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Hydrology Report

Westside Fire Recovery Project

Klamath National Forest
Siskiyou County, California

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Executive Summary

Water Quality

This section compares potential impacts and benefits to hydrologic function and water quality of project alternatives. Results of the analysis are used to verify that project alternatives adhere to existing law, regulation, and policy such as the Clean Water Act (specified by Total Maximum Daily Load requirements for the Klamath, Salmon, and Scott Rivers) and Forest Plan requirements including those related to the Aquatic Conservation Strategy. See Aquatic Conservation Report in project record.

Methodology

The effects of project alternatives on hydrologic function and water quality are analyzed based on existing Forest ecosystem analysis documents, recent watershed field surveys, and Geographic Information System (GIS) reports and modeling. Ongoing stream channel monitoring to meet North Coast Region Water Quality Control Board (Water Board) waiver requirements, and field surveys during and after the 2014 fires provided current data. Data were synthesized to define existing watershed conditions for comparison with Total Maximum Daily Load requirements for the Klamath, Salmon, and Scott Rivers, Aquatic Conservation Strategy objectives and desired watershed conditions from the Forest Plan. See Aquatic Conservation Report in project record.

The Forest uses standardized Cumulative Watershed Effects (CWE) models (Equivalent Roaded Area, Universal Soil Loss Equation, and mass-wasting) to assess effects of past, present, and reasonably foreseeable activities as described further in the body of the Hydrology resource report and relevant supporting references. Cumulative watershed effects models were used to index watershed disturbance (Equivalent Roaded Acres – ERA), evaluate the effects of soil erosion (Universal Soil Loss Equation – USLE) and evaluate the potential for mass-wasting (landsliding).

Models were updated to incorporate effects of the 2014 fires and road improvements identified in BAER assessments. The updates provide a picture of post-fire watershed conditions. The potentially ground-disturbing activities and events that are included in the CWE modeling for both US Forest Service lands and private lands in the project area are:

- Vegetation removal (timber harvest, thinning, fuels reduction);
- Roads used for temporary access;
- Log landing construction and enlargement;
- Effects of wildfires and suppression efforts (including fire lines);
- Prescribed burning;
- Road improvements (outsloping, rocking and crossing upgrades) (results shown as negative numbers); and
- Road decommissioning (results shown as negative numbers).

Ground-disturbing activities are assigned coefficients of disturbance in the Equivalent Roaded Area (ERA) model to represent the disturbance created by a road segment of equal size in area (Haskins 1986). Effects from vegetation management, wildfire, and prescribed fire show

naturally reduced disturbance over time for all three models (ERA, universal soil loss equation (USLE) and mass-wasting (GEO)). Recovery curves are displayed in figures 1, 2 and 3 for the three models. Sediment yield (cubic yards/acre/year) estimated by the USLE occurs in the first winter season, requires a 2-year, 6-hour storm, and recovers to background rates within seven years (USDA Forest Service 2004). Sediment yield (cubic yards/acre/decade) estimated by the mass-wasting model depends on a ten-year storm event, and yield recovers to background rates in 50 years (USDA Forest Service 2004). The models make assumptions regarding the rates of recovery for the processes represented by the models. As site re-vegetation provides increased interception, evapotranspiration, ground cover, and mechanical strength, the effects of ground disturbing activities lessen (see figures 3-1, 3-2 and 3-3). Road and landing areas do not recover naturally over time; however, their coefficients of disturbance can be reduced if the areas are improved by decommissioning, outsloping, rocking, or crossing upgrades.

Model results fall on a continuum. The models are indexed using a "risk ratio." The threshold of concern for the risk ratio for both models is 1.0. The threshold of concern does not represent the exact point at which adverse cumulative effects will occur. Rather it serves as a "yellow flag" indicating increasing susceptibility for adverse effects to beneficial uses in a watershed (Bell 2012).

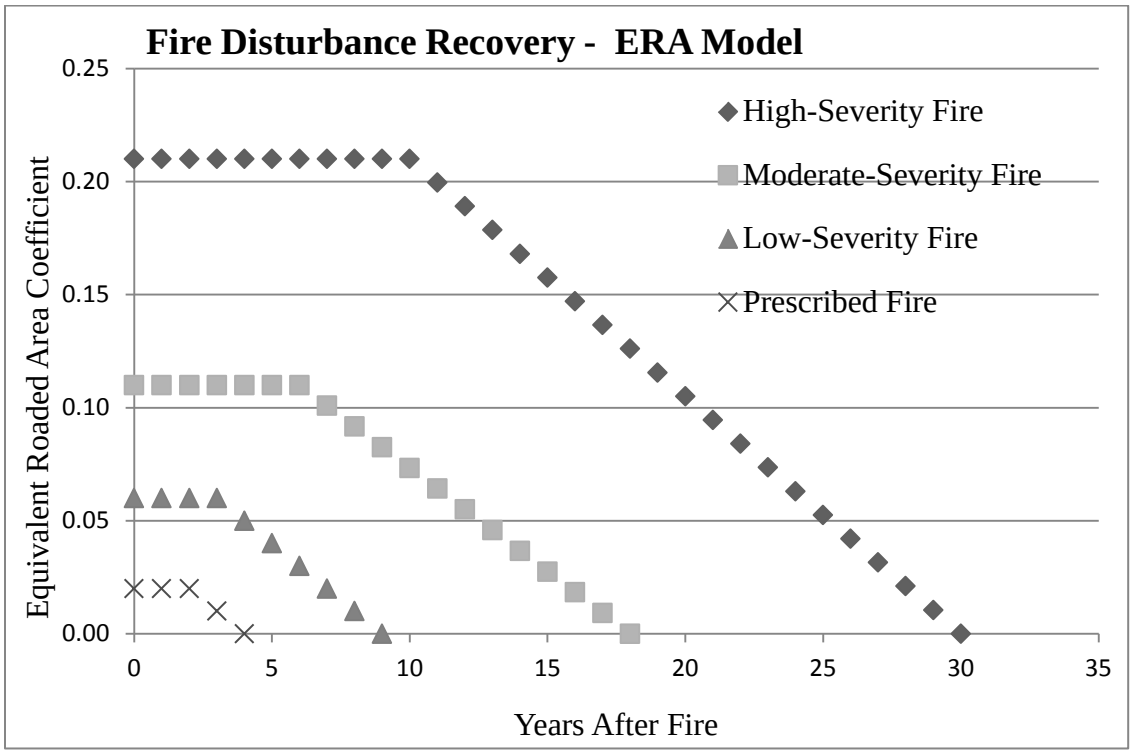

Figure 3-1: Fire disturbance recovery curves for the Forest cumulative watershed effects ERA model

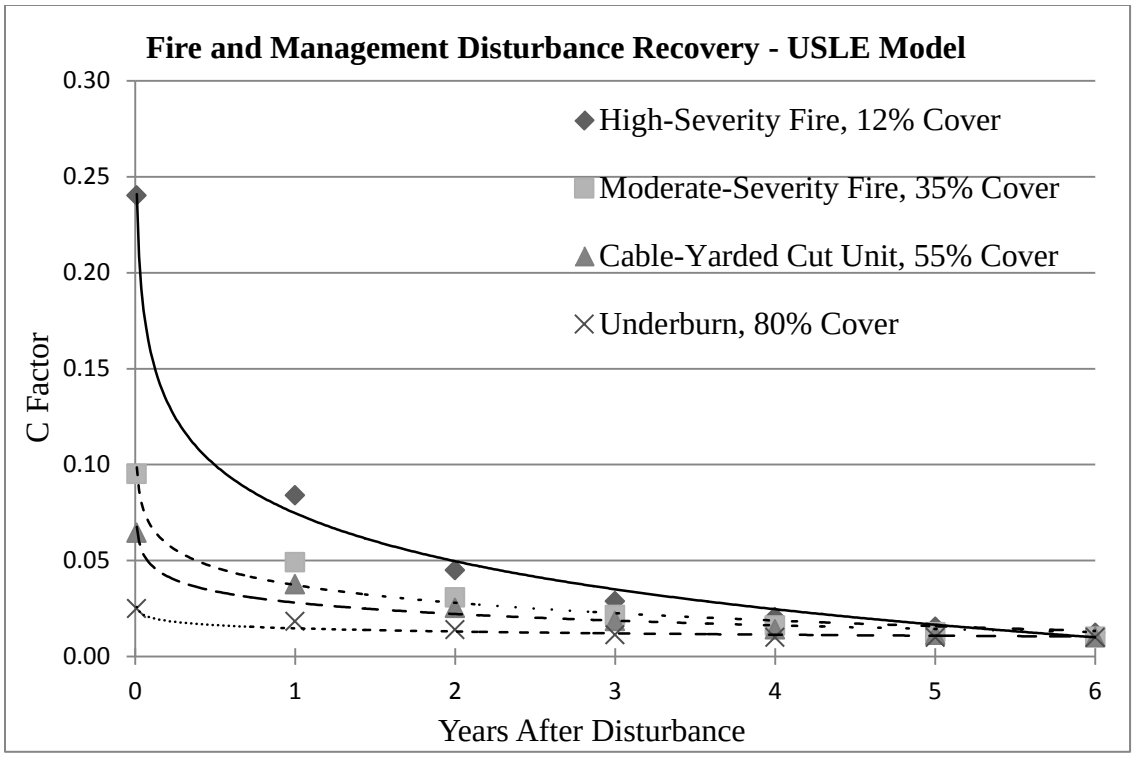

Figure 3-2: Fire and vegetation management recovery curves for the Forest cumulative watershed effects USLE model

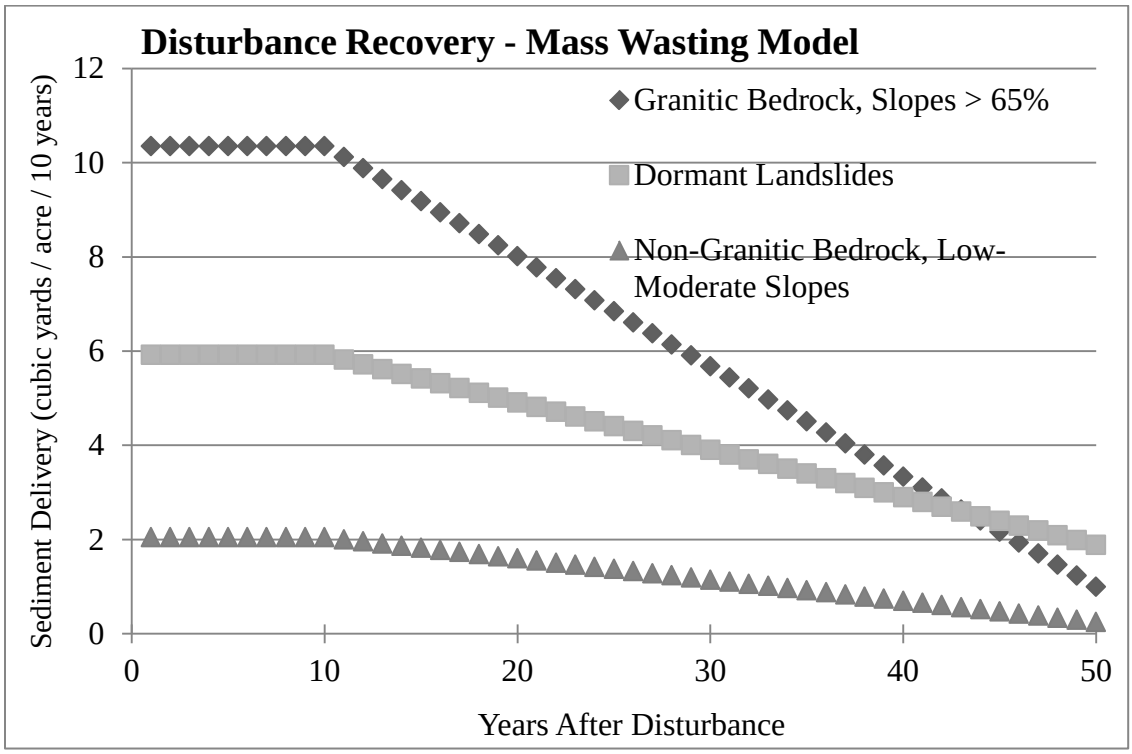

Figure 3-3: Recovery curves for the Forest cumulative watershed effects mass-wasting model

Analysis Indicators

Analysis indicators are chosen to be responsive to Total Maximum Daily Load (Clean Water Act) requirements and the Forest Plan (including Aquatic Conservation Strategy objectives), and to demonstrate potential differences between project alternatives with respect to hydrologic function and water quality.

Risk to Channel Morphology

The risk to channel morphology is analyzed using the ERA model. Watersheds with risk ratios of less than 1.0 are considered to have a low risk to channel morphology. Watersheds with risk ratios of between 1.0 and 1.5 have a moderate risk and watersheds with greater than 1.5 risk ratios have a high risk.

A low risk to channel morphology means that there is not likely to be a measurable change to peak flows and the channel bed, banks and floodplain will undergo natural modifications that are proportional to the storm events. A moderate risk indicates that peak flows may be artificially increased by the actions taken. The increased peak flow is likely to leave the channel susceptible to modifications that are slightly more than would occur under natural conditions. The perturbation of the geomorphic processes would be over the short term (about two to four years). A high risk to channel morphology means that the increase in peak flows would lead to undesirable changes (such as channel straightening and loss of coarse wood) that would require long-term recovery (greater than ten years).

Risk of Sediment Regime Alteration

The risk to water quality from sediment regime alteration is evaluated using the USLE and the mass-wasting model as described in the methodology section. Watersheds with a risk ratio for both models of less than 1.0 have a low risk of sediment regime alteration. Watersheds with at least the risk ratio between 1.0 and 1.5 of just one of the models have a moderate risk of sediment regime alteration. Watersheds with one model with risk ratios of greater than 1.5 and one greater than 1.0 have a high risk of sediment regime alteration.

A low risk means that water quality may be affected but the beneficial uses in the watershed are still occurring with nuisance interruptions in the natural processes. A moderate risk means that water quality is being affected and there are minor, short-term (2-4 years) interruptions to beneficial uses in the watershed. A high risk means that water quality is being affected on the long-term (greater than 10 years) and beneficial uses may be impaired. The effects of repairing or not repairing legacy sediment sites on the risk of erosion and sedimentation are also analyzed.

Risk of Temperature Regime Alteration

The risk to water quality from temperature regime alteration is assessed by analyzing effects to shade in Riparian Reserves. Vegetation burn severity data are used to assess effects of the 2014 fires on vegetation and related reduced shade as a baseline for the analysis of project activities. Riparian areas subject to moderate and high vegetation burn severity provide reduced shade relative to pre-fire conditions; shade protects water temperatures from solar insolation and warming. The effects of the project on shade are estimated by intersecting the treatment areas likely to remove live vegetation with Riparian Reserves. These areas are assumed to have the potential for shade loss. Shade will not be lost over much of the treatment area because the

treatments focus on removal of only dead or small live trees. However, large live trees may be felled for safety. So the areas are considered to have the potential to loss stream shading. The landslide likelihood as assessed in the geology report is also used as a proxy for vegetation loss. Landslides can trigger debris flows which have been shown to remove vegetation along stream channels. Watersheds with less than 20% of the live vegetation affected by the fire or treatments in the project in the Riparian Reserves have a low risk of temperature regime alterations. Watersheds with between 20-50% live vegetation affected or a highly likely landslide likelihood have a moderate risk of temperature regime alteration. Watersheds with more than 50% of the live vegetation affected or an almost certain landslide likelihood have a high risk of temperature regime alterations.

A low risk means that the stream temperatures will remain within the range of natural variability. A moderate risk means that the stream temperatures will be affected on the short-term until shrubs and hardwoods re-sprout in the Riparian Reserve. A high risk means that the temperature will be measurably affected and it will take more than 10 years to recover.

Trend of Riparian Function

The trend of Riparian Function is analyzed at the project scale. It is intended to give an overall look at how the Riparian Reserves are functioning and whether the function is improving (positive trend), declining (negative trend) or staying the same (neutral trend). The information from the indicators above is used to determine the magnitude and direction of the trend.

Spatial and Temporal Context

The spatial context for the hydrologic analysis is the project area that includes portions of the following eight 5th field watersheds: Beaver Creek; Humbug Creek-Klamath River; Horse Creek-Klamath River; Seiad Creek-Klamath River; Lower Scott River; Thompson Creek-Klamath River; Elk Creek; and North Fork Salmon River. The 5th field watersheds are the analysis area for *broad scale* effects analysis. The 7th field watersheds are considered *small scale* for a project area of this size. There are seventy-five 7th field watersheds that intersect portions of the three fire-related areas (Happy Camp Complex, Beaver, and Whites fires). In addition to the analysis of broad- and small-scale watersheds, the effects of proposed new infrastructure are analyzed. Effects to water quality of proposed temporary roads, stream crossings, and landings are assessed. The long-term temporal bounding for this analysis is up to 10 years because recovery of the fire-disturbed hydrologic function (from ERA modeling) and surface erosion (from USLE modeling) is appreciable in the first decade. The short-term is between 2 and 4 years after implementation.

Affected Environment

The analysis of the affected environment includes the Eddy Late Successional Reserve, Elk Thin, Fish Meadows, Glassups Timber Sale, Happy Camp Fire Protection Phase 2, Johnny O'Neil Late Successional Reserve Habitat Restoration and Fuels Reduction, Lake Mountain Foxtail Pine, Lower Scott Roads, North Fork Roads Storm-proofing, Oak Flat Thin, Singleton, Thom Seider Vegetation Management and Fuels Reduction, and Two Bit Vegetation Management projects, as well as the work done under the Burned Area Emergency Response, grazing allotments, Timber Harvest Plans since 2005, and private land salvage (under Emergency Timber Harvest Plans). These are on-going activities and the CWE model includes them in the "current" portion of the

results. To remain consistent, all of these projects are included in the analysis of the affected environment, which represents the effects of the past and on-going actions.

