Hydrology Specialist Report
Rough Fire North Zone BAER Assessment
Sierra National Forest
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by
Keith Andy Stone (Sequoia National Forest)
Elwood Cliff Raley (Trainee- Sierra National Forest)
BAER Team Hydrologists

Executive Summary

The Rough Fire burned 30,822 acres of watershed in the north zone analysis area (NZAA) on the Sierra National Forest within the Kings River watershed (Figure 1). The fire burned dense mixed conifer forest, oak scrubland, and annual grasses on slopes and drainages that have not burned in recent years. The fire within the NZAA was confined north of the South Fork Kings River and south of the North Fork of the Kings River from Pine Flat Reservoir in the west to the vicinity of Wet Meadow near Crown Valley in the east. The overall soil burn severity showed 6% high, 27% moderate, 51% low, and 16% very low to unburned. Hydrological analysis was conducted on four HUC12 watersheds and 19 pour points defined at Values at Risk. To capture the most probable storm type and the potential El Nino, 2, 25, 50, and 100 year design storms were used to model the post-fire watershed response. Most HUC12 watersheds and pour points showed minimal increases (<50%) in runoff from fire effects, but several drainage crossings along trail 27E40 and roads 11S12 and 11S12C showed increased runoff over 100% (Figure 2). The only VAR that rated "High" for life and property (from flood damage) includes campgrounds and dispersed camping along the South Fork of the Kings River, which is accessed by Forest Service road 12S01. The recommended treatment is seasonal closure of 12S01 from October, 2015 to April, 2015, with signage notifying the public of the relevant hazards.

Objectives

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

Initial Concerns

- Threats to human health and life within and downstream of the burned area.
- Threats to roads, stream crossings, or other man-made developments or property that are downstream of the fire and are at risk of being removed or damaged from future storm events. Threats identified for potential flood risk include:
    - Pine Flat Reservoir
    - Kirch Flat Campground

- Campgrounds and dispersed camping areas along Forest Service road 12S01
- Culvert and road impacts along Forest Service roads 12S01, 11S12 and 11S12C
- Erosion impacts to trail 27E40
- Balch Camp
- Black Rock Reservoir

- Threats to water quality.

I. Resource Condition Assessment

A. Resource Setting

For analysis purposes, the Rough Fire was broken into a north zone and south zone. This was done because of sustained fire activity in the southern part of the fire during the initial phase of the BAER assessment and the need to implement treatments in a timely fashion for values at risk identified in the northern part of the fire.

The Rough Fire burned 30,822 acres of watershed in the north zone analysis area (NZAA) on the Sierra National Forest within the Kings River watershed. The fire within the NZAA was confined north of the South Fork Kings River and south of the North Fork of the Kings River from Pine Flat Reservoir in the west to the vicinity of Wet Meadow near Crown Valley in the east (Figure 1). The fire burned dense mixed conifer forest, oak scrubland, and annual grasses on slopes and drainages that have not burned in recent years.

Hydrologic Unit Code 12 (HUC 12) watersheds affected by the fire are included in Table 1 and displayed in Figure 1. Within the NZAA, the USFS GIS data show 55 miles of perennial streams, 68 miles of intermittent streams, and approximately 602 miles of ephemeral streams.

Table 1. HUC 12 watersheds affected by the Rough Fire in the NZAA.

HUC 12 Watershed	Acres
Converse Creek-Kings River	28,259
Patterson Creek-North Fork Kings River	13,618
Rancheria Creek-North Fork Kings River	35,768
Verplank Creek-Kings River	17,048

Relief within the burn area ranges from approximately 1,080 feet near Pine Flat Reservoir to 9200 feet near Garlic Meadow. The mean annual precipitation in the burned area is approximately 40 inches. Most precipitation in the burn area comes in the form of winter rain between the months of November and April, with some snow falling at higher elevations. The climate is characterized by cool, moist winters followed by hot, dry summers.

