

Indian Fire BAER, August 2017 – 2500-8 Report

Inyo National Forest

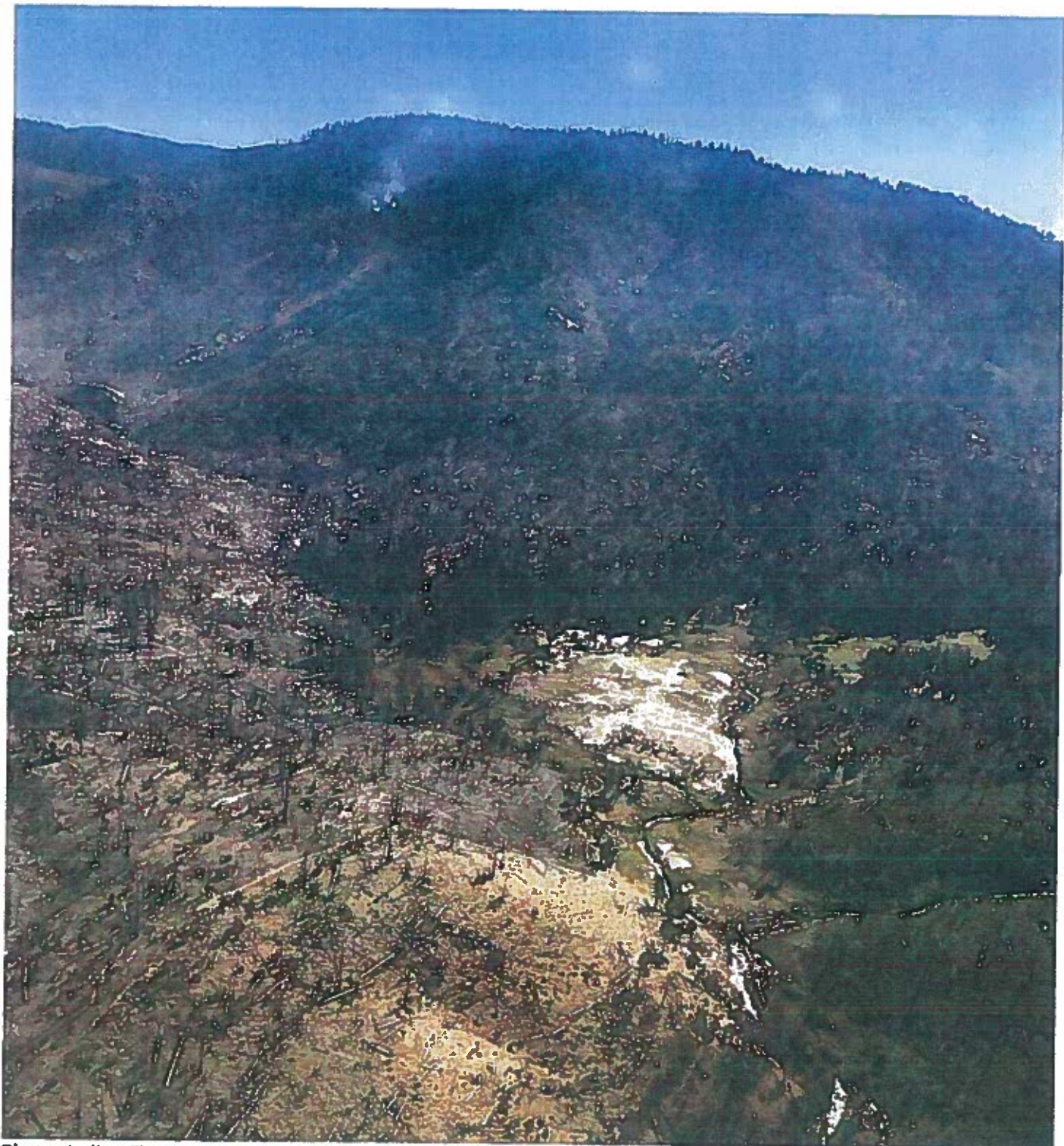


Photo: Indian Fire August 2017, Golden Trout Wilderness at confluence of Redrock and Ninemile Creeks at Jordan Hot Springs.