General information on the affected environment for the project is provided in chapter 1. Watershed hydrology is characterized by dry summer and fall months followed by significant winter precipitation. Morphology and function of the steep stream channels is controlled by large floods such as those in 1997, 1974, 1964, and 1955 (Stewart and LaMarche 1967; de la Fuente and Elder 1998), and associated landslides and debris flows. Riparian vegetation is primarily hardwood (an example is shown in figure 4) although valley bottom mixed-conifer vegetation with large Douglas-fir trees was historically significant (Mondry 2004). While significant portions of the Walker Creek watershed burned at moderate and high severity in 2014, the main-stem valley bottom was mostly unburned. The steep main stem channel (≥ 3%) and predominantly even-aged hardwood riparian forest is typical of lower-gradient streams in the analysis area. This reach was surveyed and monitored by the USDA Forest Service Redwood Sciences Lab after significant disturbance from the 1997 flood.

Figure 3-4 : Walker Creek in the Happy Camp Complex Fire area (Photo by Zack Mondry 11/15/14).

Effects of the 2014 wildfires on existing conditions in the project area are greatest where forested areas burned with continuous high severity (see figure 3-5 for an example). Post-fire sediment has already been delivered to project areas streams such as Elk and Grider creeks during winter 2014-2015 storms (B. Miller, Klamath National Forest, written communication).

Figure 3-5: Effects of high-severity fire on a forested hillslope in Whites Gulch (Photo by Zack Mondry 11/26/14).

The current risk to channel morphology by 7th field watershed is displayed in the appendices of the hydrology report. There are sixty-three watersheds with a low risk and nine watersheds with a moderate risk. Doggett and Kohl Creek are the only two watersheds with a currently high risk to channel morphology. Their elevated risk is a result of the effects of the 2014 wildfire.

Currently there are five 7th field watersheds with a high risk of sediment regime alteration. These are Soda Creek-Beaver Creek, Lower West Fork Beaver Creek, Doggett Creek, McKinney Creek and Kohl Creek. All of the watersheds, except McKinney Creek, have elevated risks due to the effects of the 2014 wildfires. McKinney Creek has an elevated risk because of the current private land timber harvest activities. There are eighteen watersheds with moderate risks and 51 watersheds with a low risk of sediment regime alteration.

One cause of impairment to water and hydrologic function is legacy sediment sites from past management including historic mining, road building, and silviculture (Water Board 2010, Water Board 2005). A majority of the legacy sediment sites are associated with the road system, most of which was constructed prior to modern best management practices (BMPs). Culverts were commonly designed to pass a 25-year flood rather than the 100-year flood required by current road standards. Road construction often did not avoid unstable slopes or riparian areas that are protected by today's BMPs. As a result of these construction practices, some of the current road system is not resilient to natural disturbance by fire and floods. Some of the impact to water quality from the 1997 floods occurred when landslides and debris flows removed riparian vegetation, reduced stream shade, and increased water temperatures (De La Fuente and Elder 1998, Water Board 2010). The Total Maximum Daily Load requirements for the Klamath, Scott, and Salmon Rivers were developed to insure that road stream crossings withstand a 100-year flood without diverting or failing.

The Forest has completed legacy sediment site inventories for most roads on the Forest (USDA Forest Service 2012). The results of the analysis by 7th field watershed are in the appendices of

the Hydrology resource report. A total of 953 legacy sediment sites were inventoried within the project boundary. The legacy sediment sites are associated with undersized culverts, stream diversion potential at road crossings, or roads located on unstable slopes. More detailed information on legacy sediment sites is provided in the Hydrology resource report.

There are currently eight watersheds with high risk of temperature regime alteration. These are Buckhorn Gulch-Beaver Creek, Kohl Creek, Lower Grider Creek, O'Neil Creek, Walker Creek, Caroline Creek, Granite Creek and Middle Elk Creek. All of these watersheds have elevated risk due to the 2014 wildfires. There are twenty-one and forty-five watersheds with a moderate and low risk respectively.

The trend of riparian function is currently a slowly climbing positive trend. The fire-killed trees will start to fall and add coarse wood to the riparian reserves which will create channel complexity. The increased landslide risk will both move coarse wood to the 3rd to 5th order streams but may also remove riparian vegetation that provides shade. The shade producing vegetation on small streams (including shrubs and hardwoods) recovers quickly; the shade on larger streams (large conifers required) will take longer to regenerate.

Environmental Consequences

Alternative 1

Direct Effects and Indirect Effects

There are no direct effects to channel morphology, water quality (sediment and temperature regimes), or channel function resulting from alternative 1. Recovery curves can be viewed as a timeline of the magnitude and duration of indirect effects on hydrologic function and hillslope sediment production of the 2014 wildfires and alternative 1.

Over the long-term, the fuel load conditions will lead to fire intensity and flame lengths that are conducive to major fire runs, crown fires, and spotting. The large fuels component (greater than 3 inches) will lead to an elevated fire intensity and duration of fire on the landscape if it should re-burn. In 10 years, the conditions under alternative 1 will lead to nine percent of the area having flame lengths greater than 11 feet. Sixty percent of the treatment area is likely to experience flame lengths between 4 and 11 feet and thirty-one percent is likely to have flame lengths of less than 4 feet. (See fire and fuels report). High flame lengths are associate with high severity fire and will contribute to accelerated sediment delivery(DeBano et al. 2005), increased stream temperatures (Pabst and Spies 2001)and stream flows (Neary, et al. 2005a)and increased potential for the introduction of toxic chemicals from fire retardant application during future fire suppression efforts(Neary, et al. 2005b).

Risk to Channel Morphology

Alternative 1 will allow for passive recovery of vegetation in the watersheds which will be slower than if treatment, including planting, would occur. The extended duration of decreased interception, use of water by plants, and ground cover will extend the risk to channel morphology over the long-term.

Risk of Sediment Regime Alteration

In the longer-term, legacy sediment sites will continue to have a high risk of failing in future floods and impacts will be similar to the channel scour, loss of stream shade, increased stream temperatures, and sedimentation that occurred in the 1997 flood as described by De La Fuente and Elder (1998). These impacts will adversely affect beneficial uses and violate the Waiver and water quality standards in the Basin Plan (State of California Water Board 2011). The risk of road failures is greater at sites located below high-severity burns due to increased runoff and peak flows.

The risk to sediment regime alteration will passively recover from current condition toward pre-fire conditions over the next four to five years for surface erosion. The recovery for landslide-related sediment will start in about 10 years and could take up to 80 years to be reduced to pre-fire levels because of the length of time required to re-establish forest vegetation without artificial regeneration (see Geology report).

Risk of Temperature Regime Alteration

The watersheds with a high risk of temperature regime alterations, without artificial regeneration, will have an extended duration of elevated risk. Natural regeneration will occur, but in general it will more than 80 years to get trees with 10 inch diameters at breast height in areas burned with high and moderate severity (personal communication, Project Silviculturist).

Trend of Riparian Function

Large-wood loading to riparian zones and stream channels that is expected to occur under this alternative is widely regarded as beneficial for sediment retention, channel function, habitat complexity, cover, and nutrient cycling (Keller and Swanson 1979; Nakamura and Swanson 1994; Grant and Swanson 1995). Given the relatively small acreage of Riparian Reserve that burned at moderate- and high-severity in 2014, and the small length of stream channels affected, negative fire effects are not expected to channel function resulting from burned Riparian Reserve areas. Where fire impacts increase large wood loading to stream channels, effects will be positive for channel sediment metering and other functions. However, the elevated likelihood of landsliding (see geology report) will take more than 80 years to recover under alternative 1. Debris flows can have substantial effects on channel function. The overall trend of riparian function is positive but has a gentle slope (long-term recovery).

Cumulative Effects

The projects added to the effects of the past actions (the affected environment) and the direct and indirect effects of the project are portions of the Jess project, Salmon Reforestation, Scott Bar Underburn, Lovers Canyon, McCollins and Sawyers Bar Fuels Reduction Project that are in the 7th field watersheds analyzed. The Jess project and Lovers Canyon project are the only two future projects that have any effect on risk ratios or number of watersheds with high or moderate disturbance.

Risk to Channel Morphology

One watershed, Jessups Gulch, moves from a low risk to a moderate risk. The cumulative elevation in risk is a result of the Jess project. These effects will be mitigated via project design features but the risk will likely remain moderate. All other watersheds remain the same as in the affected environment. Cumulatively the number of watersheds with a low risk to channel

morphology is sixty-two. The number of watersheds with a moderate risk goes from nine to ten and high risk remains at two.

Risk of Sediment Regime Alteration

There is no change in any of the risk categories for any of the 7th field watershed. The risk ratios increase by an average of 0.02 which results in no change of average risk ratio when reported to a single decimal place. The largest increase was in Jessups Gulch where the USLE and mass-wasting risk ratios increase by a value of 0.2 due to the effects of the Jess project. The risk of sediment regime alterations for Jessups Gulch remains low when cumulative effects are considered.

Risk of Temperature Regime Alteration

The cumulative effects for risk to temperature regime alterations made the assumption that there would be no loss of shade on streams from Forest Service projects because of the Total Maximum Daily Load requirements. It was assumed that there is a loss of shade for all private land harvests including private land salvage of 2014 fire areas. There is no change in the risk levels for any of the watersheds as a result of adding the actions considered in this portion of the analysis to the project effects. There were increases in the percent of the Riparian Reserves with the potential to lose shade, but none of the changes were large enough to increase the risk category.

Trend of Riparian Function

Riparian Reserve function will continue on a slow, positive trend. There may be a slight downward dip in riparian function in watersheds with private land harvest due to the loss of shade in the stream channels. This will be a short-term cumulative effect on the smaller streams as shrubs and hardwoods can provide shade, however on the main stems the downward trend will be more long-term until large conifers are shading the stream again.

Alternative 2

Direct Effects and Indirect Effects

The fire severity will remain low for 10 years post-treatment for all areas treated in the alternative. If the area should re-burn during this time, the risk to water quality will be small and short-term.

Risk to Channel Morphology

There will be sixty-three 7th field watersheds that will continue to have a low risk to channel morphology, nine watersheds that will continue to have a moderate risk, and two with a high risk. Alternative 2 proposes construction or reconstruction of temporary roads, installation and removal of stream crossings, and construction of log landings in Riparian Reserves. While effects of these activities on channel morphology is minor to undetectable at the watershed scale, site-scale effects are anticipated from some infrastructure. These temporary road actions include 14 stream crossings (four of perennial streams and 10 of intermittent streams). Temporary stream crossings will likely have short duration effects to water quality due to sediment production during in-channel actions and in the first winter after use; they will likely be small-scale and limited to the immediate downstream channel reach, depending on flow regime and channel morphology. Further detail on site-scale effects is provided in the Hydrology and Aquatic

resources reports. The project design features (table 2-35 in chapter 2) are not accounted for in the modeling and are intended mitigate effects including surface runoff from temporary roads and landings which can exacerbate peak flows.

Risk of Sediment Regime Alteration

The effects of alternative 2 do not change the risk categories for any watershed compared to alternative 1. The USLE model increases for nine watersheds and the mass-wasting model increase for seventeen watersheds. The risk ratio increase is less than 0.2 in all cases. The changes in the risk ratios are not enough to change the risk category for any of the watersheds. The treatment of legacy sites in the Elk Creek 6th field watershed will reduce the chronic sediment delivery to stream channels. Site-scale alteration of the sediment regime is anticipated in some cases as described in the Hydrology and Aquatic resources reports.

Risk of Temperature Regime Alteration

The effects to risk of temperature regime alterations assumed that the only action that would remove shade on streams would be roadside hazard treatments. There is no treatment in the Riparian Reserves in the salvage units and site preparation and fuels treatments are only removing dead vegetation. The indirect effect of alternative 2 leads to nine watersheds having high risk, one more than alternative 1. Robinson Gulch moved from moderate risk under alternative 1 to high risk for alternative 2. There are also ten watersheds that move from a low risk under alternative 1 to a moderate risk under alternative 2. These are Miller Gulch-Klamath River, Upper Grider Creek, Tom Martin Creek, Horse Creek-Klamath River, Headwaters of Elk Creek, Upper Elk Creek, Lower East Fork Elk Creek, Hoop & Devil, Lower South Russian Creek and Big Creek. The numbers of watersheds with low and moderate risk are 35 and 30, respectively.

Trend of Riparian Function

The Riparian Reserve function will have a positive trend. The trend will be for a little faster recovery due to planting of burned stands in Riparian Reserves that will increase the speed of reforestation. There is limited removal of large trees from the Riparian Reserves so coarse wood is not likely to be measurably reduced on the watershed scale. The landslide likelihood remains the same as for alternative 1. However, the duration of the elevated risk is reduced for some of the most at risk watersheds (see Geology report).

Cumulative Effects

Risk to Channel Morphology

The actions considered for cumulative effects are the same as for alternative 1. The cumulative effect on risk to channel morphology is that Jessups Gulch will move from a low risk to a high risk. These effects will be mitigated via project design features but the risk will likely remain moderate. All other watersheds remain at the same risk level as for the indirect effects of alternative 2.

Risk of Sediment Regime Alteration

Thirteen of the watersheds had an increase in the risk ratio for USLE and three for the mass-wasting model as a result of future foreseeable actions but no increase was large enough to change a risk category. The largest increase in USLE risk ratio was in Jessups Gulch (0.2). The

largest increase in the mass-wasting risk ratio was also in Jessups Gulch (0.2). The risk ratio is reduced due to the legacy site treatments in seven and six watersheds for the USLE and mass-wasting model, respectively.

Risk of Temperature Regime Alteration

The actions considered in cumulative effects increased the shade loss potential for 19 watersheds. Big Ferry-Swanson has an increase in percentage of the watershed with shade loss potential of 12.4%, Quigley's Cove has an increase of 8.6%, Doggett Creek of 7.6% and Dutch Creek of 6.7%. The other watersheds have increases of less than 3%. These increases are not enough to move any of the watersheds into another risk category.

Trend of Riparian Function

The trend of the Riparian Reserve function will remain positive. There may be a slight downward dip in riparian function in watersheds with private land harvest due to the loss of shade in the stream channels. This will be a short-term cumulative effect on the smaller streams as shrubs and hardwoods can provide shade, however along main stems, the downward trend will be longer-term until large conifers are shading streams again.

Alternative 3

Direct Effects and Indirect Effects

The fire severity will remain low for 10 years post-treatment for all areas treated in the alternative. If the area should re-burn during this time, the risk to water quality will be small and short-term.

Risk to Channel Morphology

The risk to channel morphology for all watersheds for alternative 3 is the same as for alternative 2.

Risk of Sediment Regime Alteration

The risk of sediment regime alterations is the same as for alternative 2. The mass-wasting risk ratios for eight watersheds were reduced slightly but not enough to change the risk categories for any of the watersheds. Site-scale alteration of the sediment regime is anticipated in some cases as described in the Hydrology and Aquatic resources reports.

Risk of Temperature Regime Alteration

The risk of temperature regime alterations is the same as for alternative 2.

Trend of Riparian Function

The trend of riparian function is the same as for alternative 2.

Cumulative Effects

Risk to Channel Morphology

The cumulative effects for risk to channel geomorphology for all watersheds for alternative 3 are the same as for alternative 2. The increases to the risk ratios from actions considered for cumulative effects are the same as for alternative 2.

Risk of Sediment Regime Alteration

The cumulative effects for risk of sediment regime alteration for all watersheds for alternative 3 are the same as for alternative 2. The increases to the risk ratios from actions considered for cumulative effects are the same as for alternative 2.

Risk of Temperature Regime Alteration

The cumulative effects on risk of temperature regime alterations are the same as for Alternative 2.

Trend of Riparian Function

The cumulative trend of riparian function is the same as for alternative 2.

Alternative 4

Direct Effects and Indirect Effects

The fire severity will remain low for 10 years post-treatment for all areas treated in the alternative. If the area should re-burn during this time, the risk to water quality will be small and short-term.

Risk to Channel Morphology

The risk to channel morphology for all watersheds for alternative 4 is the same as for alternative 2. Fifteen watersheds have risk ratios less than for alternative 2. However, none of the risk ratios decreased enough to reduce the risk categories.

Risk of Sediment Regime Alteration

The risk of sediment regime alterations is the same as for alternative 2. The USLE risk ratios for six watersheds are reduced and mass-wasting risk ratios for six watersheds are reduced but not enough t0 change the risk categories for any of the watersheds. Site-scale alteration of the sediment regime is less for alternative 4 than for alternatives 2 and 3 due to reduced miles of proposed temporary roads and no stream crossings as described in the Hydrology and Aquatic resources reports.

Risk of Temperature Regime Alteration

The risk of temperature regime alteration is the same as for alternative 2. However, the reduction in roadside treatments reduced the percent potential shade reduction in fourteen watersheds. Lower West Fork Beaver, Dutch Creek, Middle Creek, Deep Creek, and Horse Creek had potential shade-loss reduced by 1.1%, 1.8%, 2.7%, 1.3% and 3.1%, respectively. In the remaining watersheds, reductions were less than 1%. None of these reductions were enough to reduce risk categories.

Trend of Riparian Function

The trend of riparian function is the same as for alternative 2 with the exception of site-scale effects that are smaller for alternative 4 than for alternatives 2 and 3.

Cumulative Effects

Risk to Channel Morphology

The cumulative effects for risk to channel geomorphology for all watersheds for alternative 4 are the same as for alternative 2. The increases to the risk ratios from actions considered for cumulative effects are the same as for alternative 2.

Risk of Sediment Regime Alteration

The cumulative effects for risk of sediment regime alteration for all watersheds for alternative 3 are the same as for alternative 2. The increases to the risk ratios from actions considered for cumulative effects are the same as for alternative 2.

Risk of Temperature Regime Alteration

The cumulative effects are the same as for Alternative 2. The relative increases in the potential shade loss were the same as for alternative 2. None of the watershed risks were reduced compared to alternative 2.

Trend of Riparian Function

The cumulative trend of riparian function is the same as for alternative 2.

Alternative 5

Direct Effects and Indirect Effects

The fire severity will remain low for 10 years post-treatment for all areas treated in the alternative. If the area should re-burn during this time, the risk to water quality will be small and short-term.

Risk to Channel Morphology

The risk to channel morphology for all watersheds for alternative 5 is the same as for alternative 2. Seventeen watersheds have risk ratios less than for alternative 2; however the changes are not enough to change the risk category for any of the watersheds.