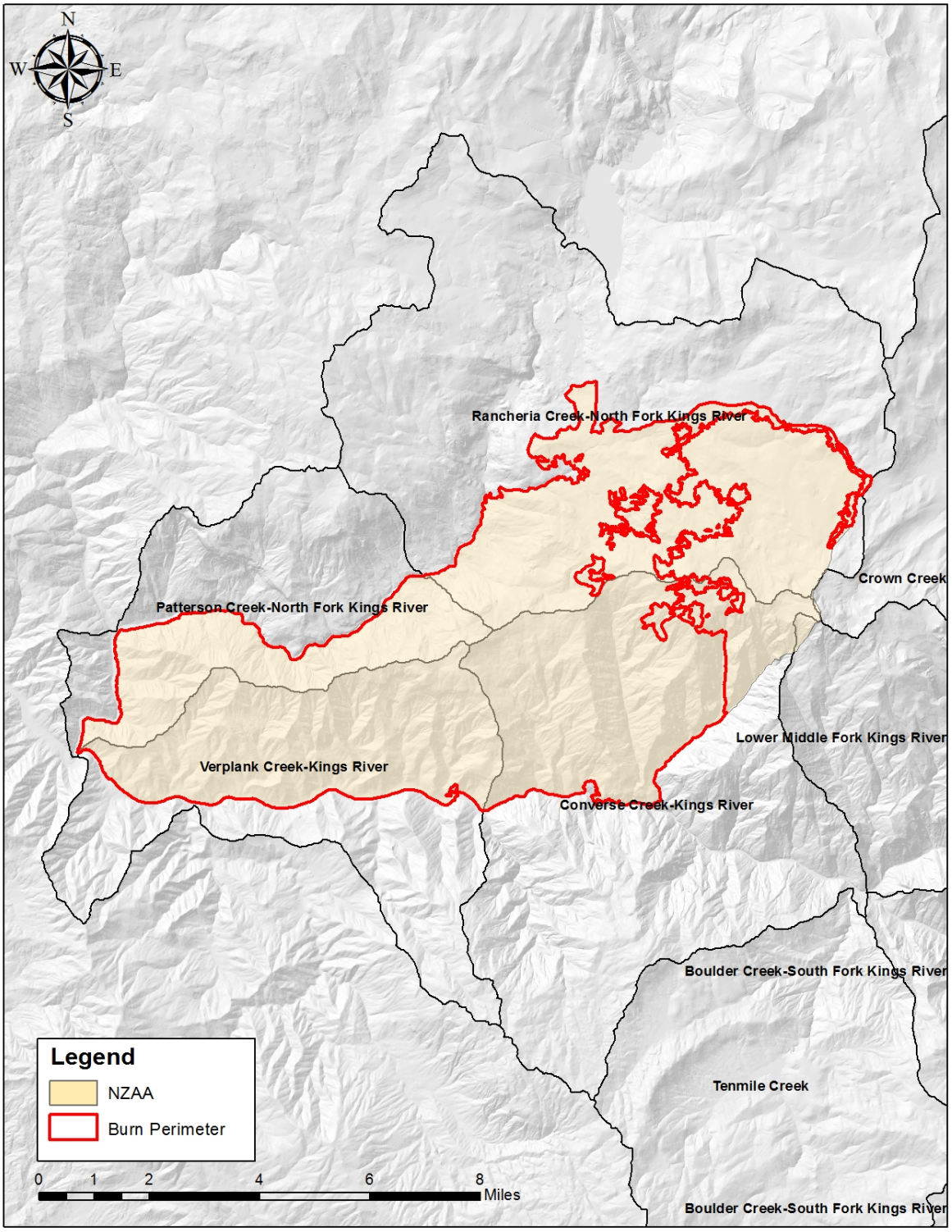

Figure 1. 6th-Field HUC 12 watersheds affected by the North Zone Rough Fire. The red line denotes the fire perimeter; the beige area denotes the North Zone Analysis Area (NZAA).

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

For analysis purposes, the burn area was separated in four 6th field HUC 12 watersheds and 19 subdrainages based on pour points located at potential Values at Risk (VAR). Figure 2 shows the location of each VAR pour point, the contributing subdrainage above the pour point, and the increased runoff from the fire.

1. Identify Values at Risk

Emergency determinations were conducted using the risk assessment matrix in the Forest Service Manual for the BAER program (USFS, 2012). This matrix (Table 2) uses a combination of the probability of damage or loss and the magnitude of consequences associated with that damage or loss to determine a level of risk. The risk level is then used to determine if an emergency exists.

Table 2. BAER risk matrix table.

Probability of Damage or Loss	**Magnitude of Consequences**		
	Major	Moderate	Minor
	RISK		
Very Likely	**Very High**	**Very High**	**Low**
Likely	**Very High**	**High**	**Low**
Possible	**High**	**Intermediate**	**Low**
Unlikely	**Intermediate**	**Low**	**Very Low**

Probability of Damage or Loss: The following descriptions provide a framework to estimate the relative probability that damage or loss would occur within 1 to 3 years (depending on the resource):

- Very likely. Nearly certain occurrence (90% - 100%))
- Likely. Likely occurrence (50% - 89%)
- Possible. Possible occurrence (10% - 49%)
- Unlikely. Unlikely occurrence (0% - 9%)

Magnitude of Consequences:

- Major. Loss of life or injury to humans; substantial property damage; irreversible damage to critical natural or cultural resources.
- Moderate. Injury or illness to humans; moderate property damage; damage to critical natural or cultural resources resulting in considerable or long term effects.
- Minor. Property damage is limited in economic value and/or to few investments; damage to critical natural or cultural resources resulting in minimal, recoverable or localized effects.

Table 3 identifies the Values at Risk in the Rough Fire within the NZAA. The primary potential threat to the VAR's is flooding and mobilization of woody and floatable debris within the affected stream channels (for detailed evaluation of road or trail impacts from erosion, please see the roads and trail reports). Debris flow potential is considered high in some areas (see soils and geology report for information on erosion and sediment yield). VAR's are listed from high to low.

Table 3: Values at Risk in the watersheds of the Rough Fire NZAA (NB: some VAR's associated with the south zone have also been included because of proximity, but will be analyzed during the south zone assessment). Risk is determined by the magnitude of consequence vs. the probability of damage or loss.

Value at Risk From Flooding	Risk Assessment	Comments
Property: Forest Road 11S12 11S12C (Forest Service road maintained and used by PG&E)	Likely/Major = **Very High**	Pour point modelling at drainages that cross 11S12 and 11S12C show low to high increases in runoff from the burn area (pour points H, I, J, K, L, and M). The risk of culvert or road damage from burn-related runoff is considered intermediate; however, the risk to life from rock fall is considered likely, thus a "very high" rating was used. Bulking from ash, sediment, and woody debris could block the culverts, potentially causing bypass, and in extreme cases, road prism failure. Cleaning the culverts before winter activity and keeping the culverts clear of debris during the first runoff-producing storms would be advisable. Signage should also be installed waring of rock fall and debris flow hazard.
Life/Property: Forest Road 12S01	Likely/Major = **Very High**	Pour point modelling at drainages that cross 12S01 show negligible increases in runoff from the burn area (pour points A, B, C, D, E, F, and G), however the risk to life from rock fall or debris flow is considered likely, thus a "very high" rating was used. Although the risk of culvert or road damage from burn-related runoff is considered low, bulking from ash, sediment, and woody debris could block the culverts, potentially causing bypass, and in extreme cases, road prism failure. Cleaning the culverts before winter activity and keeping the culverts clear of debris during the first runoff-producing storms would be advisable.
Life: Campgrounds and dispersed camp sites along SNF Road 12S01 (north of the SF Kings River). USFS	Possible/Major = **High**	Campgrounds and dispersed camp sites are situated at or below the Q50 flood elevation[1] of the SF Kings River. With a "strong" El Nino predicted for the winter of 2015-2016, there is an increased probability of a Q50 event. There is also an increased chance or severe rock fall and debris flow from the flanks of Rodger's Ridge onto 12S01. These hazards (with potential egress restrictions from rock fall) warrant closure of 12S01 and for the winter season. Signage should also be installed warning of flood and rock fall hazard. Signage should remain in place