Date of Report: September 5, 2017

BURNED-AREA REPORT
(Reference FSH 2509.13)**PART I - TYPE OF REQUEST****A. Type of Report**

- ☒ 1. Funding request for estimated emergency stabilization funds
☐ 2. Accomplishment Report
☐ 3. No Treatment Recommendation

B. Type of Action

- ☒ 1. Initial Request (Best estimate of funds needed to complete eligible stabilization measures)
☐ 2. Interim Report # _____
 ☐ Updating the initial funding request based on more accurate site data or design analysis
 ☐ Status of accomplishments to date
☐ 3. Final Report (Following completion of work)

PART II - BURNED-AREA DESCRIPTION**A. Fire Name:** Indian**B. Fire Number:** CA-INF-001264**C. State:** CA**D. County:** Tulare**E. Region:** 05**F. Forest:** Inyo NF**G. District:** Mount Whitney (54)**H. Fire Incident Job Code:** P5K8XS (0504)**I. Date Fire Started:** 08/03/17**J. Date Fire Contained:** 08/31/2017**K. Suppression Cost:** \$4,000,000 (projected 9/3/17)**L. Fire Suppression Damages Repaired with Suppression Funds**

1. Fireline waterbarred (miles): 0
2. Fireline seeded (miles) 0.0
3. Other (identify): 9.17 miles of handline (no dozer lines installed, fire in wilderness). Minimal rehabilitation done by hand crews to close line.

M. Watershed Number: HUC 10 - 180300010401 (Ninemile Creek);**N. Total Acres Burned:** 2649

NFS Acres (2649) Other Federal () State () Private ()

O. Vegetation Types: Chaparral, Mixed Conifer**P. Dominant Soils:** Cagwin, Toem, thermally altered Meadow soils by Jordan Hot Springs

Q. Geologic Types: Quartz diorite, Diorite, Granodiorite of Redrock Meadow, Igneous intrusive rock type

R. Miles of Stream Channels by Order or Class: Ephemeral: 3.4, Intermittent: 6.25, Perennial: 5.7

S. Transportation System

Trails: 5.4 miles Roads: 0 miles

PART III - WATERSHED CONDITION

A. Burn Severity (acres): 970 (low, very low -36.7%), 1466 (moderate - 55.3%), 213 (high 8.0 %)

B. Water-Repellent Soil (acres): 2406, estimated, based on knowledge of soils, vegetation and burn severity in the fire area.

C. Soil Erosion Hazard Rating (acres):
 ___ (low) 626 (moderate) 213 (high)

D. Erosion Potential: 4.5 tons/acre (2 year storm) 6.00 t/acre (high); 4.6 t/acre (Mod)

E. Sediment Potential: 1565 cubic yards / square mile

PART IV - HYDROLOGIC DESIGN FACTORS

A. Estimated Vegetative Recovery Period, (years): 3-5

B. Design Chance of Success, (percent): 80

C. Equivalent Design Recurrence Interval, (years): 5

D. Design Storm Duration, (hours): .5

E. Design Storm Magnitude, (inches): .603

F. Design Flow, (cubic feet / second/ square mile): 30

G. Estimated Reduction in Infiltration, (percent): 63

H. Adjusted Design Flow, (cfs per square mile): 69

PART V - SUMMARY OF ANALYSIS

Introduction:

The Indian Fire started the afternoon of August 3, 2017 as a result of a lightning strike in a remote area of the Golden Trout Wilderness (7 miles from trailhead and road). The fire burned approximately 2649 acres, all on Federal lands. The fire burned in the Nine Mile Creek watershed within the lower Red Rock Creek (tributary). The Indian Fire burned entirely within the 2002 McNally fire burn footprint on steep slopes. Previous to the McNally fire, the area was forested with a mature pine, fir and juniper forest and a dense shrub community and was severely burned in 2002 leaving few live trees and little ground cover (mostly high burn severity). Since 2002, many of the burned trees have fallen and extensive brush and shrub communities have developed. The Indian Fire burned the majority of the fallen trees along with heavy brush/saplings removing the bulk of existing soil cover, leaving a high amount of bare soil post fire on the steep slopes and a high risk of soil erosion post-fire.

Soils/Erosion Response Soils

Soils in the fire area have a loamy sand non-cohesive surface texture, with various amounts of gravel and cobble. Rock Outcrop is a soil map unit component within the fire area. Rock outcrop areas can shed water onto burned hillslopes leading to increased rill and gully erosion on soils with an already rapid runoff potential. The Indian fire burned within the footprint of the 2002 McNally fire. Pre-fire conditions included pockets of heavy fuel, a heavy shrub component and standing/downed dead trees. Erosion response is heavily influenced by soil burn severity, hillslope geomorphology, slope and surface texture. The burn affected soil aggregate stability, canopy cover, ground cover and infiltration rates. In areas of moderate and high burn severity, it is highly likely that increased rates of soil erosion and sediment delivery to stream channels will occur, for two or three years after the fire, particularly on steep slopes that contained shrubs and are slow to recover. Typically, in moderate and low severity areas needle cast helps mitigate post-fire erosion. Since this area burned intensely in 2002, needle cast is expected to be minimal in many areas of the fire.

This area has burned twice in the last 15 years. Recovery in the high and moderate burn severity areas may be slower due to soil loss and type conversion from the McNally fire. Recovery of high burn severity areas is generally slower because little or no ground cover remains, the potential for needle cast is low and soils may be impacted by fire effects.