Risk of Sediment Regime Alteration

The risk of sediment regime alterations is the same as for alternative 2. The mass-wasting risk ratios for nine watersheds were reduced but not enough to change the risk categories for any of the watersheds. Site-scale alteration of the sediment regime is less for alternative 5 than for alternatives 2 and 3 due to the reduced miles of proposed temporary roads and no stream crossings as described in the Hydrology and Aquatic resources reports.

Risk of Temperature Regime Alteration

The risk of temperature regime alterations is the same as for alternative 2.

Trend of Riparian Function

The trend of riparian function is the same as for alternative 2.

Cumulative Effects

Risk to Channel Morphology

The cumulative effects for risk to channel geomorphology for all watersheds for alternative 5 are the same as for alternative 2. The increases to the risk ratios from actions considered for cumulative effects are the same as for alternative 2.

Risk of Sediment Regime Alteration

The cumulative effects for risk of sediment regime alteration for all watersheds for alternative 5 are the same as for alternative 2. The increases to the risk ratios from actions considered for cumulative effects are the same as for alternative 2.

Risk of Temperature Regime Alteration

The cumulative effects on risk of temperature regime alterations are the same as for alternative 2.

Trend of Riparian Function

The cumulative trend of riparian function is the same as for alternative 2.

Comparison of Effects

The CWE model results by 7th field watershed for direct and indirect effects, and for cumulative effects, for analysis indicators are in the appendices of the hydrology report. A comparative summary of the effects of alternatives on analysis indicators for water (hydrology) is displayed in table 1.

Table Error! No text of specified style in document.**-1: Number of 7th field watersheds in each risk category for analysis indicators**

Indicator	Ranking	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Channel Morphology	Low	63	63	63	63	63
	Moderate	9	9	9	9	9
	High	2	2	2	2	2
Risk to Sediment Regimes	Low	51	51	51	51	51
	Moderate	18	18	18	18	18
	High	5	5	5	5	5
Risk to Temperature Regimes	Low	45	35	35	35	35
	Moderate	21	30	30	30	30
	High	8	9	9	9	9
Trend of Riparian Function		Very Slow, Positive	Slow, Positive	Slow, Positive	Slow, Positive	Slow, Positive

Hydrology Report

Introduction

The following project Hydrology Report is intended to compare potential impacts and benefits to hydrologic function and water quality of project alternatives. Results of the analysis will then be used to verify that project alternatives adhere to existing law, regulation, and policy such as the Total Maximum Daily Load (TMDL) requirements for the Klamath, Salmon, and Scott Rivers and the requirements of the Aquatic Conservation Strategy (ACS) within the Forest Plan.

A detailed description of the project alternatives considered for analysis can be found in chapter 2 of the draft Westside Fire Recovery Project EIS.

Methodology

Detailed Methodology

The effects of project alternatives on hydrologic function and water quality are analyzed based on existing Klamath National Forest (Forest) ecosystem analysis documents, recent watershed field surveys, and Geographic Information System (GIS) reports and modeling. Ongoing stream channel monitoring to meet North Coast Water Quality Control Board (Water Board) Waiver requirements, and field surveys during the 2014 fires and Burned Area Emergency Response (BAER) assessments provided current data. Data were synthesized to establish watershed existing conditions in the context of requirements for the Klamath, Salmon, and Scott Rivers (Total Maximum Daily Loads to meet Clean Water Act requirements), and ACS objectives and *desired conditions* from the Forest Plan.

The Total Maximum Daily Loads (TMDLs) for the Klamath, Scott, and Salmon Rivers contain numeric targets that represent attainment of State water quality standards for temperature and sediment (Water Board 2005a, 2005b, 2010). The following are watershed-wide conditions that serve as indicators of TMDL compliance and beneficial use support:

1. Less than 1% of all road-stream crossings (legacy sediment sites) divert or fail as a result of a 100-year or smaller flood.
2. Decreasing trend of road-related landslides.
3. Instream Target: 0 miles of substantial human caused sediment-related channel alteration.
4. Riparian Shade: Site-potential effective stream shade. Equal to the shade provided by topography and full potential vegetation conditions at a site, with an allowance for natural disturbances such as floods, wind throw, disease, landslides, and fire.

The Forest uses standardized Cumulative Watershed Effects (CWE) models (Equivalent Roaded Area, Universal Soil Loss Equation, mass-wasting) to assess effects of past, present, and reasonably foreseeable activities. Models were updated to incorporate effects of the 2014 fires and road improvements identified in BAER assessments. The updates provide a picture of post-fire existing conditions, as well as an initial assessment of the effects of taking no action in the project (alternative 1). Subsequently, effects of project action alternatives were modeled based on proposed vegetation treatments and associated road construction. Table 1 displays activities that are included in the Forest CWE models.

Table 2: Ground-disturbing activities and events incorporated in Forest CWE modeling

Vegetation removal (timber harvest, thinning, fuels reduction)
Road construction (including temporary roads, bulldozed fire line)
Log landing construction/enlargement
Actions on private lands documented in Timber Harvest Plans (THPs)
High- and moderate-severity wildfire
Prescribed fire
Road improvements (outsloping, rocking, crossing upgrades)[1]
Road decommissioning[1]

1 – Road improvements and road decommissioning result in reduced effects in the CWE models but the effects are not reduced to zero in the model assessments.

Ground disturbing activities in Table 1 are assigned *coefficients of disturbance* in the Equivalent Roaded Area (ERA) model in order to scale the activities to disturbance created by an equal sized (area) road segment (Haskins 1986). Effects from vegetation management, wildfire, and prescribed fire reduce over time based on *recovery curves* (Figure 1). Road and landing areas do not recover naturally over time; however, their coefficients of disturbance can be reduced if the areas are improved by decommissioning, outsloping, rocking, or crossing upgrades.

The Universal Soil Loss Equation (USLE) and mass-wasting (GEO) CWE models also incorporate recovery curves (Figures 2 and 3) to model reduced disturbance over time. Sediment yield (cubic yards/acre/year) estimated by the USLE occurs in the first winter season, requires a 2-year, 6-hour storm, and recovers to background rates within 7 years (USDA Forest Service 2004). Sediment yield (cubic yards/acre/decade) estimated by the Mass Wasting model depends on a 10-year storm event, and yield recovers to background rates in 50 years (USDA Forest Service 2004). Rates of surface erosion and mass wasting recover as site re-vegetation provides increased interception, evapotranspiration, ground cover, and mechanical strength.

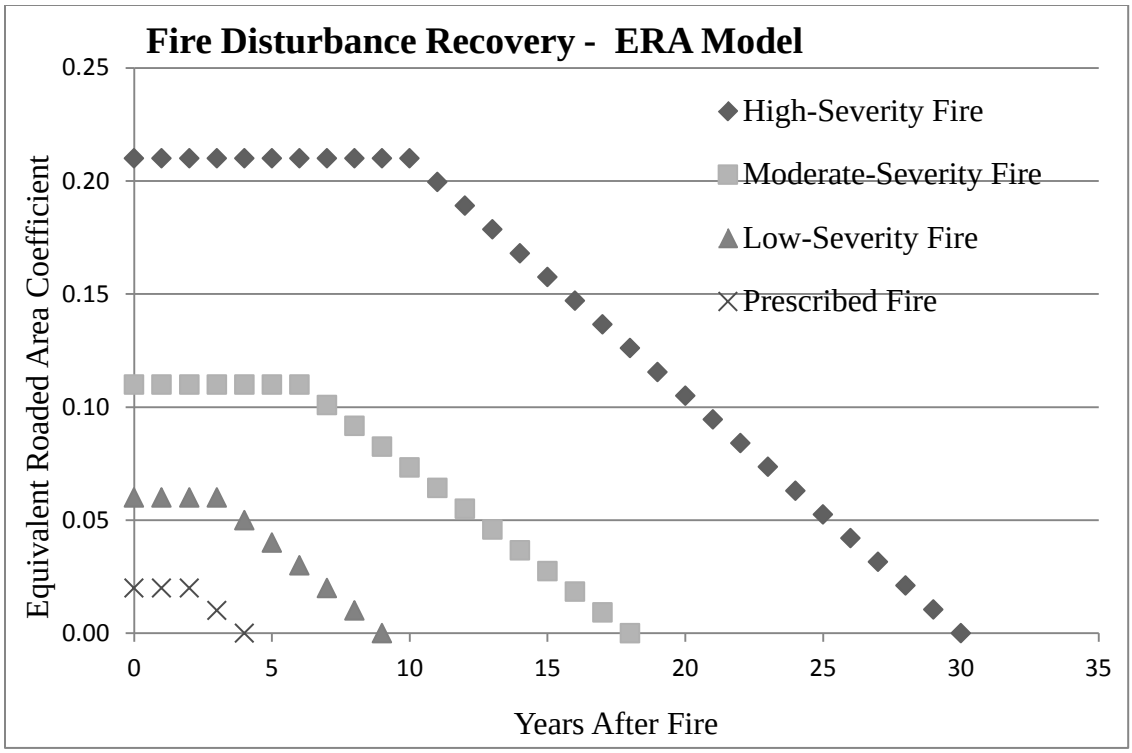

Figure 6 Fire disturbance recovery curves operating in the KNF cumulative watershed effects ERA model. Effects of high-severity fire on hydrologic function are estimated to be roughly 20% (coefficient of disturbance ~ 0.20) of those of a similar sized (area) road segment. Effects of all fire types reduce to zero within 30 years post-fire.

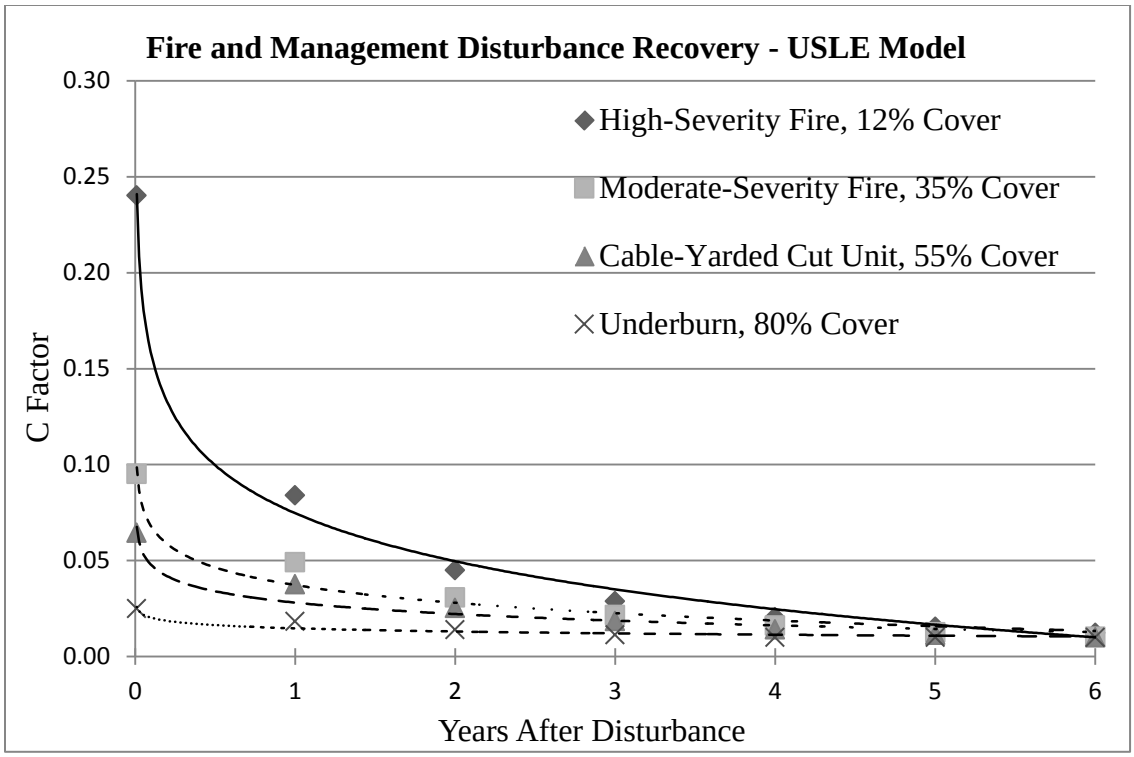

Figure 7 Fire and vegetation management recovery curves operating in the KNF cumulative watershed effects USLE model. Model assumes surface erosion produced by a 2-year, 6-hour storm. Surface erosion reduce significantly in the first year and reaches background rates in 7 years. Logarithmic decay curves fit to all data series.

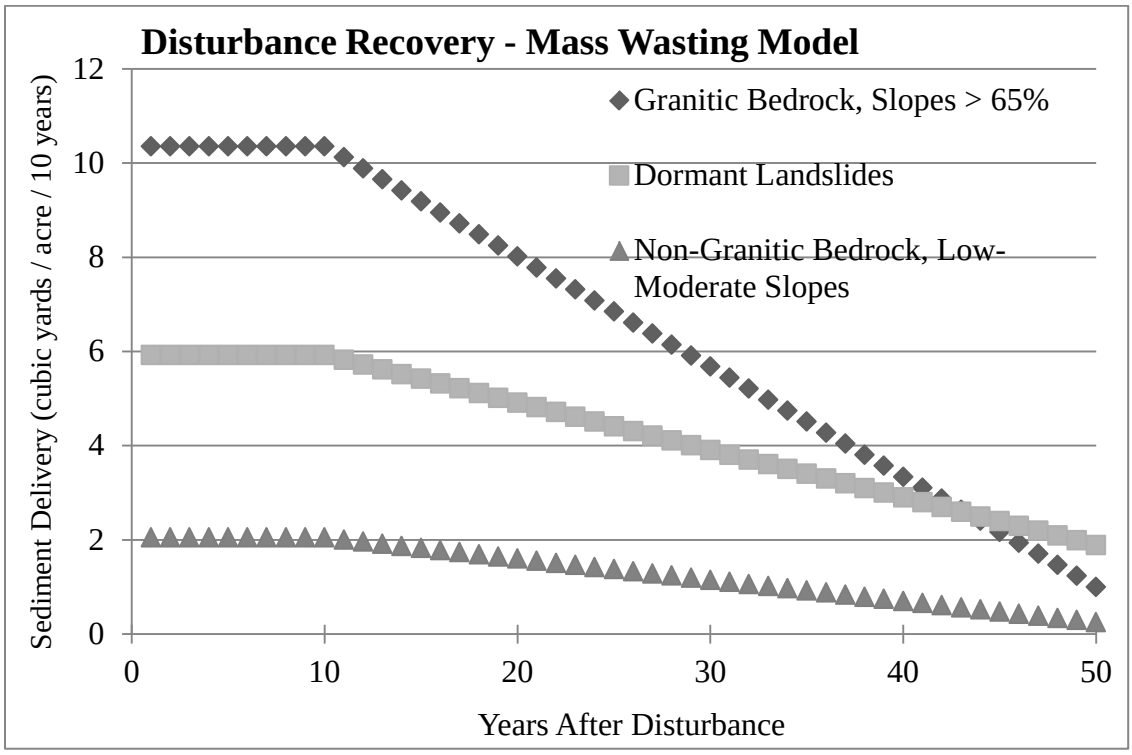

Figure 8 Recovery curves operating in the KNF cumulative watershed effects Mass Wasting model. Effects of disturbance on mass wasting are constant for 10 years and reduce to background within 50 years. Model assumes a 10-year storm event is required to produce mass wasting.

The recovery curves can be viewed as a timeline of the magnitude and duration of indirect effects on hydrologic function and hillslope sediment production of the 2014 wildfires and alternative 1.

Once all past, present, and reasonably foreseeable activities were accounted for in CWE models the resulting values of equivalent roaded area and sediment yield were compared against 5th field and 7thfield watershed *thresholds of concern* (TOC). The TOCs were established based on % equivalent roaded area and % over background sediment yield as shown in Table 2.

Table 3 Threshold of concern (TOC) for cumulative watershed effects models.

CWE Model	Threshold of Concern (TOC)
ERA (equivalent roaded area)	6 – 12 %[1]
USLE (surface erosion)	400% over background yield
Mass Wasting	200% over background yield

1-The TOC ranges from 6 to 12% in the 7th-Field watersheds that intersect the project fire areas.

Finally, modeled disturbance levels were divided by the TOC to derive watershed *risk ratios* at the 5thfield and 7thfield scales. Risk ratios in excess of 1.0 serve as a "yellow flag" for increasing susceptibility for significant adverse effects (Bell 2012). For the purposes of this analysis I generally considered risk ratios as follows:

Table 4: Qualitative assessment of CWE model risk ratios

Value of Model Risk Ratio	General Risk Category
< 1.0	Low
1.0 – 1.5	Moderate
> 1.5	High

Analysis Indicators

Analysis indicators are chosen to be responsive to TMDL requirements (Clean Water Act) and the Forest Plan (including ACS objectives), and to demonstrate potential differences between project alternatives with respect to hydrologic function and water quality.

The risk to channel morphology resulting from increased peak flow is assessed using estimated unit (cfs/mile^2) increased peak flows from the 2014 BAER reports (USDA Forest Service 2014a, 2014b, 2014c). The mass-wasting model is used to assess potential risk of channel change from landslides and potential resulting debris flows. The potential effects of temporary road and landing construction and vegetation treatments to peak flow are assessed using the ERA model.

The risk to water quality from sediment regime alteration is evaluated using the suite of cumulative watershed effects models as described in the methodology section. High- and moderate-severity wildfire, construction of temporary roads and landings, road improvements, and vegetation treatments were all included in the CWE modeling (Table 1). The effects of repairing or not repairing legacy sediment sites on the risk of erosion and sedimentation are also analyzed.

The risk to water quality from temperature regime alteration is assessed by analyzing effects to Riparian Reserves. Burned Area Reflectance Class (BARC) data was used to assess effects of the 2014 fires on vegetation and related reduced shade as a baseline for the analysis of project activities. Riparian shade buffers water temperatures from solar insolation and warming, and riparian areas subject to moderate and high-severity fire provide reduced shade relative to pre-fire conditions. The mass-wasting model is used to assess landslide risk and potential resulting debris flows can scour shade-producing streamside vegetation and affect water temperature. Additionally, Riparian Reserves proposed for planting are also analyzed because shade-producing forested conditions are expected to return more quickly after planting.

