Hydrology and Watershed Specialist Report
Rough Fire South Zone BAER Assessment
Sequoia National Forest
October 5, 2015

Overview of the Middle and South Fork confluence, Kings River

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Executive Summary

The Rough Fire started on July 31, 2015 and was a result of a lightning strike in the Rough Creek drainage. The fire burned a total of 151,102 acres within the Kings River watershed and burned over National Forest, National Park, and private land ownership (Table 5). The fire burned mixed conifer forest, oak scrubland, and annual grasses on slopes and drainages that have not burned in recent years. This report will focus on the South Zone of the burn area since an interim report was done for the North Zone in September of 2015. The fire burned from the confluence of the NF Kings in the west (near Pine Flat Reservoir) just beyond Cedar Grove in Kings Canyon National Park to the east. The fire burned north and south of the South Fork Kings River, extending approximately one mile north of Lost Meadow on the Sierra National Forest and as far south as McKenzie Ridge near Sequoia Lake in the south on the Sequoia National Forest.

The overall soil burn severity showed 4% high, 28% moderate, 44% low, and 24% very low to unburned. Hydrological analysis evaluated 11 HUC12 watersheds and 34 pour points defined at potential Values at Risk. To capture the most probable storm type and the potential "strong" 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. The most marked changes were found in the Mill Flat Creek and Converse HUC12 watersheds, which showed increases in post-fire runoff by 72% and 61%, respectively. Of the 34 pour points modelled, four showed moderate (50-100%) increases in runoff and four showed high (>100%) increases.

The key Value at Risk that has a potential *flood* hazard (based on a 2 year, 6 hour design storm), is the Mill Flat Campground at the bottom of Davis Road (12S01). This campground is at the confluence of Mill Flat Creek and the South Fork Kings River. Camping near the creek during the first runoff producing storms could potentially be a risk to life, especially if the SF Kings River is running high, thus increasing the base level of Mill Flat Creek. The recommended treatment is seasonal closure of the Mill Flat Campground by Forest Order and 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 to Values at Risk identified for potential ***flooding*** and/or ***flood damage*** include:

- Highway 180
- Culvert and road impacts along Forest Service road 12S01 (Davis Road)
- Mill Flat Campground at the confluence of Mill Flat Creek and the SF Kings River.
- 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. This report will focus on the South Zone of the burn area since an interim report was done for the North Zone in September of 2015.

The fire burned a total of 151,102 acres within the Kings River watershed and burned over National Forest, National Park, and private land ownership (Table 5). The fire burned from the confluence of the NF Kings in the west (near Pine Flat Reservoir) to the east just beyond Cedar Grove in Kings Canyon National Park. The fire burned north and south of the Kings River, extending approximately one mile north of Lost Meadow on the Sierra National Forest and as far south as McKenzie Ridge near Sequoia Lake in the south on the Sequoia National Forest. 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 Rough Fire perimeter, the NHD GIS data show 293 miles of perennial streams, 373 miles of intermittent streams, and 637 miles of ephemeral streams.

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

HUC 12 Watershed Name	HUC 12 Watershed Number	Acres
Converse Creek-Kings River	180300100702	28,259
Patterson Creek-North Fork Kings River	180300100606	13,618
Rancheria Creek-North Fork Kings River	180300100605	35,768
Verplank Creek-Kings River	180300100704	17,048
Mill Flat Creek	180300100703	31,292
Tenmile Creek	180300100701	24,788
Lower Middle Fork Kings River	180300100309	29,471
Boulder Creek- South Fork Kings River	180300100404	24,498
Big Meadows-Boulder Creek	180300100403	18,900
Lightning Creek-South Fork Kings	180300100402	14,220
Lewis Creek-South Fork Kings	180300100401	23,306

Relief within the burn area ranges from approximately 1,080 feet near Pine Flat Reservoir to 9200 feet near Garlic Meadow (Sierra National Forest). Precipitation varies with elevation, which ranges almost 8000 feet throughout the burn area. Foothill areas (<4000 feet) are characterized by mild wet winters and hot dry summers from mid-January to

mid-May, with an average annual rainfall of 26 inches. Middle elevations (4000-7000 feet) receive 40 to 45 inches of annual precipitation from December to May, with snow dominating the higher elevations.

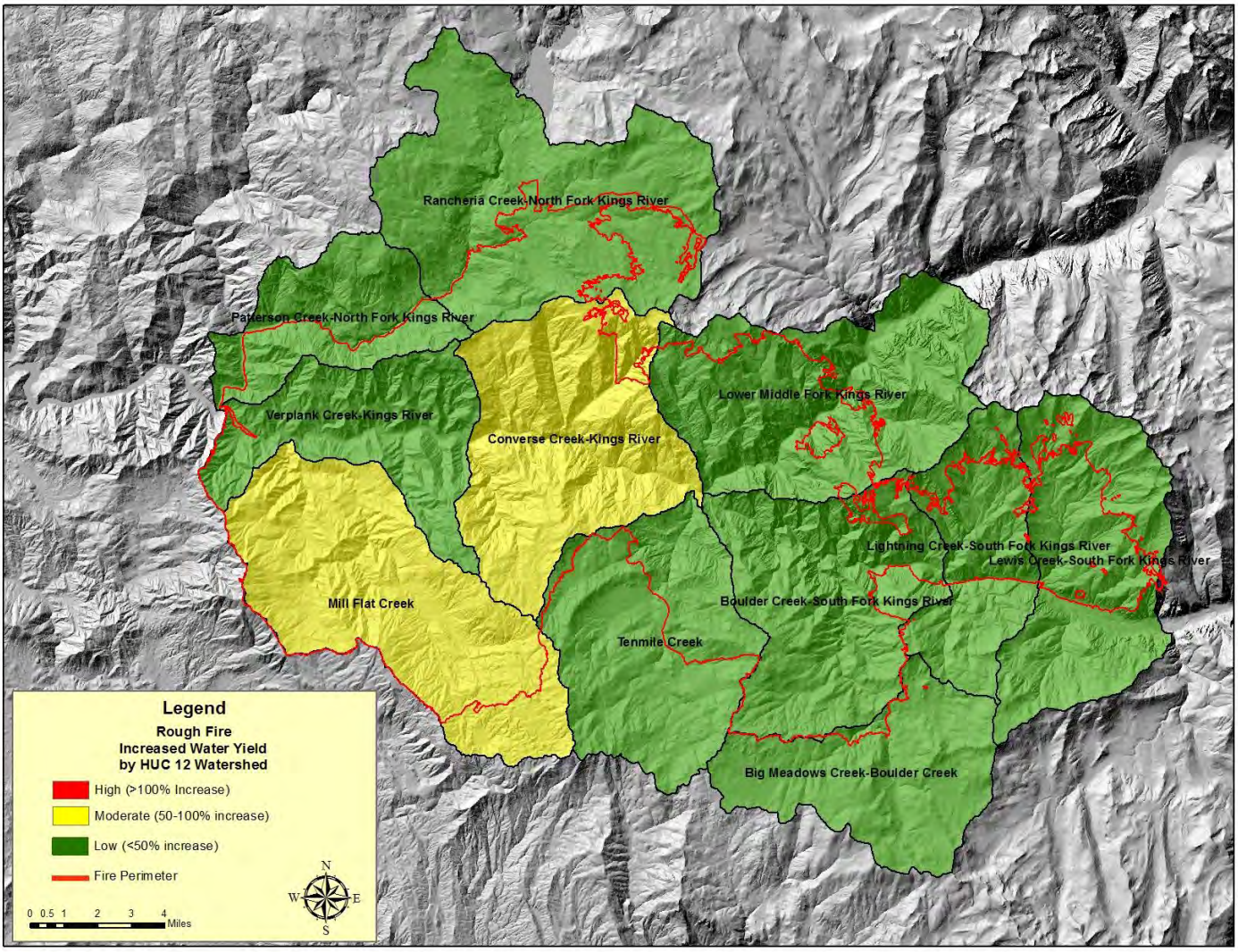

Figure 1. 6th-Field HUC 12 watersheds affected by the Rough Fire. The red line denotes the fire perimeter; the color code indicates the increase in water yield based on soil burn severity: green = <50% increase; yellow = 50-100% increase; red >100% increase.