[1] Hydrologic modeling of the Kings River watershed and associated VAR's will occur after the Rough Fire is contained and a final BARC map is available. This analysis will occur during the Rough south zone (SQF) BAER assessment.

Value at Risk From Flooding	Risk Assessment	Comments
		for the next three years. The following sites are at risk from flooding: • Gravel Flat • Bear Wallow • Bay Horse • Hermit Hole • Granite Dike
Life/Property: Kirch Flat Campground USFS	Possible/Major = **High**	Kirch Flat is situated at the Q50 flood elevation of the SF Kings River. With a "strong" El Nino predicted for the winter of 2015-2016, there is an increased probability of a Q50 event. It is recommended that this campground be closed for the winter season and signed with a flood hazard warning, which should remain in place for at least three years.
Life: Campground along SQF Road 12S01 (south of the SF Kings River). USFS	Possible/Major = **High**	Green Cabin Flat Campground[2] is situated at the Q50 flood elevation of the SF Kings River. With a "strong" El Nino predicted for the winter of 2015-2016, there is an increased probability of a Q50 event. It is recommended that this campground be closed for the winter season and signed with a flood hazard warning, which should remain in place for at least three years.
Resource/Property: Trail 27E40 (USFS)	Possible/Major = **High**	Pour point modelling at drainages that cross this trail show marked increases in runoff from areas of high soil burn severity (pour points N, O, P and Q). A flooding, debris flow, and hazard tree warning sign should be installed at the trailhead prior to winter storm activity.
Life and Property: Campgrounds along SQF Road 12S01 (south of the SF Kings River). USFS	Unlikely/Major = **Intermediate**	Structures and campgrounds[3] are situated between the Q50 and Q100 flood elevation of the SF Kings River. With a "strong" El Nino predicted for the winter of 2015-2016, there is an increased probability of a Q50 event. Signage should be installed warning of flood hazard. Signage should remain in place for the next three years. The following sites are potentially at risk from flooding if flood stage reaches or exceeds Q100: • Camp 4 ½ • Camp 4 • Mill Flat
Life and Property: Balch Camp (Private PG&E facility)	Unlikely/Major = **Intermediate**	The Balch Camp Facility is situated approximately 15 feet above Q100. As such, the probability of flood damage or loss is considered unlikely.
Life and Property: Balch Afterbay Reservoir (Private PG&E facility)	Unlikely/Major = **Intermediate**	Modelling shows negligible increases in runoff contribution from the burn area. Increases in runoff range from 2.5% to 0.6% (Q2-Q100, respectively). As such, affects to life and property due to increased flow from the burned portions of the watershed is considered unlikely.
Life and Property: Black Rock	Unlikely/Major = **Intermediate**	Modelling shows negligible increases in runoff contribution from the burn area. Increases in runoff range

[2] Since this VAR is located on the SQF, treatment will be addressed in the Rough south zone BAER report.
[3] Since this VAR is located on the SQF, treatment will be addressed in the Rough south zone BAER report.

Value at Risk From Flooding	Risk Assessment	Comments
Reservoir (Private PG&E facility)		from 1.7% to 0.4% (Q2-Q100, respectively). As such, affects to life and property due to increased flow from the burned portions of the watershed is considered unlikely.
Property: Pine Flat Reservoir (ACOE)	Possible/Minor = **Low**	Increase siltation in the reservoir could reduce the capacity of the reservoir. Changes in runoff from the fire (and increases in sedimentation) will not be modeled until the south zone BAER assessment.

2. Synopsis of Post-Fire Watershed Conditions of the Rough Fire NZAA

For analysis purposes, the burned area was separated into 19 pour points (Figure 2). Pour points are established in order to facilitate a more detailed analysis of stream discharge in smaller subdrainages. For the Rough Fire NZAA, all 19 pour points relate to downstream values at risk (Table 3).

The BAER Team received a Burned Area Reflectance Classification (BARC) satellite imagery map of the Rough Fire NZAA from the Remote Sensing Applications Center (RSAC) in Salt Lake City, Utah. The limited BAER watershed survey began on Wednesday, September 2, 2015 by conducting an on-the-ground reconnaissance within the burn area to evaluate soil hydrophobicity and soil burn severity (for more detail on hydrophobicity, see soils report). These data were used to corroborate and/or correct the BARC map to produce a soil burn severity map (Figure 3).

The BAER Team assessment found the overall soil burn severity for the 30,822 acre Rough Fire NZAA to be: 6% high, 27% moderate, 51% low, and 16% very low to unburned (Table 4).

Table 4. BARC map soil burn severity %breakout.