Similar to temperature regime alteration, the risk to channel function is evaluated by analyzing effects to Riparian Reserves. Acres of Riparian Reserve disturbed by moderate and high-severity fire will yield more sediment post-fire than in pre-fire conditions. However, these areas will also recruit more large wood to stream channels, and this process aids sediment storage, aquatic habitat development and nutrient cycling. Additionally, the mass-wasting model assessment is used because landslides and potential resulting debris flows can affect channel function.

Spatial and Temporal Bounding of Analysis Area

The spatial context for the hydrologic analysis was the project area including approximately 215,000 acres in portions of the following eight 5th field Hydrologic Unit Code (HUC) watersheds: Beaver Creek; Humbug Creek-Klamath River; Horse Creek-Klamath River; Seiad Creek-Klamath River; Lower Scott River; Thompson Creek-Klamath River; Elk Creek; and North Fork Salmon River. The 5th field watersheds are the analysis area for *broad scale* effects analysis. The 7th field watersheds are considered *small scale* for a project area of this size. There are 75 7th field watersheds that intersected portions of the three fire-related areas (Happy Camp Complex, Beaver, and Whites fires). The long-term temporal bounding for this analysis is up to 10 years because recovery of the fire-disturbed hydrologic function (from ERA modeling) and surface erosion (from USLE modeling) is appreciable in the first decade.

Affected Environment

General information on the affected environment for the project is provided in chapter 1 of the draft EIS. In terms of water (hydrology), specific information related to analysis indicators is provided in this section. Watershed hydrology is characterized by dry summer and fall months followed by significant winter precipitation. Morphology and function of the steep stream channels is controlled by large floods such as those in 1997, 1974, 1964, and 1955 (Stewart and LaMarche 1967; de la Fuente and Elder 1998), and associated landslides and debris flows. Riparian vegetation is primarily hardwood (Figure 1) although valley bottom mixed-conifer vegetation with large Douglas-fir trees was historically significant (Mondry 2004).

Figure 9 Walker Creek in the Happy Camp Complex Fire area. While significant portions of the watershed burned at moderate and high severity in 2014, the main-stem valley bottom was mostly unburned. The steep main stem channel (≥ 3%) and predominantly even-aged hardwood riparian forest is typical of lower-gradient streams in the analysis area. This reach was surveyed and monitored by the USFS Redwood Sciences Lab after significant disturbance from the 1997 flood. Photo by ZM 11/15/14.

Existing Conditions

All streams in the project area are listed as impaired under section 303(d) of the Clean Water Act, which means that current conditions do not meet water quality standards and streams are not supporting their beneficial uses (USEPA 2010). The 303(d) list identified stream temperature and sediment as the pollutants causing impairment in small tributary streams. Water quality monitoring conducted by the Forest Service has confirmed that streambed sediment has increased beyond the range of natural variability by at least one of the three indices in all sampled watersheds in the project area except for Whites Gulch and North Russian Creek (Table 3). Sediment indicators are V* (portion of pools filled with fine sediment), percent of riffle surface sediment < 2mm, percent of subsurface sediment < 6.35mm, and percent of subsurface sediment < 0.85mm).

Table 5: Streambed sediment monitoring data from project area watersheds

Stream	Year	V*	Surface Sediment <2mm (%)	SubSurface <6.35 mm (%)	SubSurface <0.85 mm (%)
Beaver Creek 1	2010	0.053	3.0	44.2	***18.2***
Beaver Creek 1	2013	0.056	2.4	***47.4***	***18.2***
Beaver Creek 2	2010	0.076	3.6	44.0	16.0
Beaver Creek 2	2013	0.074	6.3	44.4	***19.3***
West Fork Beaver Creek	2009	***0.143***	3.1	45.6	***16.9***
West Fork Beaver Creek	2013	***0.124***	6.1	45.5	***20.3***
East Fork Elk Creek	2011	0.065	***9.0***	45.6	15.2
East Fork Elk Creek	2011	0.049	***6.7***	36.6	18.9
Grider Creek	2009	0.054	3.7	***47.0***	15.8
Grider Creek	2013	0.044	2.5	32.2	9.2
North Russian Creek	2011	0.076	0.7	35.1	8.6
South Russian Creek	2011	0.056	4.5	***46.9***	13.2
Tompkins Creek	2011	0.081	2.2	***63.3***	***27.8***
Tompkins Creek	2014	0.083	2.8	***49.2***	***20.5***
Walker Creek	2011	0.103	3.8	***50.8***	***17.0***
Walker Creek	2014	***0.111***	***8.4***	***52.3***	14.5
Whites Gulch	2011	0.044	2.6	34.4	10.6
Whites Gulch	2014	0.050	1.4	35.0	9.3

Values in bold italics with shaded cells exceed thresholds determined from analysis of natural variability of reference streambed sediment. These streams are interpretted to have a measureable increase in streambed sediment due to cumulative watershed effects. Many streams have multiple survey years for comparison. Data from Laurie and Elder (2012)

One cause of impairment on National Forest System lands has been attributed to *legacy sediment sites* from past management including historic mining, road building, and silviculture (NCRWQCB 2010, NCRWQCB 2005). A majority of the legacy sediment sites are associated with the road system, most of which was constructed in the 1960s and 1970s prior to modern best management practices (BMPs). Culverts were commonly designed to pass a 25-year flood rather than the 100-year flood required by current road standards. Road construction often did not avoid unstable slopes or riparian areas that are protected by todays BMPs. As a result, some of the current road system is not resilient to natural disturbance by fire and floods. A flood in 1997 caused road failures which triggered debris torrents that traveled miles downstream. Some of the impact to water quality occurred when landslides and debris flows removed riparian vegetation, reduced stream shade, and increased water temperatures (De La Fuente and Elder 1998, NCRWQCB 2010). To minimize or eliminate water quality impacts by future floods the Total Maximum Daily Loads for the Klamath, Scott, and Salmon Rivers set load allocations that require road stream crossings to pass a 100-year flood without diverting or failing.

The Forest has completed legacy sediment site inventories for most roads on the Forest (USDA Forest Service 2012). A total of 953 legacy sediment sites were inventoried in the project

boundary (Table 3). Most of the legacy sediment sites are associated with undersized culverts, stream diversion potential at road crossings, or roads located on unstable slopes. Legacy sediment site inventories have not yet been completed for non-road sediment sources such as abandoned mines, historic hydraulic mining, past harvest units, or dredge tailings. In some watersheds these non-road legacy sediment sites could be a substantial source of additional stream sediment and reduced stream shade.

Table 6: Summary of legacy sediment site inventory data on roads in the project area by 5th field watershed

Watersheds	Number of Legacy Sediment Sites
Beaver Creek	557
Elk Creek	203
Horse Creek – Klamath River	417
Humbug Creek – Klamath River	153
Lower Scott River	155
North Fork Salmon River	323
Seiad Creek – Klamath River	188
Thompson Creek – Klamath River	125
Project Area	953

Effects of the 2014 wildfires on existing conditions in the project area were greatest where forested areas burned with continuous high severity (Figure 6). Post-fire sediment has already been delivered to project areas streams such as Elk and Grider Creeks (B. Miller, Klamath National Forest, written communication).

Figure 10 Effects of high-severity fire on a forested hillslope in Whites Gulch. Photo by ZM 11/26/14.

Desired Conditions

Desired conditions for water and Riparian Reserves are provided in the Forest Plan and summarized in this section. For Riparian Reserves, desired vegetation is an overstory of coniferous vegetation providing shade and thermal cover and understory vegetation providing further thermal regulation, nutrient regulation, and bank stability (Forest Plan pg. 4-106). Riparian vegetation is diverse and dense enough such that it stabilizes stream banks and hillslopes, promotes sediment trapping, and contributes downed large wood (Forest Plan pg. 4-107). These riparian conditions maintain and promote water quality and reduce potential stress from sediment and temperature loading. Desired conditions for stream flows (including peak flow) are such that they provide adequate protection to semi-aquatic and aquatic habitat and maintain natural hydrologic processes (Forest Plan pg. 4-107). Desired flow conditions promote and maintain channel function and resulting morphology. These flow conditions support beneficial uses such as cold freshwater habitat and associated fish migration, fish spawning, and preservation of rare and endangered species.

Environmental Consequences

Alternative 1

Direct Effects and Indirect Effects

There are no direct effects to channel morphology, water quality (sediment and temperature regimes), or channel function resulting from alternative 1. Indirect effects as determined by the analysis indicators are as follows:

Risk to Channel Morphology

The current risk to channel morphology resulting from post-fire increased peak flow is generally low because of the inherent stability of steep, armored channels (that dominate the project area). Potential effects of the 2014 fires on peak flow were analyzed by BAER assessment teams (USDA Forest Service 2014a 2014b, 2014c). These assessments rely on soil burn severity data to estimate post-fire peak flow yield (cfs/mile^2). Table 6 summarizes BAER peak flow assessments.

Table 7: Estimated peak stream flow increases from 2014 BAER assessments

Fire	Design Storm	Design Storm (inches)	Flow (cfs/mile^2)	Reduction in Infiltration (%)	Adjusted Flow (cfs/mile^2)
Beaver	5-year, 12-hour	2.1	11.6	28	14.8
Happy Camp Complex	5-year, 5-hour	2.0	112	15	209
Whites	5-year, 6-hour	1.9	148	27	188

Unit peak flow yield is expected to increase by factors of 1.3, 1.9, and 1.3 for the Beaver, Happy Camp Complex, and Whites Fires, respectively. However, increased peak flows of this magnitude are not expected to alter morphology of steep channels (>10%) and will not be measureable to step-pool channel morphology as well (Grant et al 2008). These steep gradient channels are not prone to morphologic change via sedimentation, aggradation and widening resulting from typical streamflow processes. An exception is where landslides and associated debris flows occur that can scour stored sediment, large wood, and riparian vegetation. Debris flows are identified as likely to occur with this alternative in Grider and Walker Creeks in the Happy Camp Complex Fire and in and adjacent to Robinson Gulch in the Whites Fire areas (USDA Forest Service 2014c and 2014b). Pre-fire and post-fire risk ratios for the mass-wasting model are displayed in tables 7 and 8.

Table 8: Modeled pre-fire (2012) and post-fire mass-wasting risk ratios for 5th field watersheds in the project area

5th-Field Watershed Name	Area (Acres)	Mass Wasting Risk Ratio Pre-Fire (2012)	Mass Wasting Risk Ratio Post-Fire, No Action	2014 Fire Area
Beaver Creek	69,610	0.83	1.07	Beaver
Elk Creek	60,829	1.02	0.98	Happy Camp Complex
Horse Creek-Klamath River	98,625	0.71	0.86	Beaver
Humbug Creek-Klamath River	68,023	0.85	0.84	Beaver
Lower Scott River	98,016	0.3	0.57	Happy Camp Complex
North Fork Salmon River	130,545	0.53	0.73	Whites
Seiad Creek-Klamath River	81,706	0.52	0.82	Happy Camp Complex
Thompson Creek-Klamath River	67,301	0.41	0.49	Happy Camp Complex

Table 9: 7th field watersheds that exceed the mass-wasting model threshold of concern post-fire

7th-Field Watershed Name	Mass-Wasting Risk Ratio Pre-Fire (2012)	Mass-Wasting Risk Ratio Post-Fire, No Action	2014 Fire Area
Middle Elk Creek	3.02	2.85	Happy Camp Complex
Walker Creek	0.88	1.89	Happy Camp Complex
Bishop Creek-Elk Creek	1.80	1.76	Happy Camp Complex
Caroline Creek-Klamath River	1.16	1.64	Happy Camp Complex
Granite Creek	1.53	1.52	Happy Camp Complex
O'Neil Creek	0.55	1.50	Happy Camp Complex
Soda Creek-Beaver Creek	1.40	1.46	Beaver
Deep Creek-Scott River	1.42	1.39	Happy Camp Complex
Music Creek	0.32	1.21	Whites
Kohl Creek	0.82	1.18	Beaver
Buckhorn Gulch-Beaver Creek	0.64	1.16	Beaver
Dona Creek-Klamath River	1.00	1.16	Beaver
Schutts Gulch-Klamath River	0.74	1.15	Happy Camp Complex
Doggett Creek	1.00	1.11	Beaver
Middle Creek	0.77	1.09	Happy Camp Complex
Lower Grider Creek	0.37	1.09	Happy Camp Complex
Lower West Fork Beaver Creek	1.00	1.05	Beaver
Lumgrey Creek	0.93	1.04	Beaver
Bear Creek	1.00	1.01	Happy Camp Complex

(Pre-fire (2012) risk ratios are shown for comparison. Shaded cell considered high-risk (> 1.5))

Only the Beaver Creek 5th field watershed exceeds the TOC post-fire, and risk of channel alteration by debris flow is interpreted to be low at broad scales (5th field watersheds). However, there are 19 7th-Field watersheds that exceed the Mass-wasting TOC post-fire. Five of the small scale (7th field) watersheds are interpreted to be at high risk for mass-wasting (risk ratio > 1.5) and potentially resulting debris flows, and thus at high risk for impacts to channel morphology. Increased risk of mass wasting requires 50 years for recovery (Figure 3). However, debris flows are recognized as producing beneficial aquatic habitat complexity and nutrient cycling where they mobilize and deposit large wood (Mondry 2004, Grant and Swanson 1995).

Risk to Water Quality (Sediment)

Risk posed to water quality from the 950 identified legacy sediment (table 5) sites is moderate to high over the 10-year temporal bound as a significant storm such as a 10-year event is required to produce sediment from many of the sites. Risk from legacy sites is not changed by alternative 1 and does not reduce over time as increased risk of sedimentation related to the 2014 wildfires. Longer-term, legacy sediment sites will have a high risk of failing in future floods and impacts will be similar to the channel scour, loss of stream shade, increased stream temperatures, and sedimentation that occurred in the 1997 flood as described by De La Fuente and Elder (1998). These impacts will adversely affect beneficial uses and violate the Waiver and water quality standards in the Basin Plan (NCRWQCB 2011). The risk of road failures is greater at sites located below high-severity burns due to increased runoff and peak flows.

In general, the risk of negative impacts from road failures is expected to increase in the future due to effects of a warmer climate on floods; however, there is not enough site-specific information available to apply this general information to the project area. If the project area experiences larger floods than road crossings were designed for, these crossings will have a higher risk of failing. Further, road crossings that were properly designed to pass the 100-year flood can potentially become undersized if the 100-year flood under the future climate is larger.

In addition to legacy sediment sites, there is also risk to water quality from modeled post-fire erosion and sedimentation related to broader watershed disturbance. All three CWE models were employed to assess risk of potential increased streambed sedimentation. Table 9 displays pre-fire (2012) and post-fire ERA risk ratios for the eight 5th field watersheds in the project area.

Table 10: Modeled pre-fire (2012) and post-fire ERA risk ratios for 5th field watersheds in the project area

5th-Field Watershed Name	Area (Acres)	ERA Risk Ratio Pre-Fire (2012)	ERA Risk Ratio Post-Fire, No Action	2014 Fire Area
Beaver Creek	69,610	0.69	1.01	Beaver
Elk Creek	60,829	0.52	0.51	Happy Camp Complex
Horse Creek-Klamath River	98,625	0.74	0.73	Beaver
Humbug Creek-Klamath River	68,023	0.63	0.31	Beaver
Lower Scott River	98,016	0.04	0.55	Happy Camp Complex
North Fork Salmon River	130,545	0.17	0.34	Whites
Seiad Creek-Klamath River	81,706	0.61	0.55	Happy Camp Complex
Thompson Creek-Klamath River	67,301	0.12	0.43	Happy Camp Complex

Four watersheds had increased risk ratios due to the 2014 fires. In the other four watersheds ERA disturbance remained approximately constant or decreased because 2014 fire effects were limited and effects of previous activities are recovering.

The 5th field watershed ERA risk ratios were low prior to the 2014 fires and remained so post-fire. Model results for the Humbug Creek and Seiad Creek indicate lower risk ratios post-fire because 2014 fire effects were fairly limited and previous watershed disturbance is recovering. Table 10 displays ERA model results for 7thfield watersheds that exceeded the TOC.

Table 11: Modeled pre-fire (2012) and post-fire ERA risk ratios for 7th-Field watersheds that exceed the threshold of concern

7th-Field Watershed Name	Area (Acres)	ERA Risk Ratio Pre-Fire (2012)	ERA Risk Ratio Post-Fire, No Action	2014 Fire Area
Doggett Creek	7,701	2.22	2.36	Beaver
Kohl Creek	3,537	0.99	1.56	Beaver
Dutch Creek	3,827	0.67	1.45	Beaver
Middle Elk Creek	2,727	1.56	1.40	Happy Camp Complex
Lower West Fork Beaver Creek	4,044	1.36	1.31	Beaver
Jaynes Canyon	7,009	1.20	1.16	Beaver
Big Ferry-Swanson	7,612	0.77	1.13	Happy Camp Complex
Buckhorn Gulch-Beaver Creek	8,234	0.50	1.10	Beaver
Soda Creek-Beaver Creek	7,370	1.04	1.08	Beaver
Music Creek	3,286	0.19	1.04	Whites
Walker Creek	7,635	0.50	1.03	Happy Camp Complex

Risk ratios generally increased due to 2014 fire effects with the exception of three watersheds where fire effects were limited and effects of previous activities are recovering.

Tables 11 and 12 summarize pre-fire and post-fire results for 5th field and 7th field watersheds based on USLE model assessments.