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

For analysis purposes, the burn area was separated in 11 6th field HUC 12 watersheds (Figure 1) and 34 subdrainages based on pour points located at potential Values at Risk (VAR). Figure 2 shows the location of each VAR pour point. Figure 3 shows the contributing area above pour points for subdrainages that will have increased runoff greater than 50%.

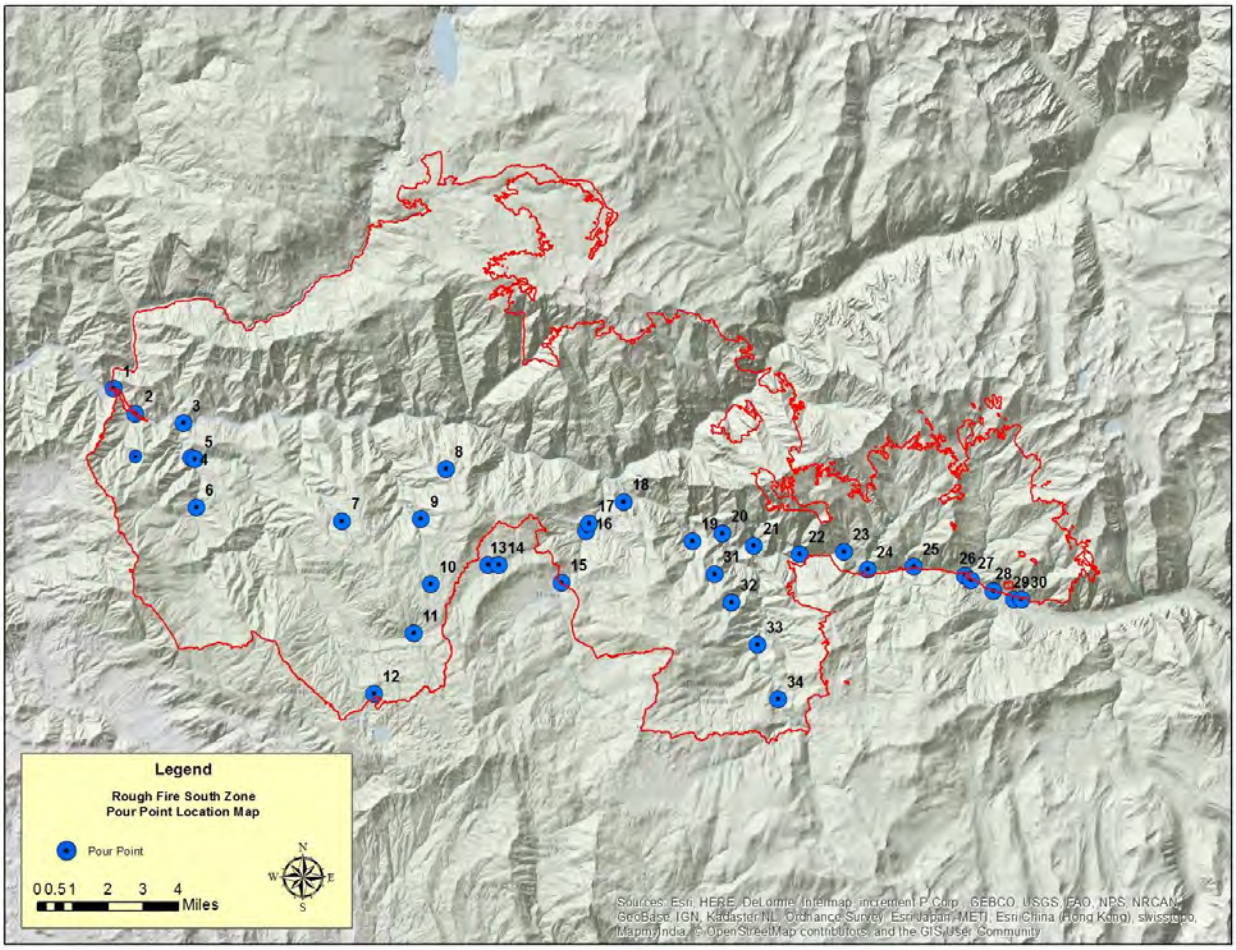

Figure 2. Locations of pour points used to model runoff response for the Rough Fire South Zone and Kings River.

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 South Zone. 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 debris flow hazard, erosion and sediment yield). VAR's are listed from high to low.

Table 3: Values at Risk in the watersheds of the Rough Fire South Zone. Risk is determined by the magnitude of consequence vs. the probability of damage or loss.

Value at Risk From Flooding	Risk Assessment	Comments
Life/Property: State Highway 180 (Caltrans)	Likely/Major = **Very High**	Pour point modelling at drainages that cross highway 180 show moderate to high increases in runoff from the burn area (pour points 18, 23 and 24). The risk of culvert or road damage from burn-related runoff is considered intermediate for these pour points; pour point 23 is a box culvert with poor channel alignment and accumulated LWD near the inlet. Blockage potential is high for this culvert, which could result in damage to the highway. This channel should be cleared of LWD. Although the risk to property is considered intermediate for these pour points, the risk to life from rock fall and debris flow in the burn area is considered likely, thus a "very high" rating was used overall. Bulking from ash, sediment, and woody debris could block the culverts, potentially causing bypass, and in extreme cases, road prism failure. Caltrans should be advised to keep culverts free of debris before winter and during the first runoff-producing storms. It is strongly advised that highway 180 in the burn area be closed for the first winter following the fire.
Life/Property: Forest Road 12S01 (Davis Road, USFS)	Likely/Major = **Very High**	A Pour point modeled for the Mill Flat Creek HUC12 at the confluence of the Kings River shows an increased runoff of 72% for a 2 year, 6 hour design storm. This is for the entire watershed (which contains 12S01), but some smaller catchments in high SBS areas show a more pronounced increase in runoff. Specifically, a culvert crossing on Sampson Creek on 12S01 shows an increase in runoff by 181% for a 2 year, 6 hour design storm, and thus blockage potential and culvert failure is high. Even if increases in runoff are not quite so extreme, bulking from ash, sediment, and woody debris could block culverts, potentially causing bypass, and in extreme cases, road prism failure. Although the risk to property would be considered intermediate for this VAR, the risk to life from rock fall or debris flow is considered likely, thus a "very high" rating was used. A storm patrol on this road is inadvisable due to the instability of the road and the potential for rock fall; as such, removing undersized culverts and installing armored (rip rap) spill ways and closing the road from Mill Flat Creek Campground to the ridge just south of Fox Springs is likely the best treatment.
Life: Mill Flat Campground (USFS)	Possible/Major = **High**	A Pour point modeled for the Mill Flat Creek HUC12 at the confluence of the SF Kings River and Mill Flat Creek shows an increased runoff of 72% for a 2 year, 6 hour design storm. Although this increase is less than the Q5 response, bulking from ash, sediment, and floatable woody debris could create a possible hazard to campers during the first runoff-producing storms. If a larger storm event occurs as is predicted due to a "strong El Nino", then there could be a flood hazard to camp sites close to the creek. Flood response in Mill Flat Creek could be further accentuated due to an increase in base level if the South Fork Kings is running high. It is recommended that