Soil Burn Severity Acres				
Unburned/V.Low	Low	Moderate	High	Total
5,039	15,703	8,243	1,837	30,822
16%	51%	27%	6%	100%

Watershed response in the burned watersheds can change significantly as compared to pre-fire conditions. Dense and well-developed areas of mixed conifer provided excellent ground cover, minimizing soil erosion, peak flows and sediment outputs from the watersheds. Vegetation and underlying organic matter slows runoff and protects soils from direct raindrop impact, assists with water infiltration to soil and releases runoff at slower rates. Consumption of organic material and high soil heating can promote the formation of water repellent layers, at or near the soil surface, which result in the loss of soil structural stability. The strength and depth of water repellency varies greatly by the duration and intensity of soil heating, type of organic matter consumed by the wildfire, and soil texture and moisture content (see soils report for more information).

Steep upper elevations of the drainages have the ability to generate sudden releases of storm runoff of high velocity. Rainfall intensity rates during large storm events are typically higher in these areas; rates can exceed 0.5 inches or higher per hour and is not uncommon during most winter rain seasons or rain-on-snow events.

With some of the hill slopes in the moderate to high soil burn severity areas now devoid of vegetation and groundcover, the first large runoff producing storms will likely create increased surface flow volumes and velocities that can transport available sediment and ash from the slopes and along the channel bottoms. This scenario, coupled with existing wet antecedent soil conditions from previous storms, could trigger a flood event with higher than normal sediment yield and runoff.

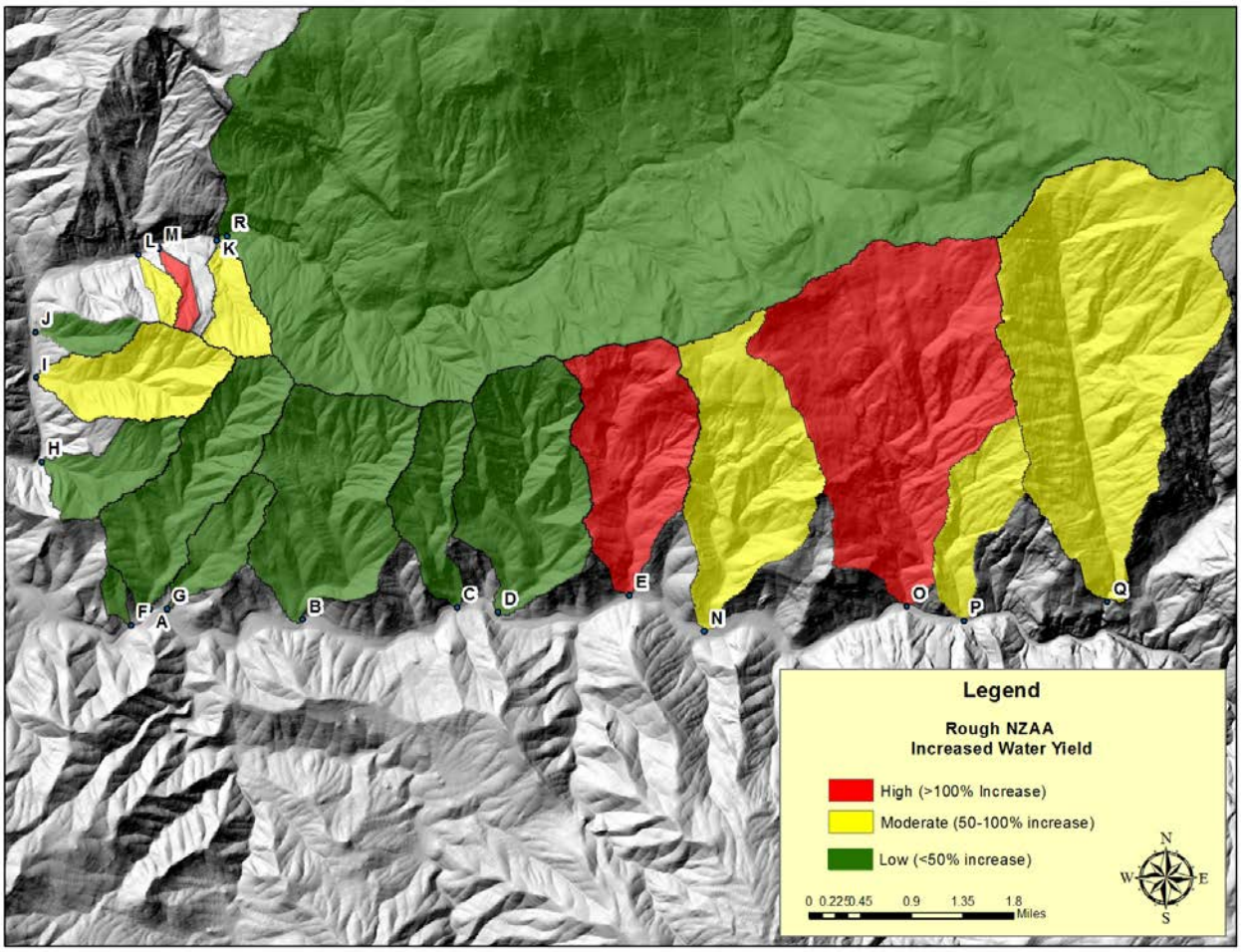

Figure 2. Map showing the location of pour points used to model post fire runoff. Color coding denotes increase in runoff due to soil burn severity: Red (High) is greater than a 100% increase in runoff; Yellow (Moderate) is between 50-100% increased runoff; and Green (Low), which is less than 50% increased runoff.