Table 12: Modeled pre-fire (2012) post-fire USLE risk ratios for 5th-Field watersheds in the project area

5th-Field Watershed Name	Area (Acres)	USLE Risk Ratio Pre-Fire (2012)	USLE Risk Ratio Post-Fire, No Action	2014 Fire Area
Beaver Creek	69,610	1.08	1.16	Beaver
Elk Creek	60,829	0.07	0.30	Happy Camp Complex
Horse Creek-Klamath River	98,625	0.66	0.81	Beaver
Humbug Creek-Klamath River	68,023	0.61	0.50	Beaver
Lower Scott River	98,016	0.05	0.48	Happy Camp Complex
North Fork Salmon River	130,545	0.05	0.33	Whites
Seiad Creek-Klamath River	81,706	0.31	0.68	Happy Camp Complex
Thompson Creek-Klamath River	67,301	0.44	0.29	Happy Camp Complex

Table 13: 7th field watersheds that exceed the USLE model threshold of concern post-fire

7th-Field Watershed Name	USLE Risk Ratio Pre-Fire (2012)	USLE Risk Ratio Post-Fire, No Action	2014 Fire Area
Jaynes Canyon	1.69	1.68	Beaver
Dutch Creek	1.19	1.65	Beaver
Lower West Fork Beaver Creek	1.57	1.65	Beaver
Soda Creek-Beaver Creek	1.49	1.59	Beaver
Doggett Creek	1.13	1.52	Beaver
Kohl Creek	0.79	1.50	Beaver
Lumgrey Creek	1.24	1.38	Beaver
O'Neil Creek	1.03	1.37	Happy Camp Complex
Buckhorn Gulch-Beaver Creek	0.67	1.28	Beaver
Rancheria Creek	0.50	1.14	Happy Camp Complex
Dona Creek-Klamath River	0.83	1.11	Beaver

Pre-fire (2012) risk ratios are shown for comparison.

Taken together, and including the mass-wasting assessment (Tables 7 and 8 in the previous section), results of post-fire CWE models indicate that impacts to water quality resulting from erosion and sedimentation are unlikely for broad scale 5th field watersheds. Post-fire risk ratios exceeded 1.5 in eleven small scale (7th field) watersheds for one of the three CWE models; therefore, these watersheds are considered to be at high risk for impacted water quality due to erosion and sedimentation. Risk is greatest in the most disturbed watersheds such as Doggett, Middle Elk, Kohl, Soda, and Lower West Fork Beaver creeks. In these watersheds, impacts are also more likely to result from large precipitation events such as the 10-year storm required to drive the mass-wasting erosion model. In alternative 1, risk to water quality from erosion and sedimentation related to equivalent roaded area, surface erosion, and mass wasting recover to pre-fire levels in approximately 30, 5, and 50 years, respectively (Figure 1-3).

Risk to Water Quality (Temperature)

The risk to water quality from increased stream temperature is elevated in alternative 1 due to reduced shade provided by Riparian Reserve vegetation that burned with high and moderate severity. Table 13 displays 2014 moderate and high severity fire acres in Riparian Reserves. Acres burned at high or moderate severity are assumed to equal negative effects to stream shade and temperature.

Table 14: 2014 moderate- and high-severity fire in project area Riparian Reserves

	2014 Fire Severity in Riparian Reserves		
Fire Area	**Moderate (Acres)**	**High (Acres)**	**Total (Acres)**
Beaver Fire	1,591	3,052	4,643
Happy Camp Complex Fire	3,656	5,662	9,318
Whites Fire	754	1,773	2,527
Total	6,001	10,487	16,488

Information derived from BARC base data

Table 14 displays intermittent and perennial stream channels impacted by high and moderate burn severities during the 2014 fires.

Table 15: Burn severity along intermittent and perennial streams in the three project fire areas

Stream Channel Burn Severity

		Very Low miles (%)	Low miles (%)	Moderate miles (%)	High miles (%)	Total (miles)
Happy Camp Complex	Intermittent	23 (9%)	196 (72%)	50 (18%)	2 (0.8%)	271
	Perennial	31 (13%)	188 (76%)	27 (11%)	0.4 (0.2%)	246
Beaver Fire	Intermittent	20 (15%)	66 (50%)	37 (28%)	10 (8%)	133
	Perennial	12 (34%)	18 (51%)	5 (14%)	<1 (<3%)	35
Whites Fire	Intermittent	18 (21%)	43 (50%)	21 (24%)	4 (5%)	86
	Perennial	16 (25%)	36 (57%)	9 (14%)	2 (3%)	63

Data from 2014 BAER assessment reports. Information derived from BARC base data.

The data displayed in Table 14 shows that the length of stream channel affected by moderate- and high-severity fire in 2014 was limited. High- and moderate-severity fire affected about 11% of perennial stream in the Happy Camp Complex and 17% of perennial channels in the Beaver and Whites Fire areas. High and moderate burn severity areas will provide shade to stream channels immediately post-fire, perhaps 50% of the pre-fire shade levels (G. Laurie, Klamath National Forest, personal communication). Given that a low percentage of the perennial channel network was affected by moderate- and high-severity fire, and that burned areas will provide residual shade, the risk to water quality and beneficial uses from increased stream temperature related to Riparian Reserve areas that burned is low. However, landslides and potential resulting debris flows can also reduce stream shade. Where debris flows scour riparian vegetation along substantial lengths of perennial channels, stream temperature will be expected to increase. Mass-wasting risk ratios exceed 1.5 for Middle Elk, Walker, Bishop, Caroline, and Granite creeks (Table 8). These watersheds have a high risk for landsliding and perhaps a moderate risk for resulting debris flows that remove vegetation and thus negatively affect stream shade and temperature.

Risk to Channel Function

Similar to the temperature regime assessment, evaluation of effects to channel function relied on Riparian Reserve burn severity data (Tables 13 and 14) and mass-wasting model assessment. High-severity burn areas are characterized by mortality of essentially all trees and shrubs. In addition, pre-fire large wood loads in intermittent channels may have been reduced by the fire. Within a few years both riparian and upland hardwood types should demonstrate considerable growth via re-sprouting. Within the first decade streamside killed trees will decay, fall, and load channels with large wood. Large wood loading to riparian zones and stream channels is widely regarded as beneficial for sediment retention, channel function, habitat complexity, cover, and nutrient cycling (see Keller and Swanson 1979; Nakamura and Swanson 1994; Grant and Swanson 1995; among others). Given the relatively small acreage of Riparian Reserve that burned at moderate- and high-severity in 2014, and the small length of stream channels affected, negative fire effects are not expected to channel function at broad or small scales resulting from burned Riparian Reserve areas. Where fire impacts increase large wood loading to stream channels, effects will be positive for channel sediment metering and other functions. However, there is a high risk of mass-wasting that translates to a moderate risk of debris flows in five 7th field watersheds (Table 8). Debris flows will have substantial effects on channel function.

Cumulative Effects

Cumulative effects of alternative depend on past, present, and reasonably foreseeable activities in the project area. The Forest produced CWE model outputs describing 2014 post-fire existing conditions that incorporated past and present actions. If alternative 1 is implemented, then impacts from past and current activities will recover over time. Additionally, planning for reasonably foreseeable activities will necessarily consider the effects of the 2014 fires because the fire information already resides in the CWE models. The risk of stream diversion at some culverts within the burn area will be reduced by the road drainage dips scheduled to be installed as part of BAER projects. However, BAER treatments will not totally eliminate the risk of road failure at these sites because they will not upgrade the capacity of undersized culverts to pass the 100-year flood. Adding the effects of BAER projects to the effects of alternative 1 will provide a small beneficial cumulative effect.

Alternative 2

Direct and Indirect Effects

Treatments proposed by this alternative include salvage harvest, roadside hazard tree removal, fuels reduction, temporary road construction, and site preparation and planting as described in chapter 2 of the DEIS. Effects of the Alternative 2 on hydrologic function are primarily related to potential ground-disturbance and compaction associated with temporary road and landing construction, mechanical skidding, and cable yarding.

Risk to Channel Morphology

As described for the alternative 1, the risk to channel morphology from post-fire increased peak flows as determined in the BAER assessments is not expected to be sizeable enough for channel alteration except in the case of landslides and potential debris flows. Temporary road and landing construction, and to a lesser degree salvage harvest and associated mechanical yarding resulting from alternative 2 have potential to further increase runoff in the project area. However, ERA model results for alternative 2 do not show any additional disturbance beyond 2014 fire effects for 5th field watersheds (Table 15).

Table 16: ERA model results comparing alternatives 1 and 2 for project 5th field watersheds

5th-Field Watershed Name	Area (Acres)	ERA Risk Ratio Post-Fire, No Action	ERA Risk Ratio Proposed Action	2014 Fire Area
Beaver Creek	69,610	1.01	1.01	Beaver
Elk Creek	60,829	0.51	0.51	Happy Camp Complex
Horse Creek-Klamath River	98,625	0.73	0.73	Beaver
Humbug Creek-Klamath River	68,023	0.31	0.31	Beaver
Lower Scott River	98,016	0.55	0.55	Happy Camp Complex
North Fork Salmon River	130,545	0.34	0.34	Whites
Seiad Creek-Klamath River	81,706	0.55	0.55	Happy Camp Complex
Thompson Creek-Klamath River	67,301	0.43	0.43	Happy Camp Complex

There is no difference between the two alternatives at the broad scale. Effects of the 2014 fires on ERA values were significant (Table 6) while subsequent effects of alternative 2 will not be at this scale.

Mass-wasting model results also reveal no additional disturbance beyond that of alternative 1 at the broad scale (Table 16).

Table 17: Mass-wasting model results comparing the alternatives 1 and 2 for project 5th field watersheds

5th-Field Watershed Name	Area (Acres)	Mass Wasting Risk Ratio Post-Fire, No Action	Mass Wasting Risk Ratio Proposed Action	2014 Fire Area
Beaver Creek	69,610	1.07	1.07	Beaver
Elk Creek	60,829	0.98	0.95	Happy Camp Complex
Horse Creek-Klamath River	98,625	0.86	0.86	Beaver
Humbug Creek-Klamath River	68,023	0.84	0.84	Beaver
Lower Scott River	98,016	0.57	0.57	Happy Camp Complex
North Fork Salmon River	130,545	0.73	0.73	Whites
Seiad Creek-Klamath River	81,706	0.82	0.82	Happy Camp Complex
Thompson Creek-Klamath River	67,301	0.49	0.49	Happy Camp Complex

Three 7th field watersheds displayed high ERA risk ratios (> 1.5) as a result of alternative 2 (Table 17). Similar to results from the ERA model, there is no difference between the two alternatives at the broad scale.

Table 18: ERA model results comparing alternatives 1 and 2for project 7th field watersheds that exceeded the TOC in alternative 1

7th-Field Watershed Name	Area (Acres)	ERA Risk Ratio Post-Fire, No Action	ERA Risk Ratio Proposed Action	2014 Fire Area
Doggett Creek	7,701	2.36	2.42	Beaver
Kohl Creek	3,537	1.56	1.58	Beaver
Dutch Creek	3,827	1.45	1.51	Beaver
Middle Elk Creek	2,727	1.40	1.40	Happy Camp Complex
Lower West Fork Beaver Creek	4,044	1.31	1.31	Beaver
Jaynes Canyon	7,009	1.16	1.16	Beaver
Big Ferry-Swanson	7,612	1.13	1.16	Happy Camp Complex
Buckhorn Gulch-Beaver Creek	8,234	1.10	1.11	Beaver
Soda Creek-Beaver Creek	7,370	1.08	1.08	Beaver
Music Creek	3,286	1.04	1.06	Whites
Walker Creek	7,635	1.03	1.07	Happy Camp Complex

Seven of the 11 watersheds showed minor incremental increases in risk ratio due to modeled effects of the alternative 2. No 7th field watersheds that were below the TOC in alternative 1 were pushed over the TOC by alternative 2.

Six 7th field watersheds had high mass-wasting risk ratios when modeling alternative 2 (Table 18).

Table 19 Mass-wasting model results comparing alternatives 1 and 2 for project 7th field watersheds that exceeded the TOC in alternative 1

7th-Field Watershed Name	Mass-Wasting Risk Ratio Post-Fire, No Action	Mass-Wasting Risk Ratio Proposed Action	2014 Fire Area
Middle Elk Creek	2.85	2.85	Happy Camp Complex
Walker Creek	1.89	1.92	Happy Camp Complex
Bishop Creek-Elk Creek	1.76	1.76	Happy Camp Complex
Caroline Creek-Klamath River	1.64	1.72	Happy Camp Complex
Granite Creek	1.52	1.52	Happy Camp Complex
O'Neil Creek	1.50	1.51	Happy Camp Complex
Soda Creek-Beaver Creek	1.46	1.46	Beaver
Deep Creek-Scott River	1.39	1.41	Happy Camp Complex
Music Creek	1.21	1.21	Whites
Kohl Creek	1.18	1.19	Beaver
Buckhorn Gulch-Beaver Creek	1.16	1.17	Beaver
Dona Creek-Klamath River	1.16	1.20	Beaver
Schutts Gulch-Klamath River	1.15	1.15	Happy Camp Complex
Doggett Creek	1.11	1.15	Beaver
Middle Creek	1.09	1.20	Happy Camp Complex
Lower Grider Creek	1.09	1.11	Happy Camp Complex
Lower West Fork Beaver Creek	1.05	1.05	Beaver
Lumgrey Creek	1.04	1.04	Beaver
Bear Creek	1.01	1.01	Happy Camp Complex

Ten of the 19 watersheds showed minor incremental increases in risk ratio due to modeled effects of alternative 2. No 7th field watersheds that were below the TOC in alternative 1 were pushed over the TOC by alternative 2.

These data support the finding that a suite of 7th field watersheds are at high risk for mass-wasting. However, alternative 2 did not appreciably increase this risk for small-scale watersheds as the number of 7th field watersheds demonstrating risk ratios in excess of 1.5 only increased by 1 (from 5 to 6 watersheds) over alternative 1 (Table 18). Additionally, watersheds with high risk for mass-wasting are assumed to have only a moderate risk for channel-changing debris flows as channel mobilization depends on other variables such as volumes of sediment and large wood previously stored along debris flow run-out zones and the resistance of valley bottom deposits and vegetation (Mondry 2004).

Risk to Water Quality (Sediment)

CWE model results for alternative 2 were presented in the previous section for the ERA and mass-wasting models (Tables 15-18). Similar to those results, activities proposed in alternative 2 do not change the results of the USLE model at the broad scale (Table 19).

Table 20: USLE model results comparing alternatives 1 and 2 for project 5th field watersheds.

5th-Field Watershed Name	Area (Acres)	USLE Risk Ratio Post-Fire, No Action	USLE Risk Ratio Proposed Action	2014 Fire Area
Beaver Creek	69,610	1.16	1.16	Beaver
Elk Creek	60,829	0.30	0.30	Happy Camp Complex
Horse Creek-Klamath River	98,625	0.81	0.81	Beaver
Humbug Creek-Klamath River	68,023	0.50	0.50	Beaver
Lower Scott River	98,016	0.48	0.48	Happy Camp Complex
North Fork Salmon River	130,545	0.33	0.33	Whites
Seiad Creek-Klamath River	81,706	0.68	0.68	Happy Camp Complex
Thompson Creek-Klamath River	67,301	0.29	0.29	Happy Camp Complex

Similar to results from the ERA and mass-wasting models, there is no difference between the two alternatives at the broad scale.

However, results of USLE modeling for small scale watersheds indicate that an additional three 7th field watersheds are considered to be high risk (Table 20), in addition to the previous nine identified by ERA and mass-wasting modeling.

Table 21: USLE model results comparing alternatives 1 and 2 for project 7th field watersheds that exceeded the TOC in alternative 1

7th-Field Watershed Name	USLE Risk Ratio Post-Fire, No Action	USLE Risk Ratio Proposed Action	2014 Fire Area
Jaynes Canyon	1.68	1.68	Beaver
Dutch Creek	1.65	1.66	Beaver
Lower West Fork Beaver Creek	1.65	1.65	Beaver
Soda Creek-Beaver Creek	1.59	1.59	Beaver
Doggett Creek	1.52	1.54	Beaver
Kohl Creek	1.50	1.51	Beaver
Lumgrey Creek	1.38	1.38	Beaver
O'Neil Creek	1.37	1.39	Happy Camp Complex
Buckhorn Gulch-Beaver Creek	1.28	1.28	Beaver
Rancheria Creek	1.14	1.14	Happy Camp Complex
Dona Creek-Klamath River	1.11	1.13	Beaver

Four of the 11 watersheds showed minor incremental increases in risk ratio. No 7th field watersheds that were below the TOC in alternative 1 were pushed over the TOC by alternative 2.

All of the CWE model results for alternative 2 support the finding that the risk of water quality impacts resulting from erosion and sedimentation is low at broad scales. The risk of water quality impacts from erosion and sedimentation at the 7th field scale is considered to be high for 12 watersheds under alternative 2. However, only O'Neil Creek moved in to the high-risk category between alternative 1 and alternative 2, and the incremental increase in risk to water quality between the two alternatives was minor.

A suite of approximately 150 legacy sediment sites will be repaired under any action alternative. The Forest and Water Board agreed that legacy sediment site treatments will be focused in Elk Creek due to its status as a Forest Plan-designated *key watershed* and because existing field data on repairs needed in Elk Creek were current and of high quality. Three 7th field watersheds that are considered high-risk for sedimentation based on CWE analysis fall within the Elk Creek 5th field watershed (Middle Elk, Bishop, and Granite creeks). As such, post-fire risk of sedimentation may be reduced by implementation of the project and associated legacy sediment site repairs.

Risk to Water Quality (Temperature)

Risk to stream temperature produced by moderate and high-severity wildfire in shade-producing Riparian Reserves was described for alternative 1 and is considered to be low due to the relatively limited extent of 2014 wildfire along perennial channels. However, the risk to stream temperature posed by mass-wasting and associated potential debris flows for small scale watersheds is greater. Table 18 displays six 7th field watersheds considered to be at high risk for mass-wasting in alternative 2. These watersheds are considered to be at moderate risk for potential vegetation-scouring debris flows and associated shade and temperature impacts.

Alternatives 2, 3 and 4 have proposed approximately 7,900 acres of site preparation and planting of native conifer species (Table 21). To the extent that planting is along perennial streams, shade will redevelop and stream temperature will benefit in the long-term.

Table 22: Acres of site preparation and subsequent planting of native conifer species proposed for alternatives 2, 3 and 4

	Beaver Fire	Happy Camp Complex	Whites Fire	Grand Total
Acres Site Preparation & Planting	1,782	5,470	654	7,906

All action alternatives have proposed approximately 11,000 acres of understory prescribed fire fuels treatment. These treatments can reduce the risk of widespread high-severity wildfire in the future and thus risk to Riparian Reserve canopy shade.