Value at Risk From Flooding	Risk Assessment	Comments
		this campground be closed by Forest Order for the 2015-2016 winter season, with signage warning the public of the relevant fire-related flood and debris flow hazards.
Life: Campgrounds along SQF Road 12S01 (along SF Kings River). USFS	Unlikely/Major = **Intermediate**	Green Cabin Flat Campground 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. A fire-related increase in runoff for the SF Kings at this location is only11.4%, so a flooding hazard from a 2 year, 6 hour storm is considered unlikely.
Life and Property: Campgrounds along SQF Road 12S01 (along SF Kings River). USFS	Unlikely/Major = **Intermediate**	Structures (Camp 4 ½) and campgrounds (Camp 4) along 12S01 are situated between the Q50 and Q100 flood elevation on 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. A fire-related increase in runoff for the SF Kings at this location is only11.4%, so a flooding hazard from a 2 year, 6 hour storm is considered unlikely.
Property: Pine Flat Reservoir (ACOE)	Possible/Moderate = **Intermediate**	Modelling shows an 8.3% increase in runoff from the burn area for the entire Kings River drainage using a 2 year, 6 hour design storm. Although the increase in runoff from the burn area is relatively small, the first runoff-producing storms will be bulked with ash, sediment, and floatable woody and other debris. The settle-able material (usually detrital sediment >2mm) could reduce the capacity of the reservoir; floating debris such as wood could possibly clog intakes. Suspended sediment or "wash load" could adversely affect the Francis turbines used to generate power. If applicable, the ACOE should consider a debris boom to protect intakes, and it is recommended that the turbines be shut down if turbidity levels become too high.
Life and Property: Hume Lake (Private)	Unlikely/Moderate = **Low**	Only a very small portion (1.56 square miles) of the 24 square mile watershed above Hume Lake burned. The increase in runoff based on a 2 year, 6 hour design storm is 3.1%. Of the area that did burn, 98% of the area exhibits low to moderate soil burn severity. As such, the risk to the Hume Lake area is considered low.
Property: Entrance road to Princess Campground	Unlikely/Moderate = **Low**	A pour point on an un-named tributary to Indian Creek showed a 70% increase in flow for a 2 year, 6 hour design storm, but is still below the Q5. The entrance road has a 36" CMP culvert, which is sufficient to handle the excess flow for that design storm. There is also a high road prism (~10 feet) with large storage capacity behind the pipe. It is recommended that the culvert be kept clear of debris during the first runoff-producing storms.

2. Synopsis of Post-Fire Watershed Conditions of the Rough Fire South Zone

For analysis purposes, the burned area was separated into 34 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 South Zone, all 34 pour points relate to potential downstream Values at Risk (Table 3).

The BAER Team received a Burned Area Reflectance Classification (BARC) satellite imagery map of the Rough Fire from the Remote Sensing Applications Center (RSAC) in Salt Lake City, Utah. The limited BAER watershed survey began on Monday, September 28, 2015 by conducting an on-the-ground reconnaissance within the burn area to evaluate flood plain elevation and channel morphology adjacent to VAR's, soil hydrophobicity and soil burn severity (for more detail on hydrophobicity, see soils report). The soils data were used to corroborate and/or correct the BARC map to produce a soil burn severity map (Figure 4).

The BAER Team assessment found the overall soil burn severity for the 151,102 acre Rough Fire to be: 4% high, 28% moderate, 44% low, and 24% very low to unburned (Table 4). The fire burned over the Sierra and Sequoia National Forests, Sequoia-Kings Canyon National Park, and private inholdings (Table 5).

Table 4. BARC map soil burn severity %breakout.

Soil Burn Severity Acres				
Unburned/V.Low	Low	Moderate	High	Total
36,631	66,497	41,943	6,031	151,102
24%	44%	28%	4%	100%

Table 5. Burn acres by ownership

Ownership	Burn Acres
National Forest: Sierra	58,527
National Forest: Sequoia	82,231
National Park	9,252
Private	1,092
Total	151,102

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.

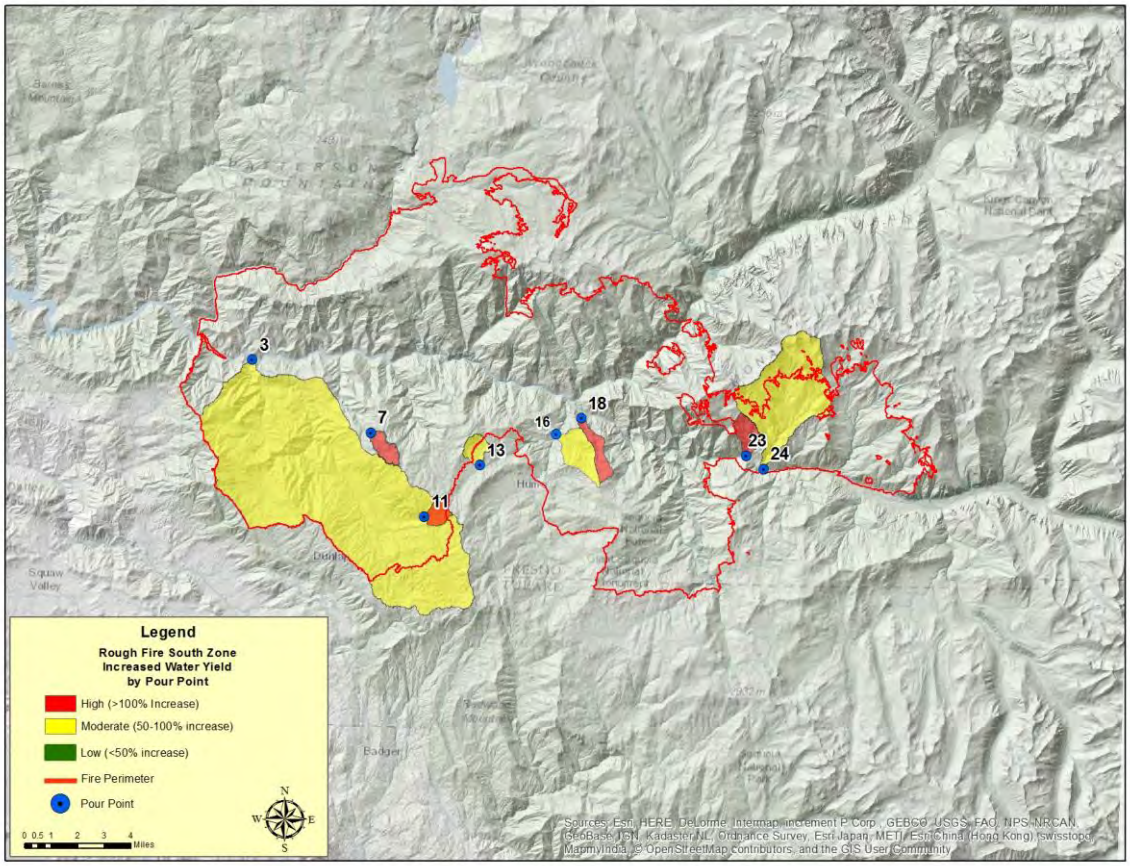

Figure 3. Map showing the location of pour points used to model post fire runoff. Color coding denotes increase in runoff due to soil burn severity: Red (High) is greater than a 100% increase in runoff; Yellow (Moderate) is between 50-100% increased runoff; and Green (Low), which is less than 50% increased runoff. Of the 34 pour points modeled only eight (3, 7, 11, 13, 16, 18, 23, 24) showed increased runoff over 50%.