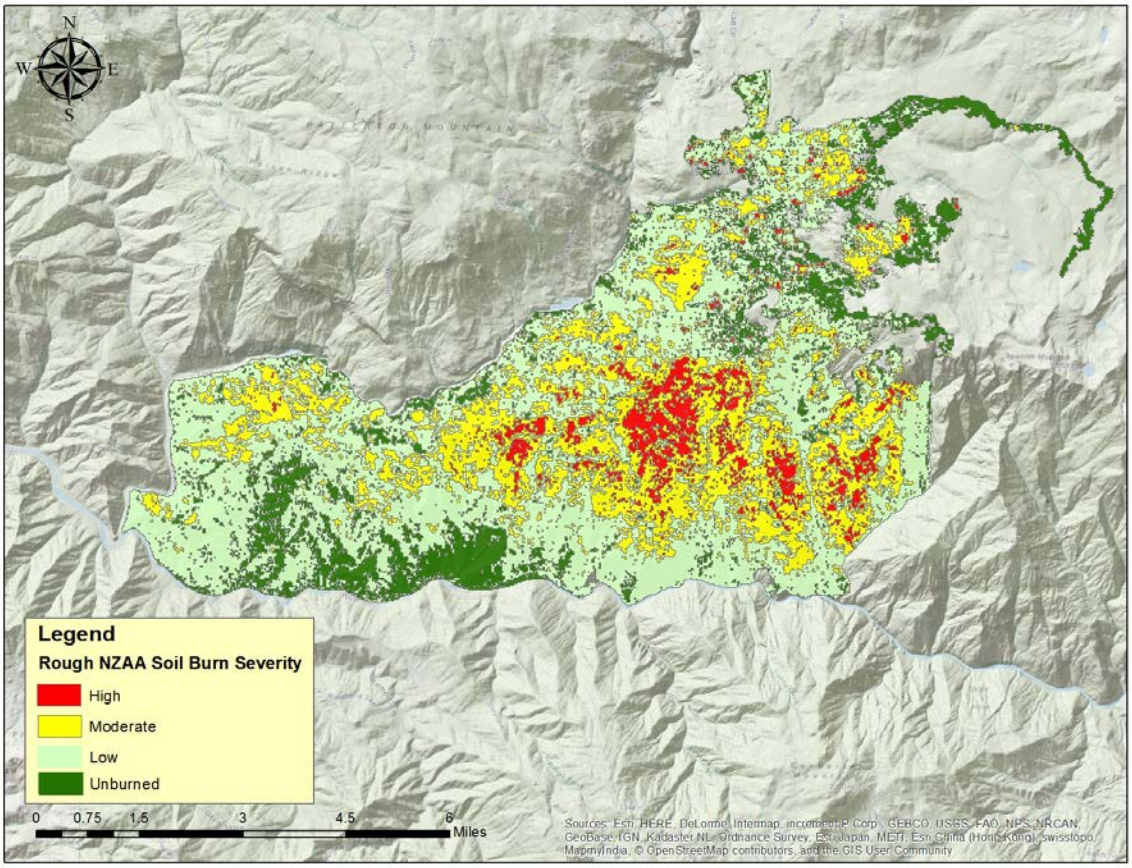

Figure 3. Soil burn severity map of the Rough Fire NZAA.

Design Flow Runoff Response

Before an adjusted design flow can be determined, pre-fire design flow must be calculated. This is the flow expected to occur prior to the fire and the flow responsible for forming present day channel conditions. These flows are used to estimate proper performance of culverts and other drainage structures. Design flow estimates for the Rough Fire NZAA have been based on the U.S. Geological Survey regression equations developed for the Sierra Nevada (Gotvald, et al., 2012).

Adjusted design flow is calculated using the same relationships as design flow; however, runoff response is estimated by assuming an increased runoff commensurate with soil burn severity in terms of recurrence interval. This recurrence interval estimates the response of the newly burnt landscape to the design storm of interest. Because a "strong" El Nino is predicted for the 2015-2016 winter season, a series of design storm magnitudes were modeled including the 2 year (6 hour) to a 100 year (6 hour) storm. The Rough Fire NZAA is expected to respond to an average rainfall event differently for the unburned, low, moderate, and high soil severity burned areas. Table 5 shows the estimated runoff response for each design storm by soil burn severity.

Table 5. Correspondence between recurrence interval and soil burn severity.

Design Storm	Recurrence Interval Q	Burn Severity			
		Unburned	Low	Moderate	High
2 year, 6 hour	2	X	X		
	5			X	
	10				X
5 year, 6 hour	5	X	X		
	10			X	
	25				X
10 year, 6 hour	10	X	X		
	25			X	
	50				X
25 year, 6 hour	25	X	X		
	50			X	
	100				X
50 year, 6 hour	50	X	X		
	100			X	
	200				X
100 year, 6 hour	100	X	X		
	200			X	
	500				X

These recurrence intervals and commensurate burn severities were found to be in good agreement with empirical watershed studies in similar hydrophysiographic settings on the Sequoia National Forest (Kaplan-Henry, 2004).

The unburned to low severity burn areas within the fire would respond as the unburned lands outside the burn area and would thus have a discharge similar to the design storm return interval. Increases in discharge associated with predicted recurrence intervals are prorated across watersheds by burn severity to yield post-fire discharge or the adjusted design flow. The fire has been analyzed at both the 6th field watershed (HUC12) and at a smaller subdrainage size where VAR pour points have been defined. Table 6 displays the amount of burned lands by severity for the affected 6th field watersheds and Table 7 shows the relative burn severities for the contributing subdrainages above pour points associated with Values at Risk.