Risk to Channel Function

Similar to results from the analysis of alternative 1, negative effects to channel function are not expected related to the relatively limited amount of streamside acreage that burned in 2014. The risk of mass-wasting and potential resulting debris flows that can scour streamside vegetation is only slightly increased from alternative 1 to alternative 2 (Table 18). Acres of site preparation and planting in Riparian Reserves will benefit channel function long-term as planted areas develop in to mature forests that provide large wood to channels.

Cumulative Effects

Cumulative effects of alternative 2 depend on past, present, and reasonably foreseeable activities in the project area. Based on results of CWE modeling for 5th field and 7th field watersheds, the incremental increases in risk from alternative 1 to alternative 2 to channel form and function and water quality are minor. The Forest has produced CWE model outputs describing watershed effects of alternative 2 added to effects of past and present actions. If alternative 2 is implemented, then the cumulative effects from it and the past and current activities will recover over time. Cumulative effects of adding the effects of alternative 2 to those of reasonable future foreseeable actions listed in appendix C will be minor.

Alternative 3

Alternative 3 proposes vegetation treatments listed in chapter 2 of the DEIS. Of these, timber salvage, site preparation and planting, construction of temporary roads, legacy site repair, and prescribed fire may all affect water quality. Tables in chapter 2 of the DEIS display how treatments are distributed.

Alternative 4

Environmental effects of alternative 4 are similar to those of alternative 2 except less mileage of temporary roads means less disturbance.

Alternative 5

Environmental effects of alternative 5 will be the same as for alternative 2 except salvage harvesting, and site preparation and planting, only on matrix lands leads to fewer effects on water quality.

Direct and Indirect Effects

Direct and indirect effects on hydrologic function and water quality of Alternative 3, 4 or 5 will be less than those determined for alternative 2.

Cumulative Effects

Cumulative effects on hydrologic function and water quality of alternatives 3, 4 or 5 would be less than those determined for alternative 2 as displayed in the executive summary of this report and chapter 3 of the draft EIS.

Comparison of Effects

See table 2-34 for a summary of the effects of alternatives on water.

Compliance with law, regulation, policy, and the Forest Plan

Project analysis indicators were developed to be responsive to law, regulation and policy. TMDL requirements (Clean Water Act) of any action alternative will be met through the implementation of a legacy sediment site repair plan approved by the North Coast Regional Water Quality Control Board. In addition, any action alternative will need approval for enrollment in the *Waiver* program covering *Nonpoint Source Discharges Related to Certain Federal Land Management Activities on National Forest System Lands* (Order Number R1-2010-0029) prior to project activities commencing. Waiver requirements will be met for all action alternatives. The Aquatic Conservation Strategy report displays how each alternative addresses the aquatic conservation strategy to meet the standards of the Forest Plan. The Forest Plan consistency checklist displays how the project complies with the Forest Plan standards related to water.

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Appendix A: CWE model results.

Table 23: ERA risk ratios for alternatives and cumulative effects.

HUC_14	HU_14_NAME	Affected Environment ERA Risk Ratio	ERA Affected Environment Cumulative Risk Ratio	Alt 2 Risk Ratio (includes Affected Environment)	Alt2 Cumulative Risk Ratio [15]	Alt 3 Risk Ratio (includes Affected Environment)	Alt3 Cumulative Risk Ratio [15]	Alt 4 Risk Ratio (includes Affected Environment)	Alt 4 Cumulative Risk Ratio [15]	Alt 5 Risk Ratio (includes Affected Environment)	Alt 5 Cumulative Risk Ratio [15]
18010206080302	Lumgrey Creek	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
18010206080303	Vesa Creek	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
18010206080304	Miller Gulch-Klamath River	0.30	0.30	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
18010206090203	Soda Creek-Beaver Creek	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
18010206090301	Jaynes Canyon	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
18010206090303	Bear Creek	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
18010206090304	Lower West Fork Beaver Creek	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31
18010206090401	Dutch Creek	1.45	1.45	1.51	1.51	1.51	1.51	1.51	1.51	1.53	1.53
18010206090402	Buckhorn Gulch-Beaver Creek	1.10	1.10	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
18010206100201	Little Humbug Creek	0.20	0.21	0.20	0.21	0.20	0.21	0.20	0.21	0.20	0.21
18010206100202	Quigleys Cove-Klamath River	0.37	0.37	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
18010206100301	Doggett Creek	2.36	2.36	2.42	2.42	2.40	2.40	2.41	2.41	2.42	2.42
18010206100302	McKinney Creek	0.80	0.83	0.80	0.83	0.80	0.83	0.80	0.83	0.80	0.83
18010206100303	Dona Creek-Klamath River	0.89	0.89	0.92	0.93	0.91	0.92	0.92	0.93	0.92	0.93
18010206100406	Buckhorn Creek	0.95	0.95	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
18010206100501	Kohl Creek	1.56	1.56	1.58	1.58	1.58	1.58	1.57	1.57	1.58	1.58

HUC_14	HU_14_NAME	Affected Environment ERA Risk Ratio	ERA Affected Environment Cumulative Risk Ratio	Alt 2 Risk Ratio (includes Affected Environment)	Alt2 Cumulative Risk Ratio [15]	Alt 3 Risk Ratio (includes Affected Environment)	Alt3 Cumulative Risk Ratio [15]	Alt 4 Risk Ratio (includes Affected Environment)	Alt 4 Cumulative Risk Ratio [15]	Alt 5 Risk Ratio (includes Affected Environment)	Alt 5 Cumulative Risk Ratio [15]
18010206100502	Collins Creek-Klamath River	0.41	0.44	0.41	0.44	0.41	0.44	0.41	0.44	0.41	0.44
18010206100503	Sambo Gulch-Klamath River	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
18010206110101	Upper Grider Creek	0.41	0.41	0.44	0.44	0.44	0.44	0.42	0.42	0.42	0.42
18010206110102	Cliff Valley Creek	0.36	0.36	0.40	0.40	0.39	0.39	0.39	0.39	0.38	0.38
18010206110103	Rancheria Creek	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
18010206110104	Lower Grider Creek	0.70	0.70	0.75	0.75	0.75	0.75	0.75	0.75	0.72	0.72
18010206110205	Lower Seiad Creek	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
18010206110301	Tom Martin Creek-Klamath River	0.53	0.53	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
18010206110302	Negro Creek	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
18010206110303	O'Neil Creek	0.80	0.80	0.88	0.88	0.88	0.88	0.88	0.88	0.85	0.85
18010206110304	Schutts Gulch-Klamath River	0.59	0.59	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
18010206110305	Walker Creek	1.03	1.03	1.07	1.07	1.06	1.06	1.06	1.06	1.05	1.05
18010206110306	Caroline Creek-Klamath River	0.54	0.54	0.64	0.64	0.61	0.61	0.61	0.61	0.57	0.57
18010206110307	West Grider Creek-Klamath River	0.41	0.41	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
18010208020301	Upper French Creek	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
18010208020402	Sugar Creek	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
18010208060101	Upper Canyon Creek	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
18010208060301	North Fork Kelsey Creek	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
18010208060302	South Fork Kelsey Creek	0.21	0.25	0.21	0.25	0.21	0.25	0.21	0.25	0.21	0.25
18010208060401	Middle Creek	0.69	0.69	0.77	0.77	0.77	0.77	0.76	0.76	0.76	0.76
18010208060402	Deep Creek-Scott River	0.44	0.51	0.45	0.52	0.45	0.52	0.45	0.52	0.45	0.52

HUC_14	HU_14_NAME	Affected Environment ERA Risk Ratio	ERA Affected Environment Cumulative Risk Ratio	Alt 2 Risk Ratio (includes Affected Environment)	Alt2 Cumulative Risk Ratio [15]	Alt 3 Risk Ratio (includes Affected Environment)	Alt3 Cumulative Risk Ratio [15]	Alt 4 Risk Ratio (includes Affected Environment)	Alt 4 Cumulative Risk Ratio [15]	Alt 5 Risk Ratio (includes Affected Environment)	Alt 5 Cumulative Risk Ratio [15]
18010208060403	Tompkins Creek	0.54	0.54	0.58	0.58	0.57	0.57	0.57	0.57	0.57	0.57
18010208060601	McCarthy Creek-Scott River	0.50	0.50	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
18010208060602	Big Ferry-Swanson	1.13	1.13	1.16	1.16	1.16	1.16	1.15	1.15	1.16	1.16
18010208060603	Franklin Gulch-Scott River	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
18010209020302	China Creek	0.84	0.84	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
18010209020303	Horse Creek	0.70	0.70	0.78	0.78	0.77	0.77	0.78	0.78	0.77	0.77
18010209020305	Fryingpan Creek-Klamath River	0.58	0.58	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
18010209030101	Headwaters Elk Creek	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
18010209030102	Rainy Valley Creek	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
18010209030103	Toms Valley Creek-Elk Creek	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
18010209030104	Granite Creek	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
18010209030105	Middle Elk Creek	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
18010209030201	Upper East Fork Elk Creek	0.58	0.58	0.61	0.56	0.56	0.56	0.56	0.56	0.56	0.56
18010209030202	Upper Elk Creek	0.51	0.51	0.59	0.56	0.56	0.56	0.54	0.54	0.54	0.54
18010209030203	Lower East Fork Elk Creek	0.41	0.41	0.44	0.40	0.39	0.39	0.39	0.39	0.40	0.40
18010209030301	Bear Creek	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66
18010209030302	Bishop Creek-Elk Creek	0.57	0.57	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
18010209030303	Doolittle Creek	0.56	0.56	0.60	0.57	0.57	0.57	0.57	0.57	0.57	0.57
18010209030304	Cougar Creek-Elk Creek	0.39	0.39	0.41	0.37	0.37	0.37	0.37	0.37	0.37	0.37
18010209030305	Hoop&Devil-Elk Creek	0.39	0.39	0.56	0.53	0.53	0.53	0.53	0.53	0.53	0.53

HUC_14	HU_14_NAME	Affected Environment ERA Risk Ratio	ERA Affected Environment Cumulative Risk Ratio	Alt 2 Risk Ratio (includes Affected Environment)	Alt2 Cumulative Risk Ratio [15]	Alt 3 Risk Ratio (includes Affected Environment)	Alt3 Cumulative Risk Ratio [15]	Alt 4 Risk Ratio (includes Affected Environment)	Alt 4 Cumulative Risk Ratio [15]	Alt 5 Risk Ratio (includes Affected Environment)	Alt 5 Cumulative Risk Ratio [15]
18010209060103	Benjamin Creek-Klamath River	0.41	0.41	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
18010210010304	Sixmile Creek	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
18010210010306	Shadow Creek	0.55	0.55	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
18010210020301	Upper South Russian Creek	0.38	0.38	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
18010210020302	Music Creek	1.04	1.04	1.06	1.06	1.06	1.06	1.06	1.06	1.05	1.05
18010210020303	Lower South Russian Creek	0.88	0.88	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
18010210020401	Upper North Russian Creek	0.39	0.39	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
18010210020402	Taylor Creek	0.54	0.54	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
18010210020403	Lower North Russian Creek	0.76	0.76	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
18010210020502	Big Creek	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
18010210020503	Yellow Dog Creek-North Fork Salmon River	0.20	0.20	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
18010210020603	Specimen Creek	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
18010210020701	Whites Gulch	0.66	0.66	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
18010210020702	Robinson Gulch-North Fork Salmon River	0.74	0.84	0.76	0.85	0.76	0.85	0.76	0.85	0.76	0.85
18010210020703	Eddy Gulch	0.49	0.54	0.49	0.54	0.49	0.54	0.49	0.54	0.49	0.54
18010210020704	Jessups Gulch-North Fork Salmon River	0.45	1.22	0.45	1.22	0.45	1.22	0.45	1.22	0.45	1.22
18010210020705	Jackass Gulch	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26

Table 24: USLE model risk ratios by 7th field watershed and cumulative analysis.

HUC_14	HU_14_NAME	Risk Ratio [9]	Cumulative Risk Ratio	Alt 2 Risk Ratio	Alt2 Cumulative Risk Ratio [15]	Alt 3 Risk Ratio	Alt3 Cumulative Risk Ratio [15]	Alt 4 Risk Ratio	Alt4 Cumulative Risk Ratio [15]	Alt 5 Risk Ratio	Alt 5 Cumulative Risk Ratio [15]
18010206080302	Lumgrey Creek	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38
18010206080303	Vesa Creek	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
18010206080304	Miller Gulch-Klamath River	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
18010206090203	Soda Creek-Beaver Creek	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
18010206090301	Jaynes Canyon	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
18010206090303	Bear Creek	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
18010206090304	Lower West Fork Beaver Creek	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
18010206090401	Dutch Creek	1.65	1.66	1.65	1.66	1.65	1.66	1.65	1.66	1.65	1.66
18010206090402	Buckhorn Gulch-Beaver Creek	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28
18010206100201	Little Humbug Creek	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
18010206100202	Quigleys Cove-Klamath River	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
18010206100301	Doggett Creek	1.52	1.54	1.52	1.54	1.52	1.54	1.52	1.54	1.52	1.54
18010206100302	McKinney Creek	1.00	1.01	1.00	1.01	1.00	1.01	1.00	1.01	1.00	1.01
18010206100303	Dona Creek-Klamath River	1.11	1.13	1.11	1.13	1.11	1.13	1.11	1.13	1.11	1.13
18010206100406	Buckhorn Creek	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
18010206100501	Kohl Creek	1.50	1.51	1.50	1.51	1.50	1.51	1.50	1.51	1.50	1.51
18010206100502	Collins Creek-Klamath River	0.89	0.90	0.89	0.90	0.89	0.90	0.89	0.90	0.89	0.90
18010206100503	Sambo Gulch-Klamath River	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
18010206110101	Upper Grider Creek	0.54	0.55	0.54	0.55	0.54	0.55	0.54	0.55	0.54	0.55
18010206110102	Cliff Valley Creek	0.63	0.63	0.64	0.64	0.63	0.63	0.63	0.63	0.63	0.63
18010206110103	Rancheria Creek	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14
18010206110104	Lower Grider Creek	0.74	0.75	0.74	0.75	0.74	0.75	0.74	0.75	0.74	0.75
18010206110205	Lower Seiad Creek	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16

HUC_14	HU_14_NAME	Risk Ratio [9]	Cumulative Risk Ratio	Alt 2 Risk Ratio	Alt2 Cumulative Risk Ratio [15]	Alt 3 Risk Ratio	Alt3 Cumulative Risk Ratio [15]	Alt 4 Risk Ratio	Alt4 Cumulative Risk Ratio [15]	Alt 5 Risk Ratio	Alt 5 Cumulative Risk Ratio [15]
18010206110301	Tom Martin Creek-Klamath River	0.78	0.79	0.78	0.79	0.78	0.79	0.78	0.79	0.78	0.79
18010206110302	Negro Creek	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
18010206110303	O'Neil Creek	1.37	1.38	1.38	1.39	1.38	1.39	1.38	1.39	1.37	1.38
18010206110304	Schutts Gulch-Klamath River	0.71	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.71	0.72
18010206110305	Walker Creek	0.93	0.94	0.94	0.94	0.93	0.94	0.93	0.94	0.93	0.94
18010206110306	Caroline Creek-Klamath River	0.60	0.63	0.65	0.68	0.61	0.63	0.61	0.63	0.63	0.65
18010206110307	West Grider Creek-Klamath River	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
18010208020301	Upper French Creek	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
18010208020402	Sugar Creek	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
18010208060101	Upper Canyon Creek	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
18010208060301	North Fork Kelsey Creek	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
18010208060302	South Fork Kelsey Creek	0.18	0.19	0.18	0.19	0.18	0.19	0.18	0.19	0.18	0.19
18010208060401	Middle Creek	0.87	0.89	0.87	0.89	0.87	0.89	0.87	0.89	0.87	0.89
18010208060402	Deep Creek-Scott River	0.52	0.55	0.52	0.55	0.52	0.55	0.52	0.55	0.52	0.55
18010208060403	Tompkins Creek	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
18010208060601	McCarthy Creek-Scott River	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
18010208060602	Big Ferry-Swanson	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
18010208060603	Franklin Gulch-Scott River	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
18010209020302	China Creek	0.75	0.75	0.75	0.76	0.75	0.75	0.75	0.75	0.75	0.75
18010209020303	Horse Creek	0.86	0.88	0.86	0.88	0.86	0.88	0.86	0.88	0.86	0.88
18010209020305	Fryingpan Creek-Klamath River	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
18010209030101	Headwaters Elk Creek	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
18010209030102	Rainy Valley Creek	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
18010209030103	Toms Valley Creek-Elk Creek	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
18010209030104	Granite Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

HUC_14	HU_14_NAME	Risk Ratio [9]	Cumulative Risk Ratio	Alt 2 Risk Ratio	Alt2 Cumulative Risk Ratio [15]	Alt 3 Risk Ratio	Alt3 Cumulative Risk Ratio [15]	Alt 4 Risk Ratio	Alt4 Cumulative Risk Ratio [15]	Alt 5 Risk Ratio	Alt 5 Cumulative Risk Ratio [15]
18010209030105	Middle Elk Creek	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
18010209030201	Upper East Fork Elk Creek	0.84	0.84	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
18010209030202	Upper Elk Creek	0.80	0.81	0.78	0.79	0.78	0.78	0.78	0.78	0.78	0.78
18010209030203	Lower East Fork Elk Creek	0.88	0.89	0.79	0.80	0.79	0.80	0.79	0.80	0.79	0.80
18010209030301	Bear Creek	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
18010209030302	Bishop Creek-Elk Creek	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
18010209030303	Doolittle Creek	0.42	0.42	0.40	0.41	0.40	0.41	0.40	0.41	0.40	0.41
18010209030304	Cougar Creek-Elk Creek	0.50	0.50	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
18010209030305	Hoop&Devil-Elk Creek	0.63	0.63	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
18010209060103	Benjamin Creek-Klamath River	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
18010210010304	Sixmile Creek	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
18010210010306	Shadow Creek	0.96	0.96	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
18010210020301	Upper South Russian Creek	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
18010210020302	Music Creek	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
18010210020303	Lower South Russian Creek	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
18010210020401	Upper North Russian Creek	0.40	0.40	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
18010210020402	Taylor Creek	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
18010210020403	Lower North Russian Creek	0.79	0.79	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
18010210020502	Big Creek	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
18010210020503	Yellow Dog Creek-North Fork Salmon River	0.30	0.30	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
18010210020603	Specimen Creek	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
18010210020701	Whites Gulch	0.91	0.91	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
18010210020702	Robinson Gulch-North Fork Salmon River	0.85	0.89	0.85	0.89	0.85	0.89	0.85	0.89	0.85	0.89
18010210020703	Eddy Gulch	0.97	0.98	0.97	0.98	0.97	0.98	0.97	0.98	0.97	0.98

HUC_14	HU_14_NAME	Risk Ratio [9]	Cumulative Risk Ratio	Alt 2 Risk Ratio	Alt2 Cumulative Risk Ratio [15]	Alt 3 Risk Ratio	Alt3 Cumulative Risk Ratio [15]	Alt 4 Risk Ratio	Alt4 Cumulative Risk Ratio [15]	Alt 5 Risk Ratio	Alt 5 Cumulative Risk Ratio [15]
18010210020704	Jessups Gulch-North Fork Salmon River	0.40	0.61	0.40	0.61	0.40	0.61	0.40	0.61	0.40	0.61
18010210020705	Jackass Gulch	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27

Table 25: Mass-Wasting (GEO) CWE model risk ratios and cumulative effects analysis by 7th field watershed.