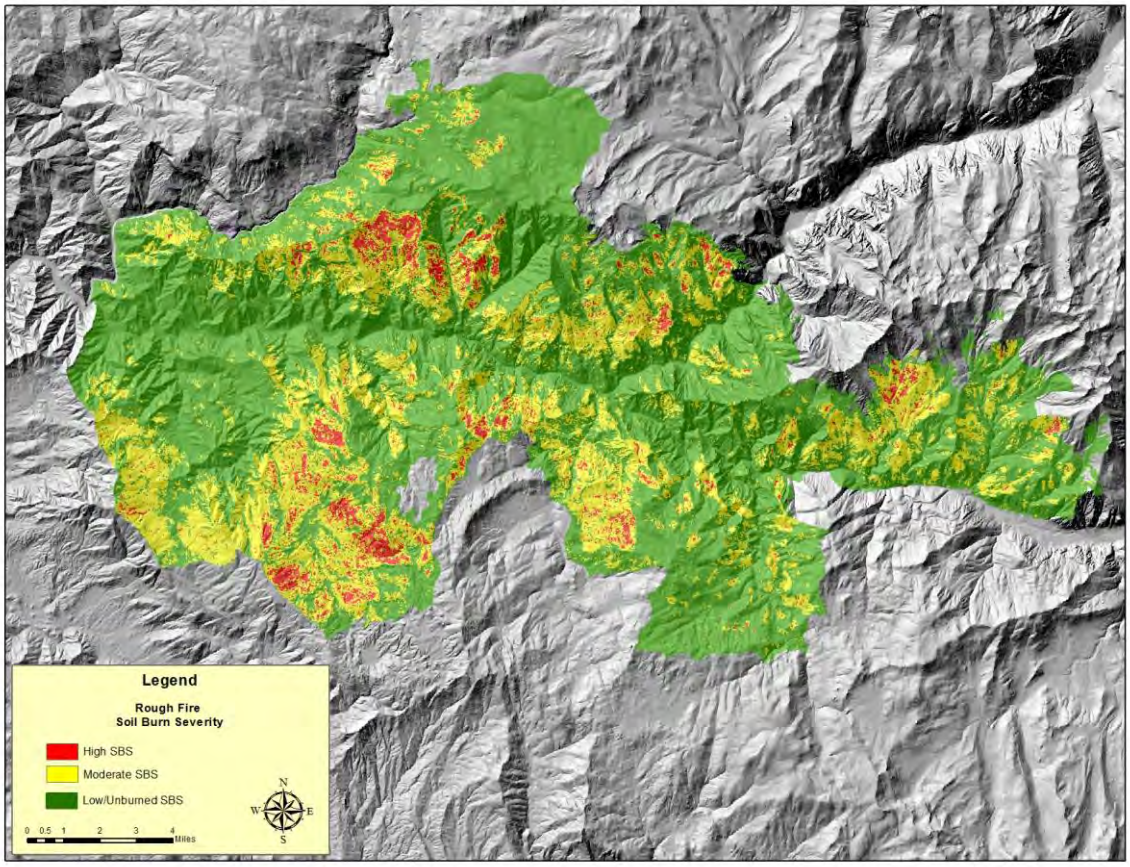

Figure 4. Soil burn severity (SBS) map of the Rough Fire. Green denotes low SBS to unburned, yellow moderate SBS and red high SBS.

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 South Zone 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 South Zone is expected to respond to an average rainfall event differently for the unburned, low, moderate, and high soil severity burned areas. Table 6 shows the estimated runoff response for each design storm by soil burn severity.

Table 6. 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 7 displays the amount of burned lands by severity for the affected 6th field HUC12 watersheds and Table 8 shows the relative burn severities for the contributing subdrainages above pour points associated with potential Values at Risk.

Table 7 - 6th Field HUC12 Watersheds Affected by the Rough Fire.

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	1.9	4.8	14.5	21
Rancheria Creek-North Fork Kings River	0.22	1.8	5.2	48.7	56
Verplank Creek-Kings River	0.73	5.9	15.5	4.5	27
Converse Creek-Kings River	2.8	12.7	18.7	10.0	44
Mill Flat Creek	3.2	17.8	16.2	11.7	49
Tenmile Creek	0.66	5.7	4.4	28.4	39
Lower Middle Fork Kings River	0.78	6.1	10.3	28.8	46
Boulder Creek-South Fork Kings River	0.33	6.6	17	14.1	38
Big Meadows Creek-Boulder Creek	0.0	0.05	0.36	28.6	29
Lightning Creek-South Fork Kings River	0.45	3.8	3.8	13.9	22
Lewis Creek-South Fork Kings River	0.15	3.0	6.9	25.9	36

Table 8 – Contributing subdrainages above pour points associated with potential Values at Risk. Refer to Figure 2 for pour point location.

Subdrainage (pour point)	Burn Severity in Miles^2				Subdrainage Area Miles ^{2}
	High	Moderate	Low	Unburned	
1	9.1	61.8	93.7	787.4	952
2	0.001	0.28	1.56	0.66	2.5
3	3.2	17.8	16.6	11.3	48.9
4	3.2	17.5	15.6	10.7	47
5	0.05	2.29	3.63	0.93	6.9
6	0.032	1.39	1.54	0.438	3.4
7	0.15	0.35	0.25	0.05	0.8
8	0.001	0.062	0.32	0.217	0.6
9	0.01	0.33	1.56	2.2	4.1
10	0.0	0.01	0.06	0.33	0.4
11	0.1	0.31	0.2	0.09	0.7
12	0.007	0.22	0.33	0.643	1.2
13	0.05	0.26	0.07	0.42	0.8
14	0.08	0.44	0.25	2.43	3.2
15	0.02	0.51	1.01	22.66	24.2
16	0.04	1.03	0.722	0.108	1.9
17	0.61	3.94	2.76	27.89	35.2
18	0.07	0.49	0.35	0.09	1.0
19	0.03	0.39	1.01	1.07	2.5
20	0.83	11.9	23.4	430.87	467
21	0.0	0.25	0.85	0.8	1.9
22	0.016	0.34	0.97	1.07	2.4
23	0.02	0.65	0.33	0.0	1.0

Subdrainage (pour point)	Burn Severity in Miles^2				Subdrainage Area Miles ^{2}
	High	Moderate	Low	Unburned	
24	0.45	2.9	1.8	4.75	9.9
25	0.001	0.56	1.2	0.239	2.0
26	0.13	2.3	4.6	9.97	17
27	ND	ND	ND	ND	ND
28	0.01	0.37	2.0	364.6	367
29	ND	ND	ND	ND	ND
30	0.01	0.31	1.35	2.13	3.8
31	0.005	0.08	0.48	0.335	0.9
32	0.005	0.16	0.49	0.345	1.0
33	0.05	1.0	4.46	33.89	39.4
34	ND	ND	ND	ND	ND

ND: No Data. These were preliminary pour points that were either redundant or did not warrant further modelling.

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 is comprised of low to moderate soil burn severity (Table 4). As a result, modelling showed only minor increases in post-fire runoff for most HUC12 watersheds and subdrainages. All but two of the 11 HUC12 watersheds showed runoff increases; most HUC12 watersheds showed runoff increases <50%, ranging from 0.3% - 41% (Table 9). Based on a 2 year, 6 hour design storm, the Mill Flat Creek HUC12 showed an increase of 72% and Converse Basin HUC12 showed an increase of 61%. Of the 34 pour point subdrainages, eight showed marked increases in runoff potential (i.e., pour points 3, 7, 11, 13, 16, 18, 23, 24). Based on the 2 year, 6 hour design storm, pour point 3 showed a 72% increase, 7 a 132% increase, 11 a 112% increase, 13 a 71% increase, 16 a 91% increase, 18 a 102% increase, 23 a 110% increase, and 24 a 57% increase (Table 9, Figure 2). Although these increases in runoff are high for the 2 year, 6 hour design storm, none exceeded the Q5 flow. Commensurate increased runoff values were found for Q5-Q100 design storms, but the relative percent change was less than that of the Q2 storm (Appendix 1).

Table 9 - Percent Increase* in Water Yield by HUC12 Watersheds and Subdrainages

6th Field HUC12 Watersheds	Watershed Area Miles^2	Percent increase in Water Yield from burn areas
Patterson Creek- North Fork Kings River	21.3	15.2%
Rancheria Creek-North Fork Kings River	55.9	5.6%
Verplank Creek-Kings River	26.6	40.7%
Converse Creek-Kings River	44.2	61.0%
Mill Flat Creek	48.9	71.7%
Tenmile Creek	39.0	24.9%
Boulder Creek- South Fork Kings River	38.0	23.9%
Big Meadows Creek-Boulder Creek	29.0	0.3%
Lower Middle Fork Kings River	46.0	20.1%
Lightning Creek- South Fork Kings River	22.0	29.6%
Lewis Creek- South Fork Kings River	36.0	12.5%
Pour Point Subdrainages		
1	952	11.4%
2	2.5	18.8%
3	48.9	71.7%
4	47	73.7%
5	6.9	55.6%
6	3.4	69.8%
7	0.8	131.6%
8	0.6	17.3%
9	4.1	12.6%
10	0.4	3.9%
11	0.7	112.9%
12	1.2	29.8%
13	0.8	70.9%
14	3.2	28.1%
15	24.2	3.1%
16	1.9	91.2%
17	35.2	20.3%
18	1.0	102.5%
19	2.5	27.5%
20	467	4.1%
21	1.9	20.5%
22	2.4	23.8%
23	1.0	110.1%
24	9.9	57.0%
25	2.0	44.4%
26	17	21.5%
27	ND[1]	ND
28	367	0.2%
29	ND	ND
30	3.8	13.2%

[1]Based on the 2 year, 6 hour design storm (Appendix 1). ND: No Data. These were preliminary pour points that were either redundant or did not warrant further modelling.

31	0.9	15.6%
32	1.0	26.4%
33	39.4	3.9%
34	ND	ND

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.