Table 6 - 6th Field Watersheds Affected by the Rough Fire NZAA

6th Field Watersheds (HUC12)	Burn Severity in Miles^2				Watershed Area Miles ^{2}
	High	Moderate	Low	Unburned	
Patterson Creek- North Fork Kings River	0.11	2.37	4.92	13.6	21
Rancheria Creek-North Fork Kings River	0.29	2.37	6.02	47.3	56
Verplank Creek-Kings River	0.42	2.72	7.95	15.9	27
Converse Creek-Kings River	2.1	5.4	5.8	30.7	44

Table 7 – Contributing subdrainages above pour points associated with Values at Risk

Subdrainage	Burn Severity in Miles^2				Subdrainage Area Miles ^{2}
	High	Moderate	Low	Unburned	
A	0	0.045	0.96	0.51	1.5
B	0.001	0.26	1.37	0.54	2.2
C	0	0.17	0.48	0.13	0.8
D	0.02	0.49	0.95	0.52	2.0
E	0.22	0.69	0.79	0.07	1.8
F	0.0	0.0	0.03	0.07	0.1
G	0.0	0.002	0.26	0.24	0.5
H	0.0	0.03	0.52	0.07	0.6
I	0.001	0.33	0.62	0.05	1.0
J	0.0	0.001	0.21	0.02	0.2
K	0.007	0.2	0.19	0.01	0.4
L	0.001	0.06	0.05	0.002	0.1
M	0.001	0.06	0.04	0.004	0.1
N	0.17	0.93	1.1	0.05	2.2
O	1.33	2.3	0.97	0.05	4.6
P	0.03	0.36	0.41	0.02	0.8
Q	0.5	1.9	2.9	0.4	5.3
R	0.4	3.8	8.6	234	247
S	0.3	2.4	6.0	225	234

The USGS regression equations for the Sierra Nevada were applied to affected HUC12 watersheds and subdrainages to yield discharge in cubic feet per second for the Q2-Q500 return intervals and then divided by the size of the watershed to give a discharge in cubic feet per second per square mile for each design storm by watershed size. These values were then multiplied by the area of soil burn severity (in square miles), which includes unburned lands, and then summed to provide an estimated post-fire discharge for both the 6th field watersheds and pour point subdrainages. Appendix 1 includes the modelling results for the Q2, Q25, Q50, and Q100 design storms.

Runoff Modeling Results

Most of the Rough Fire NZAA is comprised of low to moderate soil burn severity. As a result, modeling showed only minor increases in post-fire runoff for most watersheds and subdrainages. The four HUC12 watersheds all showed runoff increases <50%, ranging from 7% - 32% (Table 8). Of the 19 pour point subdrainages, three showed marked increases in runoff potential (pour points E, O, and M). Based on the 2 year, 6 hour design storm, pour point E showed a 103% increase, M a 111% increase and O a 177% increase (Table 8). These have been color coded red as "high" (Figure 2). Pour points N, P, Q, I, L, and K showed increased runoff values ranging for 50 to 100% using the same design storm and have been color coded yellow for "moderate" (Figure 2). The remaining pour points show increases in runoff between 0-49% using the 2 year, 6 hour design storm (Q2). These were color green for "low". Commensurate increased runoff values were found for Q5-Q100 design storms, but the relative percent change was less than that of the Q2 storm.

Table 8 - Percent Increase* in Water Yield by HUC12 Watersheds and Subdrainages

6th Field Watersheds	Watershed Area Miles^2	Percent increase in Water Yield
Patterson Creek- North Fork Kings River	21.3	19.0%
Rancheria Creek-North Fork Kings River	55.9	7.4%
Verplank Creek-Kings River	26.6	19.6%
Converse Creek-Kings River	44.2	32%
Pour Point Subdrainages		
Subdrainage A	1.5	6.0%
Subdrainage B	2.2	18.4%
Subdrainage C	0.8	33.7%
Subdrainage D	2.0	42.7%
Subdrainage E	1.8	102.8%
Subdrainage F	0.1	0.0%
Subdrainage G	0.5	1.1%
Subdrainage H	0.6	11.9%
Subdrainage I	1.0	55.1%
Subdrainage J	0.2	16.4%
Subdrainage K	0.4	89.7%
Subdrainage L	0.1	99.2%
Subdrainage M	0.1	111%
Subdrainage N	2.2	98.3%
Subdrainage O	4.6	177%
Subdrainage P	0.8	91.1%
Subdrainage Q	5.3	93.9%
Subdrainage R	247	2.5%
Subdrainage S	234	1.7%

* Based on the 2 year, 6 hour design storm (Appendix 1).

II. Emergency Determination

1. Threats to Human Life and Property

Emergency determinations were conducted using the risk assessment matrix in the Forest Service Manual for the BAER program (USFS, 2012). This matrix uses a combination of the probability of damage or loss and the magnitude of consequences associated with that damage or loss to determine a level of risk. The risk level is then used to determine if an emergency exists (Table 2). Below are the VAR's that are susceptible to flood hazards only. For a detailed discussion of rock fall and debris flow threats to VAR's, please refer to the geology and soils reports.

- There is a potential flood threat to human life at campgrounds and dispersed camping areas adjacent to the South Fork Kings River at the southern periphery of the burn area (Table 3). These sites include:
    - Kirch Flat Campground
    - Gravel Flat
    - Bear Wallow
    - Bay Horse
    - Hermit Hole
    - Granite Dike

The above threats will be the most acute during the first runoff-producing storms, which typically occur in November, however, with a "strong" El Nino predicted for the 2015-2016 winter season, winter precipitation could occur as early as October, lasting through April. There will be a higher level of flood risk during the next three to five years until there is sufficient vegetative recovery to mitigate increased runoff.

2. Threats to Water Quality

Surface waters in the fire area will be bulked by ash, debris, and other floatable and transportable material during storm events. It is likely that stream flows from the first post-fire runoff producing rain events will see high concentrations of ash and fine sediment that will cause considerable turbidity and degradation of water quality and the beneficial uses of water. Beneficial uses of water are identified and protected by the California State Water Quality Control Board by regulation as found in Basin Plans. Beneficial uses are: municipal water supply, industrial process and service supply, agriculture, groundwater re-charge, contact and non-contact recreation, wildlife habitat, warm and cold water aquatic habitat, wetland habitat, rare species habitat, and spawning.