HUC_14	HU_14_NAME	Affected Environment Risk Ratio	Cumulative Risk Ratio - Alt. 1	alt 2 Risk Ratio	Alt2 Cumulative Risk Ratio [15]	alt 3 Risk Ratio	Alt3 Cumulative Risk Ratio [15]	alt 4 Risk Ratio	Alt 4 Cumulative Risk Ratio [15]	alt 5 Risk Ratio	Alt 5 Cumulative Risk Ratio [15]
18010206080302	Lumgrey Creek	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
18010206080303	Vesa Creek	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
18010206080304	Miller Gulch-Klamath River	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
18010206090203	Soda Creek-Beaver Creek	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46
18010206090301	Jaynes Canyon	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
18010206090303	Bear Creek	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
18010206090304	Lower West Fork Beaver Creek	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
18010206090401	Dutch Creek	0.93	0.93	0.96	0.96	0.96	0.96	0.96	0.96	0.98	0.98
18010206090402	Buckhorn Gulch-Beaver Creek	1.16	1.16	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17
18010206100201	Little Humbug Creek	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
18010206100202	Quigleys Cove-Klamath River	0.72	0.72	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
18010206100301	Doggett Creek	1.11	1.11	1.15	1.15	1.14	1.14	1.14	1.14	1.15	1.15
18010206100302	McKinney Creek	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.97
18010206100303	Dona Creek-Klamath River	1.16	1.16	1.20	1.20	1.19	1.19	1.20	1.20	1.20	1.20
18010206100406	Buckhorn Creek	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
18010206100501	Kohl Creek	1.18	1.18	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19
18010206100502	Collins Creek-Klamath River	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
18010206100503	Sambo Gulch-Klamath River	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
18010206110101	Upper Grider Creek	0.31	0.31	0.35	0.35	0.35	0.35	0.33	0.33	0.33	0.33
18010206110102	Cliff Valley Creek	0.33	0.33	0.34	0.34	0.33	0.33	0.33	0.33	0.33	0.33
18010206110103	Rancheria Creek	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
18010206110104	Lower Grider Creek	1.09	1.09	1.11	1.11	1.11	1.11	1.11	1.11	1.09	1.09

HUC_14	HU_14_NAME	Affected Environment Risk Ratio	Cumulative Risk Ratio - Alt. 1	alt 2 Risk Ratio	Alt2 Cumulative Risk Ratio [15]	alt 3 Risk Ratio	Alt3 Cumulative Risk Ratio [15]	alt 4 Risk Ratio	Alt 4 Cumulative Risk Ratio [15]	alt 5 Risk Ratio	Alt 5 Cumulative Risk Ratio [15]
18010206110205	Lower Seiad Creek	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
18010206110301	Tom Martin Creek-Klamath River	0.44	0.44	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
18010206110302	Negro Creek	1.50	1.50	1.51	1.51	1.50	1.50	1.50	1.50	1.50	1.50
18010206110303	O'Neil Creek	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
18010206110304	Schutts Gulch-Klamath River	1.89	1.89	1.92	1.92	1.91	1.91	1.91	1.91	1.90	1.90
18010206110305	Walker Creek	1.64	1.64	1.72	1.72	1.65	1.65	1.65	1.65	1.65	1.65
18010206110306	Caroline Creek-Klamath River	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
18010206110307	West Grider Creek-Klamath River	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
18010208020301	Upper French Creek	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
18010208020402	Sugar Creek	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
18010208060101	Upper Canyon Creek	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
18010208060301	North Fork Kelsey Creek	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
18010208060302	South Fork Kelsey Creek	0.35	0.38	0.35	0.38	0.35	0.38	0.35	0.38	0.35	0.38
18010208060401	Middle Creek	1.09	1.09	1.20	1.20	1.19	1.19	1.19	1.19	1.19	1.19
18010208060402	Deep Creek-Scott River	1.39	1.41	1.39	1.41	1.39	1.41	1.39	1.41	1.39	1.41
18010208060403	Tompkins Creek	0.85	0.85	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
18010208060601	McCarthy Creek-Scott River	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
18010208060602	Big Ferry-Swanson	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
18010208060603	Franklin Gulch-Scott River	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
18010209020302	China Creek	0.75	0.75	0.77	0.77	0.76	0.76	0.76	0.76	0.76	0.76
18010209020303	Horse Creek	0.76	0.76	0.85	0.85	0.84	0.84	0.85	0.85	0.84	0.84
18010209020305	Fryingpan Creek-Klamath River	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
18010209030101	Headwaters Elk Creek	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
18010209030102	Rainy Valley Creek	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
18010209030103	Toms Valley Creek-Elk Creek	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60

HUC_14	HU_14_NAME	Affected Environment Risk Ratio	Cumulative Risk Ratio - Alt. 1	alt 2 Risk Ratio	Alt2 Cumulative Risk Ratio [15]	alt 3 Risk Ratio	Alt3 Cumulative Risk Ratio [15]	alt 4 Risk Ratio	Alt 4 Cumulative Risk Ratio [15]	alt 5 Risk Ratio	Alt 5 Cumulative Risk Ratio [15]
18010209030104	Granite Creek	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52
18010209030105	Middle Elk Creek	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85
18010209030201	Upper East Fork Elk Creek	0.54	0.54	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
18010209030202	Upper Elk Creek	0.43	0.43	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
18010209030203	Lower East Fork Elk Creek	0.48	0.48	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
18010209030301	Bear Creek	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
18010209030302	Bishop Creek-Elk Creek	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76
18010209030303	Doolittle Creek	0.46	0.46	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
18010209030304	Cougar Creek-Elk Creek	0.64	0.64	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
18010209030305	Hoop&Devil-Elk Creek	0.60	0.60	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
18010209060103	Benjamin Creek-Klamath River	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
18010210010304	Sixmile Creek	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
18010210010306	Shadow Creek	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
18010210020301	Upper South Russian Creek	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
18010210020302	Music Creek	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
18010210020303	Lower South Russian Creek	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66
18010210020401	Upper North Russian Creek	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
18010210020402	Taylor Creek	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
18010210020403	Lower North Russian Creek	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
18010210020502	Big Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18010210020503	Yellow Dog Creek-North Fork Salmon River	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
18010210020603	Specimen Creek	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
18010210020701	Whites Gulch	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
18010210020702	Robinson Gulch-North Fork Salmon River	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80

HUC_14	HU_14_NAME	Affected Environment Risk Ratio	Cumulative Risk Ratio - Alt. 1	alt 2 Risk Ratio	Alt2 Cumulative Risk Ratio [15]	alt 3 Risk Ratio	Alt3 Cumulative Risk Ratio [15]	alt 4 Risk Ratio	Alt 4 Cumulative Risk Ratio [15]	alt 5 Risk Ratio	Alt 5 Cumulative Risk Ratio [15]
18010210020703	Eddy Gulch	0.76	0.77	0.76	0.77	0.76	0.77	0.76	0.77	0.76	0.77
18010210020704	Jessups Gulch-North Fork Salmon River	0.59	0.66	0.59	0.66	0.59	0.66	0.59	0.66	0.59	0.66
18010210020705	Jackass Gulch	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19

Appendix B: Model Results for Analysis Indicators

Table 26: Risk to channel morphology by alternative and cumulative risk.

HUC_14	HU_14_NAME	Affected Env. Channel Morphology Risk	Alt. 1 Cumulative Effects Channel Morphology Risk	Alt 2 Channel Morphology Risk	Alt 2 Channel Morphology Cumulative Risk	Alt 3 Channel Morphology Risk	Alt 3 Channel Morphology Cumulative Risk	Alt 4 Channel Morphology Risk	Alt 4 Channel Morphology Cumulative Risk	Alt 5 Channel Morphology Risk	Alt 5 Channel Morphology Cumulative Risk
18010206080302	Lumgrey Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206080303	Vesa Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206080304	Miller Gulch-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206090203	Soda Creek-Beaver Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206090301	Jaynes Canyon	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206090303	Bear Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206090304	Lower West Fork Beaver Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206090401	Dutch Creek	Moderate	Moderate	High	High	High	High	High	High	High	High
18010206090402	Buckhorn Gulch-Beaver Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206100201	Little Humbug Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206100202	Quigleys Cove-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206100301	Doggett Creek	High	High	High	High	High	High	High	High	High	High
18010206100302	McKinney Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206100303	Dona Creek-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206100406	Buckhorn Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206100501	Kohl Creek	High	High	High	High	High	High	High	High	High	High

HUC_14	HU_14_NAME	Affected Env. Channel Morphology Risk	Alt. 1 Cumulative Effects Channel Morphology Risk	Alt 2 Channel Morphology Risk	Alt 2 Channel Morphology Cumulative Risk	Alt 3 Channel Morphology Risk	Alt 3 Channel Morphology Cumulative Risk	Alt 4 Channel Morphology Risk	Alt 4 Channel Morphology Cumulative Risk	Alt 5 Channel Morphology Risk	Alt 5 Channel Morphology Cumulative Risk
18010206100502	Collins Creek-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206100503	Sambo Gulch-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110101	Upper Grider Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110102	Cliff Valley Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110103	Rancheria Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110104	Lower Grider Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110205	Lower Seiad Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110301	Tom Martin Creek-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110302	Negro Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110303	O'Neil Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110304	Schutts Gulch-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110305	Walker Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206110306	Caroline Creek-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110307	West Grider Creek-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208020301	Upper French Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208020402	Sugar Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208060101	Upper Canyon Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208060301	North Fork Kelsey Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208060302	South Fork Kelsey Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208060401	Middle Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

HUC_14	HU_14_NAME	Affected Env. Channel Morphology Risk	Alt. 1 Cumulative Effects Channel Morphology Risk	Alt 2 Channel Morphology Risk	Alt 2 Channel Morphology Cumulative Risk	Alt 3 Channel Morphology Risk	Alt 3 Channel Morphology Cumulative Risk	Alt 4 Channel Morphology Risk	Alt 4 Channel Morphology Cumulative Risk	Alt 5 Channel Morphology Risk	Alt 5 Channel Morphology Cumulative Risk
18010208060402	Deep Creek-Scott River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208060403	Tompkins Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208060601	McCarthy Creek-Scott River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208060602	Big Ferry-Swanson	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010208060603	Franklin Gulch-Scott River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209020302	China Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209020303	Horse Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209020305	Fryingpan Creek-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030101	Headwaters Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030102	Rainy Valley Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030103	Toms Valley Creek-Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030104	Granite Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030105	Middle Elk Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010209030201	Upper East Fork Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030202	Upper Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030203	Lower East Fork Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030301	Bear Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030302	Bishop Creek-Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030303	Doolittle Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030304	Cougar Creek-Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

HUC_14	HU_14_NAME	Affected Env. Channel Morphology Risk	Alt. 1 Cumulative Effects Channel Morphology Risk	Alt 2 Channel Morphology Risk	Alt 2 Channel Morphology Cumulative Risk	Alt 3 Channel Morphology Risk	Alt 3 Channel Morphology Cumulative Risk	Alt 4 Channel Morphology Risk	Alt 4 Channel Morphology Cumulative Risk	Alt 5 Channel Morphology Risk	Alt 5 Channel Morphology Cumulative Risk
18010209030305	Hoop&Devil-Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209060103	Benjamin Creek-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210010304	Sixmile Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210010306	Shadow Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020301	Upper South Russian Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020302	Music Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010210020303	Lower South Russian Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020401	Upper North Russian Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020402	Taylor Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020403	Lower North Russian Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020502	Big Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020503	Yellow Dog Creek-North Fork Salmon River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020603	Specimen Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020701	Whites Gulch	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020702	Robinson Gulch-North Fork Salmon River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020703	Eddy Gulch	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020704	Jessups Gulch-North Fork Salmon River	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate
18010210020705	Jackass Gulch	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Table 27: Risk to sediment regime for 7th field watersheds and cumulative analysis.

HUC_14	HU_14_NAME	Current Condition risk to Sediment Regime	Alt. 1 Cumulative Risk to Sediment Regime	Alt. 2 Risk to Sediment Regime	Alt. 2 Cumulatie Risk to Sediment Regime	Alt. 3 Risk to Sediment Regime	Alt. 3 Cumulatie Risk to Sediment Regime	Alt. 4 Risk to Sediment Regime	Alt. 4 Cumulatie Risk to Sediment Regime	Alt. 5 Risk to Sediment Regime	Alt. 5 Cumulatie Risk to Sediment Regime
18010206080302	Lumgrey Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206080303	Vesa Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206080304	Miller Gulch-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206090203	Soda Creek-Beaver Creek	High	High	High	High	High	High	High	High	High	High
18010206090301	Jaynes Canyon	Moderate	Moderate	moderate	Moderate	moderate	Moderate	moderate	Moderate	moderate	Moderate
18010206090303	Bear Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206090304	Lower West Fork Beaver Creek	High	high	High	High	High	High	High	High	High	High
18010206090401	Dutch Creek	Moderate	Moderate	moderate	Moderate	moderate	Moderate	moderate	Moderate	moderate	Moderate
18010206090402	Buckhorn Gulch-Beaver Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206100201	Little Humbug Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206100202	Quigleys Cove-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206100301	Doggett Creek	High	High	High	High	High	High	High	High	High	High
18010206100302	McKinney Creek	High	high	High	High	High	High	High	High	High	High
18010206100303	Dona Creek-Klamath River	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206100406	Buckhorn Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206100501	Kohl Creek	High	High	High	High	High	High	High	High	High	High
18010206100502	Collins Creek-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206100503	Sambo Gulch-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110101	Upper Grider Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110102	Cliff Valley Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

HUC_14	HU_14_NAME	Current Condition risk to Sediment Regime	Alt. 1 Cumulative Risk to Sediment Regime	Alt. 2 Risk to Sediment Regime	Alt. 2 Cumulatie Risk to Sediment Regime	Alt. 3 Risk to Sediment Regime	Alt. 3 Cumulatie Risk to Sediment Regime	Alt. 4 Risk to Sediment Regime	Alt. 4 Cumulatie Risk to Sediment Regime	Alt. 5 Risk to Sediment Regime	Alt. 5 Cumulatie Risk to Sediment Regime
18010206110103	Rancheria Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206110104	Lower Grider Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206110205	Lower Seiad Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110301	Tom Martin Creek-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110302	Negro Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206110303	O'Neil Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206110304	Schutts Gulch-Klamath River	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206110305	Walker Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206110306	Caroline Creek-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010206110307	West Grider Creek-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208020301	Upper French Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208020402	Sugar Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208060101	Upper Canyon Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208060301	North Fork Kelsey Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208060302	South Fork Kelsey Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208060401	Middle Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010208060402	Deep Creek-Scott River	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010208060403	Tompkins Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208060601	McCarthy Creek-Scott River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010208060602	Big Ferry-Swanson	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

HUC_14	HU_14_NAME	Current Condition risk to Sediment Regime	Alt. 1 Cumulative Risk to Sediment Regime	Alt. 2 Risk to Sediment Regime	Alt. 2 Cumulatie Risk to Sediment Regime	Alt. 3 Risk to Sediment Regime	Alt. 3 Cumulatie Risk to Sediment Regime	Alt. 4 Risk to Sediment Regime	Alt. 4 Cumulatie Risk to Sediment Regime	Alt. 5 Risk to Sediment Regime	Alt. 5 Cumulatie Risk to Sediment Regime
18010208060603	Franklin Gulch-Scott River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209020302	China Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209020303	Horse Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209020305	Fryingpan Creek-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030101	Headwaters Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030102	Rainy Valley Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030103	Toms Valley Creek-Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030104	Granite Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010209030105	Middle Elk Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010209030201	Upper East Fork Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030202	Upper Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030203	Lower East Fork Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030301	Bear Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010209030302	Bishop Creek-Elk Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010209030303	Doolittle Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030304	Cougar Creek-Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209030305	Hoop&Devil-Elk Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010209060103	Benjamin Creek-Klamath River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210010304	Sixmile Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210010306	Shadow Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020301	Upper South Russian Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020302	Music Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

HUC_14	HU_14_NAME	Current Condition risk to Sediment Regime	Alt. 1 Cumulative Risk to Sediment Regime	Alt. 2 Risk to Sediment Regime	Alt. 2 Cumulatie Risk to Sediment Regime	Alt. 3 Risk to Sediment Regime	Alt. 3 Cumulatie Risk to Sediment Regime	Alt. 4 Risk to Sediment Regime	Alt. 4 Cumulatie Risk to Sediment Regime	Alt. 5 Risk to Sediment Regime	Alt. 5 Cumulatie Risk to Sediment Regime
18010210020303	Lower South Russian Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020401	Upper North Russian Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020402	Taylor Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020403	Lower North Russian Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020502	Big Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020503	Yellow Dog Creek-North Fork Salmon River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020603	Specimen Creek	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020701	Whites Gulch	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020702	Robinson Gulch-North Fork Salmon River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020703	Eddy Gulch	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020704	Jessups Gulch-North Fork Salmon River	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18010210020705	Jackass Gulch	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Table 28: Percent of 7th field watershed Riparian Reserves with potential shade reduction.