- Hydrologic modelling using a 2 year, 6 hour design storm shows only moderate increases in runoff from most of the burn area. As such, hazards from *flooding only* are limited. The VAR most susceptible to flooding hazard would be the Mill Flat Campground at the confluence of Mill Flat Creek and the South Fork Kings River. A pour point modeled at this location shows an increased runoff of 72% for a 2 year, 6 hour design storm. Although this increase is less than the Q5 response, bulking from ash, sediment, and floatable woody debris could create a possible hazard to campers during the first runoff-producing storms. If a larger storm event occurs as is predicted due to a "strong El Nino", then there could be a flood hazard to camp sites close to the creek. Flood response in Mill Flat Creek could be further accentuated due to an increase in base level if the South Fork Kings is running high. It is recommended that this campground be closed by Forest Order for the 2015-2016 winter season, with signage warning the public of the relevant fire-related flood and debris flow hazards.

The above threat will be the most acute during the first runoff-producing storms, which typically occur December to May, 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 the Tulare Basin Plan. Beneficial uses are: municipal water supply, contact and non-contact recreation, wildlife habitat, warm and cold water aquatic habitat, rare species habitat, fresh water replenishment, 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, Pine Flat Reservoir will be notified of these potential impacts.

III. Treatments to mitigate the flooding emergency

- To protect life and at Mill Flat Creek campground (at the confluence of Mill Flat Creek and South Fork Kings River, Forest Service road 12S01, Sequoia National Forest) it is recommended that the campground be closed by Forest Order for the 2015-2016 winter season, from October 2015 through April, 2016, with signage warning the public of the relevant fire-related flood and debris flow hazards.

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

Hydrologic modelling output is included in the tables below. Each calculation "block" represents a different design storm. For example, the Q2, Q5, Q10 block represents the 2 year, 6 hour design storm; the Q10, Q25, Q50 block represents the 10 year, 6 hour design storm and so forth. Each calculation block shows the soil burn severity in square miles and the corresponding discharge. The final output is the total post burn discharge represented in cfs and cfs/square mile. To the right of each block is the percent increase in post-fire discharge (runoff) for each design storm. All HUC 12 watersheds are included and the eight subdrainage pour points that showed increases of runoff ranging from moderate (50-100% increase) to high (>100% increase).

HUC12 Watersheds

Rancheria-NF Kings River

Burn Severity	Acres	mi²	Q2	Q5	Q10		% Increase
Unburned		48.68	563.433989				
V.Low and Low BS		5.2	60.1860465				
Moderate		1.8		49.8			
High		0.22			9.772093023		
Total Affected Area		7.22					
Total Post Burn Discharge					**683.21**		**5.6**
Total Post Burn Discharge cfs/mi^2					**12.22**		

Burn Severity	Acres	mi²	Q5	Q10	Q25		
Unburned		48.68	1347.1907				
V.Low and Low BS		5.2	143.906977				
Moderate		1.8		79.9534884			
High		0.22			15.83291592		
Total Affected Area		7.22					
Total Post Burn Discharge					**1586.88**		**2.6**
Total Post Burn Discharge cfs/mi^2					**28.39**		

Burn Severity		mi²	Q10	Q25	Q50		
Unburned		48.68	2162.29767				
V.Low and Low BS		5.2	230.976744				
Moderate		1.8		129.542039			
High		0.22			21.96851521		
Total Affected Area		7.22					
Total Post Burn Discharge					**2544.78**		**2.5**
Total Post Burn Discharge cfs/mi^2					**45.52**		

Burn Severity		mi²	Q25	Q50	Q100		
Unburned		48.68	3503.39249				
V.Low and Low BS		5.2	374.232558				
Moderate		1.8		179.742397			
High		0.22			29.34776386		
Total Affected Area		7.22					
Total Post Burn Discharge					**4086.72**		**1.6**
Total Post Burn Discharge cfs/mi^2					**73.11**		

Patterson Creek-NF Kings River

Burn Severity	Acres	mi²	Q2	Q5	Q10		% Increase
Unburned		14.5	160.657277				
V.Low and Low BS		4.8	53.1830986				
Moderate		1.9		53.5			
High		0.1			4.507042254		
Total Affected Area		6.8					
Total Post Burn Discharge					**271.87**		**15.2**
Total Post Burn Discharge cfs/mi^2					**12.76**		

Burn Severity	Acres	mi²	Q5	Q10	Q25		
Unburned		14.5	408.450704				
V.Low and Low BS		4.8	135.211268				
Moderate		1.9		85.6338028			
High		0.1			7.159624413		
Total Affected Area		6.8					
Total Post Burn Discharge					**636.46**		**6.1**
Total Post Burn Discharge cfs/mi^2					**29.88**		

Burn Severity		mi²	Q10	Q25	Q50		
Unburned		14.5	653.521127				
V.Low and Low BS		4.8	216.338028				
Moderate		1.9		136.032864			
High		0.1			9.704225352		
Total Affected Area		6.8					
Total Post Burn Discharge					**1015.60**		**5.8**
Total Post Burn Discharge cfs/mi^2					**47.68**		

Burn Severity		mi²	Q25	Q50	Q100		
Unburned		14.5	1038.14554				
V.Low and Low BS		4.8	343.661972				
Moderate		1.9		184.380282			
High		0.1			12.66197183		
Total Affected Area		6.8					
Total Post Burn Discharge					**1578.85**		**3.5**
Total Post Burn Discharge cfs/mi^2					**74.12**		

Converse Creek-Kings River

Burn Severity	Acres	mi²	Q2	Q5	Q10		
Unburned		10	107.013575				
V.Low and Low BS		18.7	200.115385				
Moderate		12.7		335.6			
High		2.8			118.7782805		
Total Affected Area		**34.2**					**% Increase**
Total Post Burn Discharge					**761.51**		**61.0**
Total Post Burn Discharge cfs/mi^2					**17.23**		

Burn Severity	Acres	mi²	Q5	Q10	Q25
Unburned		10	264.253394		
V.Low and Low BS		18.7	494.153846		
Moderate		12.7		538.744344	
High		2.8			190.8054299
Total Affected Area		**34.2**			
Total Post Burn Discharge					**1487.96**
Total Post Burn Discharge cfs/mi^2					**33.66**

Burn Severity		mi²	Q10	Q25	Q50
Unburned		10	424.208145		
V.Low and Low BS		18.7	793.269231		
Moderate		12.7		865.438914	
High		2.8			262.0723982
Total Affected Area		**34.2**			
Total Post Burn Discharge					**2344.99**
Total Post Burn Discharge cfs/mi^2					**53.05**

Burn Severity		mi²	Q25	Q50	Q100
Unburned		10	681.447964		
V.Low and Low BS		18.7	1274.30769		
Moderate		12.7		1188.68552	
High		2.8			346.4524887
Total Affected Area		**34.2**			
Total Post Burn Discharge					**3490.89**
Total Post Burn Discharge cfs/mi^2					**78.98**

Verplank Creek-Kings River

Burn Severity	Acres	mi²	Q2	Q5	Q10		% Increase
Unburned		4.47	57.8075188				
V.Low and Low BS		15.5	200.451128				
Moderate		5.9		189.2			
High		0.73			36.63721805		
Total Affected Area		22.13					
Total Post Burn Discharge					**484.10**		**40.7**
Total Post Burn Discharge cfs/mi^2					**18.20**		

Burn Severity	Acres	mi²	Q5	Q10	Q25		
Unburned		4.47	143.342481				
V.Low and Low BS		15.5	497.048872				
Moderate		5.9		296.109023			
High		0.73			56.50639098		
Total Affected Area		22.13					
Total Post Burn Discharge					**993.01**		**16.4**
Total Post Burn Discharge cfs/mi^2					**37.33**		

Burn Severity		mi²	Q10	Q25	Q50		
Unburned		4.47	224.340226				
V.Low and Low BS		15.5	777.913534				
Moderate		5.9		456.695489			
High		0.73			75.08571429		
Total Affected Area		22.13					
Total Post Burn Discharge					**1534.03**		**14.9**
Total Post Burn Discharge cfs/mi^2					**57.67**		

Burn Severity		mi²	Q25	Q50	Q100		
Unburned		4.47	346.004887				
V.Low and Low BS		15.5	1199.79323				
Moderate		5.9		606.857143			
High		0.73			96.13496241		
Total Affected Area		22.13					
Total Post Burn Discharge					**2248.79**		**9.2**
Total Post Burn Discharge cfs/mi^2					**84.54**		

