails need to be evaluated annually, to prioritize areas identified as possibly requiring extended closure. The closures should be accomplished by gate closures and informing the public at strategic locations of access points outside and within the fire perimeter which will effectively close off the burn area and associated sites.

Discussion/Summary/Recommendations

Wildfires result in increased runoff and sediment yield commensurate with soil burn severity. Due to the steepness of these drainages, the amount of moderate and high burn severity, and the large areas now devoid of vegetation and groundcover after the fire, large runoff producing storms will likely create increased surface flow volumes and that can transport available sediment from the slopes and along the channel bottoms.

Those areas that have the highest potential for flooding and potential for road failures resulting from the fire are identified in Appendix A. Forest Service values at risk associated with increases in water yield include FS roads 1920, 1920-306, 5080, 312, 659, 1089, 1090, 1137. Treatments identified to ameliorate fire effects include improving FS road drainages throughout the burn area. Details on the potential treatments to NFS lands may be found in Appendix A and the 2500-8 BAER Report for the Kaniksu Complex Fire.

Recommended Monitoring

IMPLEMENTATION MONITORING: The purpose of implementation monitoring is to determine if the treatments were conducted as prescribed. Implementation monitoring is part of, and except as noted, is included in the costs of conducting the specific treatments. Project inspectors will evaluate land treatments during implementation to assure contract specifications are being met.

TREATMENT EFFECTIVENESS MONITORING: This monitoring is specifically designed to answer the question: Did the BAER treatments provide the planned protection and stabilization of the burned area? Have the objectives of the treatments been met and if not, why? The purpose is NOT to prove, for example, that increased ground cover reduces erosion; rather, it is to see if the ground cover improvement treatment that was implemented increased ground cover as desired. This monitoring will be needed if a storm event occurs to "test" the treatment.

Consultation

Personal Communication with Katherine Rowden from the National Weather Service, National Oceanic and Atmospheric Administration (NOAA) Spokane, WA Office. Contact information (509)-244-0427.

Personal Communication with Dan Scaife and Tim Price, Tower Fire Lead READs, Idaho Panhandle National Forests.

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