HUC_14	HU_14_NAME	Alt. 1, 2, 3, 4 and 5 Landslide Likelihood (From Geology Report)	Average of RRAcres	percent RR with high and moderate veg. burn severity	Cumulative Percent RR with Potential Shade Reduction	Alt 2, 3 and 5 percent of RR with potential shade reduction	Alt 2, 3 and 5 cumulative percent of RR with potential shade reduction	Alt 4 percent of RR with Potenial Shade Reduction	Alt 4 Cumulative percent of RR with Potenial Shade Reduction
18010206080302	Lumgrey Creek	Highly Likely	1326.362	1.4%	1.4%	3.9%	4.0%	3.9%	4.0%
18010206080303	Vesa Creek	Likely	758.2052	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18010206080304	Miller Gulch-Klamath River	Likely	1588.913	15.1%	15.3%	27.4%	27.6%	27.4%	27.6%
18010206090203	Soda Creek-Beaver Creek	Highly Likely	1655.961	6.7%	6.8%	9.7%	9.8%	8.8%	9.0%
18010206090301	Jaynes Canyon	Likely	1451.229	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18010206090303	Bear Creek	Likely	869.5767	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18010206090304	Lower West Fork Beaver Creek	Highly Likely	970.0323	0.7%	0.7%	3.5%	3.6%	2.4%	2.5%
18010206090401	Dutch Creek	Highly Likely	778.1609	35.4%	42.0%	39.2%	45.9%	37.3%	43.9%
18010206090402	Buckhorn Gulch-Beaver Creek	Highly Likely	1971.83	53.3%	53.9%	59.1%	59.7%	59.0%	59.6%
18010206100201	Little Humbug Creek	Likely	1605.235	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18010206100202	Quigleys Cove-Klamath River	Likely	1721.524	22.3%	22.7%	24.3%	24.7%	24.3%	24.7%
18010206100301	Doggett Creek	Highly Likely	2023.834	25.3%	33.9%	29.4%	38.0%	29.0%	37.6%
18010206100302	McKinney Creek	Likely	1946.548	0.0%	7.6%	0.0%	7.6%	0.0%	7.6%
18010206100303	Dona Creek-Klamath River	Highly Likely	1141.912	29.5%	30.7%	31.4%	32.6%	31.4%	32.6%
18010206100406	Buckhorn Creek	Likely	2228.325	4.2%	4.2%	4.6%	4.6%	4.4%	4.4%

HUC_14	HU_14_NAME	Alt. 1, 2, 3, 4 and 5 Landslide Likelihood (From Geology Report)	Average of RRAcres	percent RR with high and moderate veg. burn severity	Cumulative Percent RR with Potential Shade Reduction	Alt 2, 3 and 5 percent of RR with potential shade reduction	Alt 2, 3 and 5 cumulative percent of RR with potential shade reduction	Alt 4 percent of RR with Potenial Shade Reduction	Alt 4 Cumulative percent of RR with Potenial Shade Reduction
18010206100501	Kohl Creek	Highly Likely	874.8382	68.0%	68.3%	69.7%	70.1%	69.7%	70.1%
18010206100502	Collins Creek-Klamath River	Likely	2011.732	9.6%	10.6%	11.8%	12.8%	11.6%	12.7%
18010206100503	Sambo Gulch-Klamath River	Likely	1431.194	0.0%	0.1%	0.5%	0.5%	0.5%	0.5%
18010206110101	Upper Grider Creek	Likely	1800.033	19.2%	19.2%	20.6%	20.6%	20.6%	20.6%
18010206110102	Cliff Valley Creek	Likely	883.08	9.1%	9.1%	18.8%	18.8%	18.8%	18.8%
18010206110103	Rancheria Creek	Highly Likely	828.9872	48.3%	48.6%	49.5%	49.8%	49.5%	49.8%
18010206110104	Lower Grider Creek	Almost Certain	2447.839	27.9%	28.0%	31.1%	31.1%	31.1%	31.1%
18010206110205	Lower Seiad Creek	Highly Likely	852.707	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18010206110301	Tom Martin Creek-Klamath River	Likely	2300.864	18.4%	19.1%	23.7%	24.4%	23.7%	24.4%
18010206110302	Negro Creek	Likely	415.4481	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18010206110303	O'Neil Creek	Almost Certain	419.2753	13.9%	13.9%	25.9%	25.9%	25.9%	25.9%
18010206110304	Schutts Gulch-Klamath River	Highly Likely	1544.863	3.2%	3.2%	12.4%	12.5%	12.4%	12.5%
18010206110305	Walker Creek	Almost Certain	1639.116	19.6%	19.6%	34.2%	34.2%	34.2%	34.2%
18010206110306	Caroline Creek-Klamath River	Almost Certain	476.813	1.4%	1.4%	9.2%	9.2%	9.2%	9.2%
18010206110307	West Grider Creek-Klamath River	Likely	955.4937	0.3%	0.3%	4.8%	4.8%	4.5%	4.5%
18010208020301	Upper French Creek	Likely	2703	0.1%	3.1%	0.1%	3.1%	0.1%	3.1%
18010208020402	Sugar Creek	Unlikely	2200.162	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

HUC_14	HU_14_NAME	Alt. 1, 2, 3, 4 and 5 Landslide Likelihood (From Geology Report)	Average of RRAcres	percent RR with high and moderate veg. burn severity	Cumulative Percent RR with Potential Shade Reduction	Alt 2, 3 and 5 percent of RR with potential shade reduction	Alt 2, 3 and 5 cumulative percent of RR with potential shade reduction	Alt 4 percent of RR with Potenial Shade Reduction	Alt 4 Cumulative percent of RR with Potenial Shade Reduction
18010208060101	Upper Canyon Creek	Unlikely	1175.76	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18010208060301	North Fork Kelsey Creek	Likely	1376.303	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%
18010208060302	South Fork Kelsey Creek	Likely	1434.728	1.0%	1.0%	2.8%	2.8%	2.8%	2.8%
18010208060401	Middle Creek	Highly Likely	1043.572	5.9%	5.9%	17.9%	17.9%	15.2%	15.2%
18010208060402	Deep Creek-Scott River	Highly Likely	930.7913	1.2%	1.5%	17.1%	17.4%	16.4%	16.7%
18010208060403	Tompkins Creek	Likely	2141.828	6.3%	6.4%	19.1%	19.1%	18.7%	18.8%
18010208060601	McCarthy Creek-Scott River	Likely	2682.293	2.4%	3.4%	7.1%	8.2%	6.8%	7.8%
18010208060602	Big Ferry-Swanson	Highly Likely	2025.049	2.8%	15.2%	6.6%	19.0%	6.3%	18.7%
18010208060603	Franklin Gulch-Scott River	Likely	1412.4	5.9%	6.0%	13.0%	13.1%	12.8%	13.0%
18010209020302	China Creek	Likely	1407.568	4.4%	4.5%	4.5%	4.6%	4.5%	4.6%
18010209020303	Horse Creek	Likely	544.0291	9.9%	9.9%	49.9%	49.9%	46.8%	46.8%
18010209020305	Fryingpan Creek-Klamath River	Likely	1929.157	2.6%	2.6%	7.1%	7.2%	7.1%	7.2%
18010209030101	Headwaters Elk Creek	Likely	579.1567	0.0%	0.0%	23.8%	23.8%	23.2%	23.2%
18010209030102	Rainy Valley Creek	Likely	773.0939	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18010209030103	Toms Valley Creek-Elk Creek	Likely	1069.399	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18010209030104	Granite Creek	Almost Certain	2236.083	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18010209030105	Middle Elk Creek	Almost Certain	652.0944	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

HUC_14	HU_14_NAME	Alt. 1, 2, 3, 4 and 5 Landslide Likelihood (From Geology Report)	Average of RRAcres	percent RR with high and moderate veg. burn severity	Cumulative Percent RR with Potential Shade Reduction	Alt 2, 3 and 5 percent of RR with potential shade reduction	Alt 2, 3 and 5 cumulative percent of RR with potential shade reduction	Alt 4 percent of RR with Potenial Shade Reduction	Alt 4 Cumulative percent of RR with Potenial Shade Reduction
18010209030201	Upper East Fork Elk Creek	Likely	898.7333	19.6%	19.6%	19.6%	19.6%	19.6%	19.6%
18010209030202	Upper Elk Creek	Likely	627.6835	12.6%	12.6%	33.4%	33.4%	33.4%	33.4%
18010209030203	Lower East Fork Elk Creek	Likely	708.1362	19.0%	19.0%	27.3%	27.3%	27.3%	27.3%
18010209030301	Bear Creek	Highly Likely	1451.119	5.0%	5.0%	12.6%	12.6%	12.6%	12.6%
18010209030302	Bishop Creek-Elk Creek	Highly Likely	2112.62	0.0%	0.0%	1.5%	1.5%	1.5%	1.5%
18010209030303	Doolittle Creek	Highly Likely	910.7846	9.3%	9.3%	11.4%	11.4%	11.4%	11.4%
18010209030304	Cougar Creek-Elk Creek	Likely	1824.184	3.1%	3.1%	7.6%	7.6%	7.6%	7.6%
18010209030305	Hoop&Devil-Elk Creek	Likely	739.3112	1.6%	1.6%	41.6%	41.6%	41.6%	41.6%
18010209060103	Benjamin Creek-Klamath River	Likely	2561.368	0.0%	0.6%	4.8%	5.4%	4.8%	5.4%
18010210010304	Sixmile Creek	Likely	998.3152	2.7%	2.7%	7.3%	7.3%	7.3%	7.3%
18010210010306	Shadow Creek	Likely	1276.73	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
18010210020301	Upper South Russian Creek	Likely	1707.45	10.6%	10.6%	10.7%	10.7%	10.7%	10.7%
18010210020302	Music Creek	Highly Likely	636.3573	35.6%	35.6%	41.0%	41.0%	41.0%	41.0%
18010210020303	Lower South Russian Creek	Likely	463.8749	12.7%	12.7%	22.2%	22.2%	22.2%	22.2%
18010210020401	Upper North Russian Creek	Highly Likely	647.7315	2.4%	2.4%	12.6%	12.6%	12.6%	12.6%
18010210020402	Taylor Creek	Likely	1167.836	10.8%	10.8%	18.0%	18.0%	18.0%	18.0%
18010210020403	Lower North Russian Creek	Highly Likely	1068.43	20.6%	20.6%	24.3%	24.4%	24.3%	24.4%

HUC_14	HU_14_NAME	Alt. 1, 2, 3, 4 and 5 Landslide Likelihood (From Geology Report)	Average of RRAcres	percent RR with high and moderate veg. burn severity	Cumulative Percent RR with Potential Shade Reduction	Alt 2, 3 and 5 percent of RR with potential shade reduction	Alt 2, 3 and 5 cumulative percent of RR with potential shade reduction	Alt 4 percent of RR with Potenial Shade Reduction	Alt 4 Cumulative percent of RR with Potenial Shade Reduction
18010210020502	Big Creek	Likely	549.0673	0.0%	0.0%	28.4%	28.4%	28.4%	28.4%
18010210020503	Yellow Dog Creek-North Fork Salmon River	Likely	2336.541	10.5%	10.5%	10.5%	10.5%	10.5%	10.5%
18010210020603	Specimen Creek	Likely	1008.812	0.0%	0.0%	2.0%	2.0%	2.0%	2.0%
18010210020701	Whites Gulch	Highly Likely	1878.558	27.5%	27.5%	27.5%	27.5%	27.5%	27.5%
18010210020702	Robinson Gulch-North Fork Salmon River	Highly Likely	1246.591	36.8%	36.8%	54.0%	54.0%	54.0%	54.0%
18010210020703	Eddy Gulch	Likely	1073.838	0.0%	0.0%	11.9%	11.9%	11.9%	11.9%
18010210020704	Jessups Gulch-North Fork Salmon River	Likely	1068.646	0.0%	0.0%	0.2%	0.2%	0.2%	0.2%
18010210020705	Jackass Gulch	Likely	686.3235	0.0%	0.0%	0.4%	0.4%	0.4%	0.4%

Table 29: Risk to temperature regime alteration by 7th field watersheds and cumulative analysis.

HUC_14	HU_14_NAME	Current Risk to Temperature Regime Alteration	Cumulative Current Risk to Temperature Regime Alteration	Alt 2, 3 and 5 Risk to Temperature Regime Alteration	Cumulative Alt. 2, 3, and 5 Risk to Temperature Regime Alteration	Cumulative Alt. 4 Risk to Temperature Regime Alteration	Cumulative Alt. 4 Risk to Temperature Regime Alteration
18010206080302	Lumgrey Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206080303	Vesa Creek	Low	Low	Low	Low	Low	Low
18010206080304	Miller Gulch-Klamath River	Low	Low	Moderate	Moderate	Moderate	Moderate
18010206090203	Soda Creek-Beaver Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206090301	Jaynes Canyon	Low	Low	Low	Low	Low	Low
18010206090303	Bear Creek	Low	Low	Low	Low	Low	Low
18010206090304	Lower West Fork Beaver Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206090401	Dutch Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206090402	Buckhorn Gulch-Beaver Creek	High	High	High	High	High	High
18010206100201	Little Humbug Creek	Low	Low	Low	Low	Low	Low
18010206100202	Quigleys Cove-Klamath River	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206100301	Doggett Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206100302	McKinney Creek	Low	Low	Low	Low	Low	Low
18010206100303	Dona Creek-Klamath River	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206100406	Buckhorn Creek	Low	Low	Low	Low	Low	Low
18010206100501	Kohl Creek	High	High	High	High	High	High
18010206100502	Collins Creek-Klamath River	Low	Low	Low	Low	Low	Low
18010206100503	Sambo Gulch-Klamath River	Low	Low	Low	Low	Low	Low
18010206110101	Upper Grider Creek	Low	Low	Moderate	Moderate	Moderate	Moderate
18010206110102	Cliff Valley Creek	Low	Low	Low	Low	Low	Low
18010206110103	Rancheria Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

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18010206110104	Lower Grider Creek	high	High	High	High	High	High
18010206110205	Lower Seiad Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206110301	Tom Martin Creek-Klamath River	Low	Low	Moderate	Moderate	Moderate	Moderate
18010206110302	Negro Creek	Low	Low	Low	Low	Low	Low
18010206110303	O'Neil Creek	High	High	High	High	High	High
18010206110304	Schutts Gulch-Klamath River	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010206110305	Walker Creek	High	High	High	High	High	High
18010206110306	Caroline Creek-Klamath River	High	High	High	High	High	High
18010206110307	West Grider Creek-Klamath River	Low	Low	Low	Low	Low	Low
18010208020301	Upper French Creek	Low	Low	Low	Low	Low	Low
18010208020402	Sugar Creek	Low	Low	Low	Low	Low	Low
18010208060101	Upper Canyon Creek	Low	Low	Low	Low	Low	Low
18010208060301	North Fork Kelsey Creek	Low	Low	Low	Low	Low	Low
18010208060302	South Fork Kelsey Creek	Low	Low	Low	Low	Low	Low
18010208060401	Middle Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010208060402	Deep Creek-Scott River	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010208060403	Tompkins Creek	Low	Low	Low	Low	Low	Low
18010208060601	McCarthy Creek-Scott River	Low	Low	Low	Low	low	Low
18010208060602	Big Ferry-Swanson	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010208060603	Franklin Gulch-Scott River	Low	Low	Low	Low	Low	Low
18010209020302	China Creek	Low	Low	Low	Low	Low	Low
18010209020303	Horse Creek	Low	Low	Moderate	Moderate	Moderate	Moderate

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18010209020305	Fryingpan Creek-Klamath River	Low	Low	Low	Low	low	Low
18010209030101	Headwaters Elk Creek	Low	Low	Moderate	Moderate	Moderate	Moderate
18010209030102	Rainy Valley Creek	Low	Low	Low	Low	Low	Low
18010209030103	Toms Valley Creek-Elk Creek	Low	Low	Low	Low	Low	Low
18010209030104	Granite Creek	High	High	High	High	High	High
18010209030105	Middle Elk Creek	High	High	High	High	High	High
18010209030201	Upper East Fork Elk Creek	Low	Low	Low	Low	Low	Low
18010209030202	Upper Elk Creek	Low	Low	Moderate	Moderate	Moderate	Moderate
18010209030203	Lower East Fork Elk Creek	Low	Low	Moderate	Moderate	Moderate	Moderate
18010209030301	Bear Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010209030302	Bishop Creek-Elk Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010209030303	Doolittle Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010209030304	Cougar Creek-Elk Creek	Low	Low	Low	Low	low	Low
18010209030305	Hoop&Devil-Elk Creek	Low	Low	Moderate	Moderate	Moderate	Moderate
18010209060103	Benjamin Creek-Klamath River	Low	Low	Low	Low	Low	Low
18010210010304	Sixmile Creek	Low	Low	Low	Low	low	Low
18010210010306	Shadow Creek	Low	Low	Low	Low	Low	Low
18010210020301	Upper South Russian Creek	Low	Low	Low	Low	Low	Low
18010210020302	Music Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010210020303	Lower South Russian Creek	Low	Low	Moderate	Moderate	Moderate	Moderate
18010210020401	Upper North Russian Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010210020402	Taylor Creek	Low	Low	Low	Low	Low	Low

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18010210020403	Lower North Russian Creek	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010210020502	Big Creek	Low	Low	Moderate	Moderate	Moderate	Moderate
18010210020503	Yellow Dog Creek-North Fork Salmon River	Low	Low	Low	Low	Low	Low
18010210020603	Specimen Creek	Low	Low	Low	Low	Low	Low
18010210020701	Whites Gulch	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
18010210020702	Robinson Gulch-North Fork Salmon River	Moderate	Moderate	High	High	High	High
18010210020703	Eddy Gulch	Low	Low	Low	Low	Low	Low
18010210020704	Jessups Gulch-North Fork Salmon River	Low	Low	Low	Low	Low	Low
18010210020705	Jackass Gulch	Low	Low	Low	Low	Low	Low