Mill Flat Creek

Burn Severity	Acres	mi²	Q2	Q5	Q10		% Increase
Unburned		11.7	136.380368				
V.Low and Low BS		16.2	188.834356				
Moderate		17.8		509.611452			
High		3.2			143.96728		
Total Affected Area		37.20					
Total Post Burn Discharge					**978.79**		**71.71815018**
Total Post Burn Discharge cfs/mi^2					**20.02**		

Burn Severity	Acres	mi²	Q5	Q10	Q25		
Unburned		11.7	334.969325				
V.Low and Low BS		16.2	463.803681				
Moderate		17.8		800.817996			
High		3.2			229.498081		
Total Affected Area		37.20					
Total Post Burn Discharge					**1829.09**		**30.64922019**
Total Post Burn Discharge cfs/mi^2					**2286.36**		

Burn Severity	Acres	mi²	Q10	Q25	Q50		
Unburned		11.7	526.4				
V.Low and Low BS		16.2	728.834356				
Moderate		17.8		1259.4683			
High		3.2			304.948875		
Total Affected Area		37.20					
Total Post Burn Discharge					**2819.63**		**28.16508645**
Total Post Burn Discharge cfs/mi^2					**57.66**		

Burn Severity	Acres	mi²	Q25	Q50	Q100		
Unburned		11.7	827.852761				
V.Low and Low BS		16.2	1146.25767				
Moderate		17.8		1696.27812			
High		3.2			396.564417		
Total Affected Area		37.20					
Total Post Burn Discharge					**4066.95**		**17.54199321**
Total Post Burn Discharge cfs/mi^2					**83.17**		

Burn Severity	Acres	mi²	Q50	Q100	Q200		
Unburned		11.7	1114.96933				
V.Low and Low BS		16.2	1543.80368				
Moderate		17.8		2205.88957			
High		3.2			499.304703		
Total Affected Area		37.20					
Total Post Burn Discharge					**5363.97**		**15.1**
Total Post Burn Discharge cfs/mi^2					**109.69**		

Burn Severity	Acres	mi²	Q100	Q200	Q500		
Unburned		11.7	1449.93865				
V.Low and Low BS		16.2	2007.60736				
Moderate		17.8		2777.38241			
High		3.2			660.940695		
Total Affected Area		37.20					
Total Post Burn Discharge					**6895.87**		**13.8**
Total Post Burn Discharge cfs/mi^2					**8619.84**		

Tenmile Creek

Burn Severity	Acres	mi²	Q2	Q5	Q10		% Increase
Unburned		28.24	373.636923				
V.Low and Low BS		4.4	58.2153846				
Moderate		5.7		179.8			
High		0.66			33		
Total Affected Area		10.76					
Total Post Burn Discharge					**644.62**		**24.9**
Total Post Burn Discharge cfs/mi^2					**24.23**		

Burn Severity	Acres	mi²	Q5	Q10	Q25		
Unburned		28.24	890.646154				
V.Low and Low BS		4.4	138.769231				
Moderate		5.7		285			
High		0.66			52.29230769		
Total Affected Area		10.76					
Total Post Burn Discharge					**1366.71**		**11.1**
Total Post Burn Discharge cfs/mi^2					**51.38**		

Burn Severity		mi²	Q10	Q25	Q50		
Unburned		28.24	1412				
V.Low and Low BS		4.4	220				
Moderate		5.7		451.615385			
High		0.66			71.58461538		
Total Affected Area		10.76					
Total Post Burn Discharge					**2155.20**		**10.5**
Total Post Burn Discharge cfs/mi^2					**81.02**		

Burn Severity		mi²	Q25	Q50	Q100		
Unburned		28.24	2237.47692				
V.Low and Low BS		4.4	348.615385				
Moderate		5.7		618.230769			
High		0.66			94.09230769		
Total Affected Area		10.76					
Total Post Burn Discharge					**3298.42**		**6.7**
Total Post Burn Discharge cfs/mi^2					**124.00**		

Boulder Creek-SF Kings River

Burn Severity	Acres	mi²	Q2	Q5	Q10		% Increase
Unburned		14.07	272.143421				
V.Low and Low BS		17	328.815789				
Moderate		6.6		289.0			
High		0.33			20.39052632		
Total Affected Area		**23.93**					
Total Post Burn Discharge					**910.36**		**23.9**
Total Post Burn Discharge cfs/mi^2					**34.22**		

Burn Severity	Acres	mi²	Q5	Q10	Q25		
Unburned		14.07	616.117895				
V.Low and Low BS		17	744.421053				
Moderate		6.6		407.810526			
High		0.33			32.68736842		
Total Affected Area		**23.93**					
Total Post Burn Discharge					**1801.04**		**8.2**
Total Post Burn Discharge cfs/mi^2					**67.71**		

Burn Severity		mi²	Q10	Q25	Q50		
Unburned		14.07	869.377895				
V.Low and Low BS		17	1050.42105				
Moderate		6.6		653.747368			
High		0.33			42.17052632		
Total Affected Area		**23.93**					
Total Post Burn Discharge					**2615.72**		**11.4**
Total Post Burn Discharge cfs/mi^2					**98.34**		

Burn Severity		mi²	Q25	Q50	Q100		
Unburned		14.07	1393.67053				
V.Low and Low BS		17	1683.89474				
Moderate		6.6		843.410526			
High		0.33			56.38657895		
Total Affected Area		**23.93**					
Total Post Burn Discharge					**3977.36**		**5.7**
Total Post Burn Discharge cfs/mi^2					**149.52**		

Big Meadows-Boulder Creek

Burn Severity	Acres	mi²	Q2	Q5	Q10		
Unburned		28.59	320.405172				
V.Low and Low BS		0.36	4.03448276				
Moderate		0.05		1.4			
High		0			0		
Total Affected Area		**0.41**					**% Increase**
Total Post Burn Discharge					**325.89**		**0.3**
Total Post Burn Discharge cfs/mi^2					**12.25**		

Burn Severity	Acres	mi²	Q5	Q10	Q25		
Unburned		28.59	828.124138				
V.Low and Low BS		0.36	10.4275862				
Moderate		0.05		2.14655172			
High		0			0		
Total Affected Area		**0.41**					
Total Post Burn Discharge					**840.70**		**0.1**
Total Post Burn Discharge cfs/mi^2					**31.61**		

Burn Severity		mi²	Q10	Q25	Q50		
Unburned		28.59	1227.39828				
V.Low and Low BS		0.36	15.4551724				
Moderate		0.05		3.60172414			
High		0			0		
Total Affected Area		**0.41**					
Total Post Burn Discharge					**1246.46**		**0.1**
Total Post Burn Discharge cfs/mi^2					**46.86**		

Burn Severity		mi²	Q25	Q50	Q100		
Unburned		28.59	2059.46586				
V.Low and Low BS		0.36	25.9324138				
Moderate		0.05		4.79655172			
High		0			0		
Total Affected Area		**0.41**					
Total Post Burn Discharge					**2090.19**		**0.1**
Total Post Burn Discharge cfs/mi^2					**78.58**		

Lower Middle Fork Kings

Burn Severity	Acres	mi²	Q2	Q5	Q10		% Increase
Unburned		28.82	544.948609				
V.Low and Low BS		10.3	194.759565				
Moderate		6.1		258.1			
High		0.78			46.39982609		
Total Affected Area		17.18					
Total Post Burn Discharge					**1044.23**		**20.1**
Total Post Burn Discharge cfs/mi^2					**39.26**		

Burn Severity	Acres	mi²	Q5	Q10	Q25		
Unburned		28.82	1219.52457				
V.Low and Low BS		10.3	435.846739				
Moderate		6.1		362.870435			
High		0.78			74.21869565		
Total Affected Area		17.18					
Total Post Burn Discharge					**2092.46**		**7.5**
Total Post Burn Discharge cfs/mi^2					**78.66**		

Burn Severity		mi²	Q10	Q25	Q50		
Unburned		28.82	1714.41409				
V.Low and Low BS		10.3	612.715652				
Moderate		6.1		580.428261			
High		0.78			95.57713043		
Total Affected Area		17.18					
Total Post Burn Discharge					**3003.14**		**9.7**
Total Post Burn Discharge cfs/mi^2					**112.90**		