Water Quality

- The most noticeable effects on water quality will be increased sediment and ash from the burned area into the North and South Fork of the Kings River and other waterbodies in and downstream of the fire area. This material could increase the rate of pool filling by fines, which may affect aquatic habitat. Bulking of ash, debris, and sediment can also have a detrimental effect to hydroelectric infrastructure. Turbid water and debris can clog intakes and potentially affect turbines. As such, PG&E will be notified of these potential impacts.

III. Treatments to mitigate the flooding emergency

- To protect life and property at campgrounds and dispersed camping areas along the South Fork of the Kings River, Forest Service road 12S01 (Sierra National Forest) should be closed from October, 2015 to April, 2016. Signage notifying the public of flood, rock fall and debris flow hazard should be installed at the point of closure.

- To protect life and property at Kirch Flat campground along the South Fork of the Kings River, the campground should be closed from October, 2015 to April, 2016. Signage notifying the public of flood flow hazard should be installed at the point of closure.

References

Kaplan-Henry, T.A., 2004. McNally Post-Fire Discharge and the Relationship of Sierra Nevada-wide Flood Frequency Curves and Local Kern River Discharge Curves, in: M Furniss, C Clifton, and K Ronnenberg, eds., 2007. *Advancing the Fundamental Sciences: Proceedings of the Forest Service National Earth Sciences Conference, San Diego, CA, 18-22 October 2004*, PNWGTR-689, Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Gotvald, Anthony J.; Barth, Nancy A.; Veilleux, Andrea G. and Parrett, Charles. Methods for Determining Magnitude and Frequency of Floods in California, Based on Data through Water Year 2006. Scientific Investigations Report 2012–5113, U.S. Department of the Interior, U.S. Geological Survey.

USDA Forest Service Handbook (FSH) 2509.13. Burned Area Emergency Handbook. Effective January 12, 1995.

Appendix 1

Tables 1 and 2 provide values of predicted post burn discharges in both cubic feet per second and cubic feet per second per square mile for the HUC12 watersheds and the pour point subdrainages affected by the Rough fire.

Table 1 - Pre and Post Fire Discharge for 6th Field HUC12 Watersheds by Burn Severity

Watershed			Discharge by Severity in cfs*				Discharge by Watershed in cfs**		Discharge by Watershed in cfs/mi^{2**}	
HUC12 Watersheds	Design Storm	*Affected WS Area Miles^2	High Severity Burn	Moderate Severity	Low Severity	Unburned	Pre fire*	Post Fire	Pre-fire flow in cfs/ mi^2	Post-fire flow in cfs/mi^2
Patterson Creek-NF Kings River	2	7.41	4.9	67.6	54.3	153.9	236	281	11.1	13.2
	25	7.41	13.9	232.9	350.8	994	1525	1592	71.6	74.8
Rancheria Creek-NF Kings River	2	8.68	12.9	65.6	69.7	546.5	647	694.7	11.6	12.4
	25	8.68	38.7	236.7	433	3398	4023	4107	72.0	73.5
Converse Creek-Kings River	2	13.3	89.1	142.7	62.1	330.7	473	624.5	10.7	14.1
	25	13.3	259.8	505.4	395.2	2105.7	3012	3266	68.1	73.9
Verplank Creek-Kings River	2	11.07	21.1	86.6	102.8	200.8	344	411	12.9	15.5
	25	11.07	55.3	277.7	615.4	1202.1	2059	2150.5	77.4	80.8

*Affected WS area only includes acres of burned watershed, but discharge calculations also include unburned acres.

Table 2 - Pre and Post Fire Discharge for subdrainage pour points by Burn Severity

Values at Risk			Discharge by Severity in cfs*				Discharge by Watershed in cfs		Discharge by Watershed in cfs/mi^2	
Sub-drainage	Design Storm	*Affected WS Area Miles^2	High Severity Burn	Moderate Severity	Low Severity	Unburned	Pre fire*	Post Fire	Pre-fire flow in cfs/ mi^2	Post-fire flow in cfs/ mi^2
A	2	1.01	0	1.7	13.9	7.3	21.7	23.0	14.5	15.3
	25	1.01	0	6.03	95.4	50.7	149	152.1	99.3	101.4
	50	1.01	0	7.8	128.6	68.3	201	204.8	134.0	136.5
	100	1.01	0	14.7	166.4	88.4	260	269.5	173.3	269.5
B	2	2.2	0.06	9.4	18.7	7.4	30.1	35.6	13.7	16.2
	25	2.2	0.16	33.1	128.9	50.8	207.0	213.0	94.1	96.8
	50	2.2	0.20	43.0	174.4	68.7	280.0	286.3	127.3	130.1
	100	2.2	0.27	54.0	226.7	89.3	364	370.3	165.5	168.3
C	2	0.65	0	6.4	6.72	1.82	11.2	14.9	14	18.7
	25	0.65	0	23.8	49	13.2	81.7	86.1	102.1	107.6
	50	0.65	0	31.2	67.2	18.2	112	116.6	140	145.8
	100	0.65	0	39.7	88.2	23.9	147	151.8	183.8	189.8
D	2	1.46	1.2	18.0	13.2	7.2	27.8	39.7	13.9	19.8
	25	1.46	3.38	63.7	90.7	49.7	191	207.5	95.5	103.7
	50	1.46	4.26	82.8	123.5	67.6	260	278.1	130	139.1
	100	1.46	5.6	104.4	160.5	87.9	338	358.4	169	179.2
E	2	1.7	12.9	24.7	10.7	0.94	24.3	49.3	13.5	27.4
	25	1.7	37.9	90.5	75.5	6.7	172	210.5	95.6	116.9