Burn Severity		mi²	Q25	Q50	Q100		
Unburned		28.82	2742.28565				
V.Low and Low BS		10.3	980.067391				
Moderate		6.1		747.462174			
High		0.78			127.5588261		
Total Affected Area		17.18					
Total Post Burn Discharge					**4597.37**		**5.0**
Total Post Burn Discharge cfs/mi^2					**172.83**		

Lightning Creek-SF Kings

Burn Severity	Acres	mi²	Q2	Q5	Q10		
Unburned		13.95	244.125				
V.Low and Low BS		3.8	66.5				
Moderate		3.8		160.8			
High		0.45			27.53181818		
Total Affected Area		**8.05**					**% Increase**
Total Post Burn Discharge					**498.97**		**29.6**
Total Post Burn Discharge cfs/mi^2					**18.76**		

Burn Severity	Acres	mi²	Q5	Q10	Q25		
Unburned		13.95	590.338636				
V.Low and Low BS		3.8	160.809091				
Moderate		3.8		232.490909			
High		0.45			44.91818182		
Total Affected Area		**8.05**					
Total Post Burn Discharge					**1028.56**		**10.5**
Total Post Burn Discharge cfs/mi^2					**38.67**		

Burn Severity		mi²	Q10	Q25	Q50		
Unburned		13.95	853.486364				
V.Low and Low BS		3.8	232.490909				
Moderate		3.8		379.309091			
High		0.45			58.74545455		
Total Affected Area		**8.05**					
Total Post Burn Discharge					**1524.03**		**13.2**
Total Post Burn Discharge cfs/mi^2					**57.29**		

Burn Severity		mi²	Q25	Q50	Q100		
Unburned		13.95	1392.46364				
V.Low and Low BS		3.8	379.309091				
Moderate		3.8		496.072727			
High		0.45			79.79318182		
Total Affected Area		**8.05**					
Total Post Burn Discharge					**2347.64**		**6.9**
Total Post Burn Discharge cfs/mi^2					**88.26**		

Lewis Creek-SF Kings

Burn Severity	Acres	mi²	Q2	Q5	Q10		% Increase
Unburned		25.95	399.341667				
V.Low and Low BS		6.9	106.183333				
Moderate		3		109.8			
High		0.15			7.9		
Total Affected Area		10.05					
Total Post Burn Discharge					**623.26**		**12.5**
Total Post Burn Discharge cfs/mi^2					**23.43**		

Burn Severity	Acres	mi²	Q5	Q10	Q25		
Unburned		25.95	950.058333				
V.Low and Low BS		6.9	252.616667				
Moderate		3		158			
High		0.15			12.89166667		
Total Affected Area		10.05					
Total Post Burn Discharge					**1373.57**		**4.2**
Total Post Burn Discharge cfs/mi^2					**51.64**		

Burn Severity		mi²	Q10	Q25	Q50		
Unburned		25.95	1366.7				
V.Low and Low BS		6.9	363.4				
Moderate		3		257.833333			
High		0.15			16.8375		
Total Affected Area		10.05					
Total Post Burn Discharge					**2004.77**		**5.7**
Total Post Burn Discharge cfs/mi^2					**75.37**		

Burn Severity		mi²	Q25	Q50	Q100		
Unburned		25.95	2230.25833				
V.Low and Low BS		6.9	593.016667				
Moderate		3		336.75			
High		0.15			22.8625		
Total Affected Area		10.05					
Total Post Burn Discharge					**3182.89**		**2.9**
Total Post Burn Discharge cfs/mi^2					**119.66**		

Subdrainage Pour Points with moderate to high increases in runoff

Subdrainage 7

Burn Severity	Acres	mi²	Q2	Q5	Q10		
Unburned		0.05	0.8				
V.Low and Low BS		0.25	4				
Moderate		0.35		14.48125			
High		0.15			10.36875		
Total Affected Area		0.75					% Increase
Total Post Burn Discharge					**29.65**		**131.6**
Total Post Burn Discharge cfs/mi^2					**37.06**		

Burn Severity	Acres	mi²	Q10	Q25	Q50		
Unburned		0.05	3.45625				
V.Low and Low BS		0.25	17.28125				
Moderate		0.35		40.38125			
High		0.15			24.375		
Total Affected Area		0.75					
Total Post Burn Discharge					**85.49**		**54.6**
Total Post Burn Discharge cfs/mi^2					**106.87**		

Burn Severity		mi²	Q25	Q50	Q100		
Unburned		0.05	5.76875				
V.Low and Low BS		0.25	28.84375				
Moderate		0.35		56.875			
High		0.15			32.625		
Total Affected Area		0.75					
Total Post Burn Discharge					**124.11**		
Total Post Burn Discharge cfs/mi^2					**155.14**		**34.5**

Burn Severity		mi²	Q50	Q100	Q200		
Unburned		0.05	8.125				
V.Low and Low BS		0.25	40.625				
Moderate		0.35		76.125			
High		0.15			42.5625		
Total Affected Area		0.75					
Total Post Burn Discharge					**167.44**		
Total Post Burn Discharge cfs/mi^2					**209.30**		**28.8**

Burn Severity		mi²	Q100	Q200	Q500		
Unburned		0.05	10.875				
V.Low and Low BS		0.25	54.375				
Moderate		0.35		99.3125			
High		0.15			58.3125		
Total Affected Area		0.75					
Total Post Burn Discharge					**222.88**		**28.1**
Total Post Burn Discharge cfs/mi^2					**123.82**		

Subdrainage 11

Burn Severity	Acres	mi²	Q2	Q5	Q10		% Increase
Unburned		0.09	1.71				
V.Low and Low BS		0.2	3.8				
Moderate		0.31		14.88			
High		0.1			7.92857143		
Total Affected Area		**0.61**					
Total Post Burn Discharge					**28.32**		**112.9**
Total Post Burn Discharge cfs/mi^2					**40.46**		

Burn Severity	mi²	Q25	Q50	Q100		
Unburned	0.09	11.8285714				
V.Low and Low BS	0.2	26.2857143				
Moderate	0.31		57.1285714			
High	0.1			24.7142857		
Total Affected Area	**0.61**					
Total Post Burn Discharge				**119.96**		**30.4**
Total Post Burn Discharge cfs/mi^2				**171.37**		

Burn Severity	mi²	Q50	Q100	Q200		
Unburned	0.09	16.5857143				
V.Low and Low BS	0.2	36.8571429				
Moderate	0.31		76.6142857			
High	0.1			32.1428571		
Total Affected Area	**0.61**					
Total Post Burn Discharge				**162.20**		**25.7**
Total Post Burn Discharge cfs/mi^2				**231.71**		

Burn Severity	mi²	Q100	Q200	Q500		
Unburned	0.09	22.2428571				
V.Low and Low BS	0.2	49.4285714				
Moderate	0.31		99.6428571			
High	0.1			44		
Total Affected Area	**0.61**					
Total Post Burn Discharge				**215.31**		**24.5**
Total Post Burn Discharge cfs/mi^2				**529.03**		

Subdrainage 13

Burn Severity	Acres	mi²	Q2	Q5	Q10		
Unburned		0.42	7.245				
V.Low and Low BS		0.07	1.2075				
Moderate		0.26		11.5			
High		0.05			3.65625		
Total Affected Area		0.38					% Increase
Total Post Burn Discharge					**23.58**		**70.9**
Total Post Burn Discharge cfs/mi^2					**233.48**		
Burn Severity		mi²	Q10	Q25	Q50		
Unburned		0.42	30.7125				
V.Low and Low BS		0.07	5.11875				
Moderate		0.26		31.655			
High		0.05			8.5625		
Total Affected Area		0.38					
Total Post Burn Discharge					**76.05**		**30.0**
Total Post Burn Discharge cfs/mi^2					**752.96**		

Burn Severity	mi²	Q25	Q50	Q100		
Unburned	0.42	51.135				
V.Low and Low BS	0.07	8.5225				
Moderate	0.26		44.525			
High	0.05			11.5		
Total Affected Area	0.38					
Total Post Burn Discharge				**115.68**		**18.8**
Total Post Burn Discharge cfs/mi^2				**1145.37**		

Burn Severity	mi²	Q50	Q100	Q200		
Unburned	0.42	71.925				
V.Low and Low BS	0.07	11.9875				
Moderate	0.26		59.8			
High	0.05			14.9375		
Total Affected Area	0.38					
Total Post Burn Discharge				**158.65**		**15.8**
Total Post Burn Discharge cfs/mi^2				**1570.79**		

Burn Severity	mi²	Q100	Q200	Q500		
Unburned	0.42	96.6				
V.Low and Low BS	0.07	16.1				
Moderate	0.26		77.675			
High	0.05			20.4375		
Total Affected Area	0.38					
Total Post Burn Discharge				**210.81**		**14.6**
Total Post Burn Discharge cfs/mi^2				**2087.25**		

Subdrainage 16

Burn Severity	Acres	mi²	Q2	Q5	Q10		
Unburned		0.108	1.68821053				
V.Low and Low BS		0.722	11.286				
Moderate		1.03		41.2			
High		0.04			2.61052632		
Total Affected Area		1.792					% Increase
Total Post Burn Discharge					**56.78**		**91.2**
Total Post Burn Discharge cfs/mi^2					**0.24**		

Burn Severity	mi²	Q10	Q25	Q50		
Unburned	0.108	7.04842105				
V.Low and Low BS	0.722	47.12				
Moderate	1.03		110.047			
High	0.04			5.89473684		
Total Affected Area	1.792					
Total Post Burn Discharge				**170.11**		**37.2**
Total Post Burn Discharge cfs/mi^2				**0.73**		

Burn Severity	mi²	Q25	Q50	Q100		
Unburned	0.108	11.5389474				
V.Low and Low BS	0.722	77.14				
Moderate	1.03		151.789			
High	0.04			7.81052632		
Total Affected Area	1.792					
Total Post Burn Discharge				**248.28**		**22.3**
Total Post Burn Discharge cfs/mi^2				**1.06**		

Burn Severity	mi²	Q50	Q100	Q200		
Unburned	0.108	15.9157895				
V.Low and Low BS	0.722	106.4				
Moderate	1.03		201.121			
High	0.04			10.0210526		
Total Affected Area	1.792					
Total Post Burn Discharge				**333.46**		**19.1**
Total Post Burn Discharge cfs/mi^2				**1.43**		

Burn Severity	mi²	Q100	Q200	Q500		
Unburned	0.108	21.0884211				
V.Low and Low BS	0.722	140.98				
Moderate	1.03		258.042			
High	0.04			13.5157895		
Total Affected Area	1.792					
Total Post Burn Discharge				**433.63**		**16.9**
Total Post Burn Discharge cfs/mi^2				**1.85**		

Subdrainage 18

Burn Severity	Acres	mi²	Q2	Q5	Q10		
Unburned		0.09	1.377				
V.Low and Low BS		0.35	5.355				
Moderate		0.49		19.6			
High		0.07			4.648		
Total Affected Area		0.91					% Increase
Total Post Burn Discharge					**30.98**		**102.5**
Total Post Burn Discharge cfs/mi^2					**0.13**		

Burn Severity	mi²	Q10	Q25	Q50		
Unburned	0.09	5.976				
V.Low and Low BS	0.35	23.24				
Moderate	0.49		53.9			
High	0.07			10.78		
Total Affected Area	0.91					
Total Post Burn Discharge				**93.90**		**41.4**
Total Post Burn Discharge cfs/mi^2				**0.38**		

Burn Severity	mi²	Q25	Q50	Q100		
Unburned	0.09	9.9				
V.Low and Low BS	0.35	38.5				
Moderate	0.49		75.46			
High	0.07			14.42		
Total Affected Area	0.91					
Total Post Burn Discharge				**138.28**		**25.7**
Total Post Burn Discharge cfs/mi^2				**0.56**		

Burn Severity	mi²	Q50	Q100	Q200		
Unburned	0.09	13.86				
V.Low and Low BS	0.35	53.9				
Moderate	0.49		100.94			
High	0.07			18.62		
Total Affected Area	0.91					
Total Post Burn Discharge				**187.32**		**21.6**
Total Post Burn Discharge cfs/mi^2				**0.76**		

Burn Severity	mi²	Q100	Q200	Q500		
Unburned	0.09	18.54				
V.Low and Low BS	0.35	72.1				
Moderate	0.49		130.34			
High	0.07			25.41		
Total Affected Area	0.91					
Total Post Burn Discharge				**246.39**		**19.6**
Total Post Burn Discharge cfs/mi^2				**1.00**		

Subdrainage 23

Burn Severity	Acres	mi²	Q2	Q5	Q10		
Unburned		0	0				
V.Low and Low BS		0.33	5.082				
Moderate		0.65		25.9			
High		0.02			1.332		
Total Affected Area		1					% Increase
Total Post Burn Discharge					**32.35**		**110.1**
Total Post Burn Discharge cfs/mi^2					**0.14**		

Burn Severity	mi²	Q10	Q25	Q50		
Unburned	0	0				
V.Low and Low BS	0.33	21.978				
Moderate	0.65		72.15			
High	0.02			3.12		
Total Affected Area	1					
Total Post Burn Discharge				**97.25**		**46.0**
Total Post Burn Discharge cfs/mi^2				**0.42**		

Burn Severity	mi²	Q25	Q50	Q100		
Unburned	0	0				
V.Low and Low BS	0.33	36.63				
Moderate	0.65		101.4			
High	0.02			4.22		
Total Affected Area	1					
Total Post Burn Discharge				**142.25**		**28.2**
Total Post Burn Discharge cfs/mi^2				**0.61**		

Burn Severity	mi²	Q50	Q100	Q200		
Unburned	0	0				
V.Low and Low BS	0.33	51.48				
Moderate	0.65		137.15			
High	0.02			5.48		
Total Affected Area	1					
Total Post Burn Discharge				**194.11**		**24.4**
Total Post Burn Discharge cfs/mi^2				**0.83**		

Burn Severity	mi²	Q100	Q200	Q500		
Unburned	0	0				
V.Low and Low BS	0.33	69.63				
Moderate	0.65		178.1			
High	0.02			7.54		
Total Affected Area	1					
Total Post Burn Discharge				**255.27**		**21.0**
Total Post Burn Discharge cfs/mi^2				**1.09**		

Subdrainage 24

Burn Severity	Acres	mi²	Q2	Q5	Q10		
Unburned		4.75	61.8939394				
V.Low and Low BS		1.8	23.4545455				
Moderate		2.9		93.4			
High		0.45			23.72727273		
Total Affected Area		5.15					% Increase
Total Post Burn Discharge					**202.52**		**57.0**
Total Post Burn Discharge cfs/mi^2					**0.87**		

Burn Severity	mi²	Q10	Q25	Q50		
Unburned	4.75	250.454545				
V.Low and Low BS	1.8	94.9090909				
Moderate	2.9		252.212121			
High	0.45			55		
Total Affected Area	5.15					
Total Post Burn Discharge				**652.58**		**25.0**
Total Post Burn Discharge cfs/mi^2				**2.79**		

Burn Severity	mi²	Q25	Q50	Q100		
Unburned	4.75	413.106061				
V.Low and Low BS	1.8	156.545455				
Moderate	2.9		354.444444			
High	0.45			73.63636364		
Total Affected Area	5.15					
Total Post Burn Discharge				**997.73**		**15.9**
Total Post Burn Discharge cfs/mi^2				**4.26**		

Burn Severity	mi²	Q50	Q100	Q200		
Unburned	4.75	580.555556				
V.Low and Low BS	1.8	220				
Moderate	2.9		474.545455			
High	0.45			96.36363636		
Total Affected Area	5.15					
Total Post Burn Discharge				**1371.46**		**13.3**
Total Post Burn Discharge cfs/mi^2				**5.86**		

Burn Severity	mi²	Q100	Q200	Q500		
Unburned	4.75	777.272727				
V.Low and Low BS	1.8	294.545455				
Moderate	2.9		621.010101			
High	0.45			132.7272727		
Total Affected Area	5.15					
Total Post Burn Discharge				**1825.56**		**12.7**
Total Post Burn Discharge cfs/mi^2				**7.80**		