Values at Risk			Discharge by Severity in cfs*				Discharge by Watershed in cfs		Discharge by Watershed in cfs/mi^2	
	50	1.7	48.3	118.8	103.6	9.18	236	279.9	131.1	155.5
	100	1.7	64.4	151.4	136.1	12.1	310	363.9	172.2	202.2
F	2	0.03	0	0	0.57	1.33	1.9	1.9	19.0	19.0
	25	0.03	0	0	4.17	9.73	13.9	1.9	139.0	139.0
	50	0.03	0	0	5.58	13.0	18.6	13.9	186.0	186.0
	100	0.03	0	0	7.14	16.7	23.8	18.6	238.0	238.0
G	2	0.26	0	0.09	4.17	3.85	8.03	8.12	16.1	16.2
	25	0.26	0	0.31	29.5	27.3	56.8	57.1	113.6	114.2
	50	0.26	0	0.39	39.7	36.7	76.4	76.8	152.8	153.6
	100	0.26	0	0.49	51.3	47.3	98.7	99.2	197.4	55.1
H	2	0.55	0	1.3	8.3	1.12	9.6	10.7	16.0	17.9
	25	0.55	0	4.53	58.3	7.85	67.3	70.7	112.2	117.8
	50	0.55	0	5.85	78.5	10.6	90.6	94.9	151.0	158.2
	100	0.55	0	7.3	101.4	13.6	117	122.3	195.0	203.9
I	2	0.95	0.07	14.0	9.92	0.8	16	24.8	16	24.8
	25	0.95	0.19	48.5	67.6	5.45	109	121.7	109	121.7
	50	0.95	0.24	62.7	91.1	7.35	147	161.4	147	161.4
	100	0.95	0.31	78.5	117.8	9.5	190	206.1	190	206.1
J	2	0.2	0	0.05	4.1	0.39	3.9	4.49	19.3	22.5
	25	0.2	0	0.18	28.6	2.72	27.2	31.5	136.0	157.3
	50	0.2	0	0.24	38.5	3.67	36.7	42.4	183.5	212.2
	100	0.2	0	0.29	49.8	4.8	47.4	54.8	237.0	274.0
K	2	0.4	0.49	8.5	2.98	0.15	6.4	12.1	15.7	29.8
	25	0.4	1.45	31.6	21.8	1.15	46.8	56.1	115.0	137.7
	50	0.4	1.86	41.6	30.0	1.58	64.3	75.1	158.0	184.5
	100	0.4	2.46	53.1	39.5	2.08	84.7	97.1	208.1	238.7
L	2	0.111	0.081	2.95	0.90	0.036	1.99	3.96	17.9	35.72
	25	0.111	0.236	10.81	6.62	0.26	14.7	17.93	132.4	161.56
	50	0.111	0.30	14.16	9.01	0.36	20.0	23.83	180.2	214.67
	100	0.111	0.39	17.84	11.80	0.47	26.2	30.50	236.0	274.81
M	2	0.101	0.087	3.1	0.76	0.76	1.91	4.04	18.9	39.97
	25	0.101	0.25	11.64	5.66	0.57	14.3	18.13	141.6	179.48
	50	0.101	0.32	15.27	7.76	0.78	19.6	24.13	194.1	238.9
	100	0.101	0.43	19.37	10.18	1.02	25.7	30.99	254.5	306.83
N	2	2.2	9.43	31.3	13.95	0.63	27.9	55.34	12.7	25.15
	25	2.2	28.05	116.25	99.5	4.52	199	248.32	90.5	112.87
	50	2.2	35.78	153.45	137.5	6.25	275	332.98	125.0	151.35
	100	2.2	47.99	195.72	181.5	8.25	363	433.46	165.0	197.03
O	2	4.6	67.94	71.0	11.51	0.59	54.6	151.05	11.9	32.84
	25	4.6	205.57	267	81.18	4.18	385	558	83.7	121.29
	50	4.6	264.84	355.5	112.6	5.80	534	739	116	161
	100	4.6	358.52	458	150	7.72	711	974	155	212
P	2	0.801	1.93	14.0	5.96	0.29	11.6	22.17	14.5	27.72
	25	0.801	5.78	52.2	43.31	2.1	84.3	103.4	105.4	129.24

Values at Risk			Discharge by Severity in cfs*				Discharge by Watershed in cfs		Discharge by Watershed in cfs/mi^2	
	50	0.801	7.35	69.3	59.6	2.9	116	139	145	174
	100	0.801	9.86	88.2	79.12	3.85	154	181	193	226
Q	2	5.3	26.5	61.3	36.5	5.03	66.7	129.34	12.6	24.4
	25	5.3	81.0	230	253	34.9	462	599	87.2	113
	50	5.3	104.7	308	351	48.5	642	812	121	153
	100	5.3	142	398	470	65	859	1075	162	203
R	2	12.8	15.29	91.8	89.1	2427	2560	2624	10.4	10.62
	25	12.8	44.7	320	526	14317	15100	15208	61.1	61.6
	50	12.8	57.7	425	724	19722	20800	20929	84.2	84.7
	100	12.8	78.4	548	961	26170	27600	27757	111.7	112.4
S	2	8.7	11.6	58.7	63.1	2369	2460	2502	10.5	10.7
	25	8.7	33.97	204	372	13961	14500	14571	62.0	62.3
	50	8.7	43.8	272	510	19160	19900	19986	85.0	85.4
	100	8.7	59.7	351	679	25515	26500	26605	113.2	113.7

*Affected WS area only includes acres of burned watershed, but discharge calculations also include unburned acres.