Quantitative erosion figures were estimated using the Erosion Risk Management Tool (ERMiT) batch model. ERMiT is a Water Erosion Prediction Project (WEPP)-based application developed by USFS Rocky Mountain Research Station USFS, RMRS-GTR-188, 2007) specifically for use with post-fire erosion modeling. The model estimates only sheet and rill erosion, which occurs when rainfall exceeds infiltration rates, and surface runoff entrains surface soil particles. The model does not account for shallow landslides or gully erosion, stream-bank erosion, road effects, or fire-line erosion and gully erosion, which could present large additional sources of sediment entering the fluvial systems.

ERMiT models erosion potential based on single hillslopes, single-storm "runoff events," and post-fire soil burn severity. Background erosion rates were calculated to be .65t/acre for a two year storm event for a 50% forested slope. Hillslopes include soil and topography inputs. Soil inputs include texture and matrix rock content, which was based upon soil map unit information and professional knowledge of the fire area. Generalized hillslope gradients and profiles were developed in GIS by to characterize topography. Various storm runoff-event magnitudes may be chosen in ERMiT for erosion response estimates; a 2-year, event was run for this analysis. ERMiT uses the PRISM module to generate climatic input parameters; a customized climate interpolated for the Indians fire was generated for the fire area to account for the variations in precipitation across the fire perimeter.

Soil Burn Severity

The soil burn severity (SBS) map shows approximately 63% burned at moderate and high soil burn severity. Areas of high and moderate soil burn severity (especially high) are considered "flood source" areas and can produce accelerated runoff and sedimentation affecting roads, trails, water quality, and downstream infrastructure.

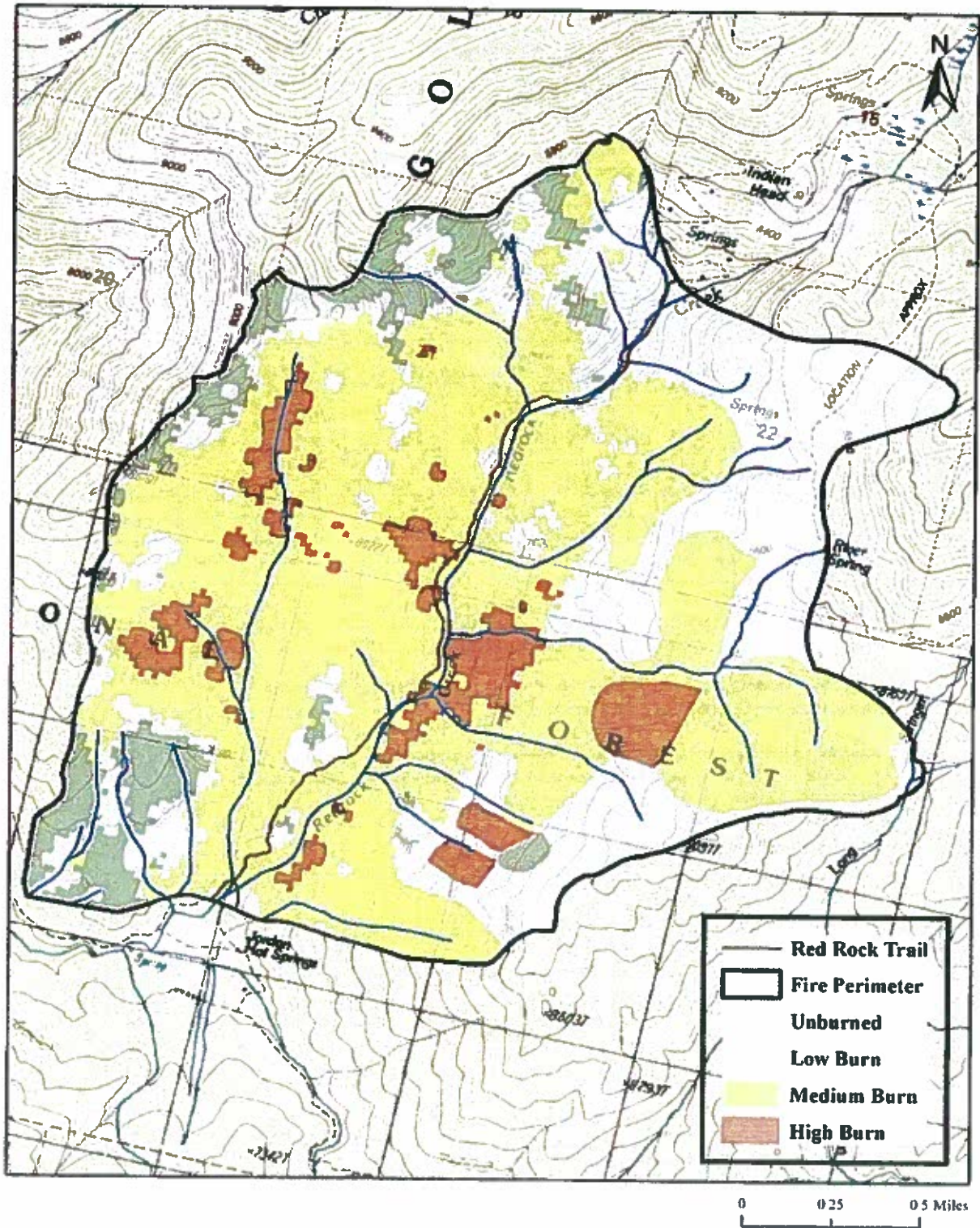
Watershed Response:

The fire occurred within the Red Rock Creek (HUC 12) watershed on steep to very steep slopes previously burned in 2002 during the McNally Fire. A slight amount of the fire spilled over into an adjoining watershed, Long Canyon Stringer. Only the Red Rock Creek watershed in the fire area was delineated and hydrologic modeling conducted during the BAER assessment. Pre-fire slope stability and recovery of watershed hydrologic response is dependent on many factors and typically occurs within 3-5 years following the fire. Recovery of moderate burn severity areas are generally slow for the first 1-2 years and usually recovers quickly afterwards because vegetation was not severely burned.

Hydrologic modeling was conducted for the fire area and the watershed modeled have an expected increase in the Q5 discharge compared to pre-fire conditions. The Red Rock Creek watershed is expected to have an increase in Q5 discharge by 55% more than the pre-fire conditions. This is due to the large amount of moderate and to a lesser extent high soil burn severity that occurred as a result of the fire.

*Change in flow is the increase in flow resulting from the reduction in soil infiltration after a fire based on a paper by Terry Henry. Acres of unburned and low soil burn severity are modeled at Q5, acres of moderate soil burn severity are modeled at Q10 and acres of high soil are modeled at Q25. A weighted average is then calculated to arrive at post fire Q5.

Inyo National Forest: Indian Fire Burn Severity Map



Map 1: Soil burn severity map for the Indian Fire within the Red Rock Creek watershed. FS Trail #3418 is located in the mid-section of the fire up steep slopes.

Table 2: Displays the amount of burn severity and acres burned throughout the fire area.

Watershed	Total Acres	Unburned Acres	Low Severity Acres	Moderate Severity Acres	High Severity Acres
Red Rock	2649	243	727	1466	213
	Percent Burned	9.3%	27.4%	55.3%	8.0%

Water Quality

Redrock Creek and small tributaries are the primary perennial streams within the fire area. It is likely that post-fire ash, fine soil, and debris will temporarily degrade water quality in these streams. The streams have hydrologic continuity to Ninemile Creek and the North Fork Kern River. Moderate and short lived episodes of sediment and ash could enter Redrock and Ninemile Creek that could impact fisheries. Table 1 above shows that there is a 55 % increase in peak flow into Redrock Creek at Ninemile Creek confluence (Jordan Hot Springs) as compared to pre-fire conditions with a five year return interval event.

Geology/Geologic Response:

Rock Fall: Rock fall hazards are low in the fire area, but possibly a threat to trail users during a storm event. Existing rock outcrops are mostly intact.

Debris Flow: There is a history of large fire related debris flows in the Ninemile Creek watershed based on observations made after the McNally fire of 2002. Due to the steep area of Redrock Creek burned in this fire and large area of missing ground cover there is the potential for a debris flow event that may impact the Jordan Hot Springs area below the fire. Jordan Hot Springs is used by equestrians who use the public pasture for stock, and hikers use the hot springs and for camping. The Redrock Creek channel flows to the west of these use areas and debris flows would not likely cause impacts. The risk for mud flow occurrence because of the fire as a result of the fire is considered to be moderate two years following the fire and will decrease in year three.

A. Describe Critical Values/Resources and Threats:

The risk matrix below, Exhibit 2 of Interim Directive No.: 2520-2010-1 was used to evaluate the Risk Level for each value identified during Assessment. Only values at risk that had a risk of Intermediate or above are discussed.

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

Threats to Life/Safety and Property

Jordan Hot Springs to Redrock Trail (FS Trail 3418, Redrock Trail) Golden Trout Wilderness

The Jordan/Redrock Creek Trail traverses through the Indian Fire area for 5.4 miles within the middle of the burn area and below extensively burned slopes, adjacent to Redrock Creek. The trail climbs for 2500 feet from Jordan Hot Springs to Redrock Meadow with uphill grade. Approximately 4.5 miles of the trail is located in and below moderate and high burned severity slopes. The trail is a popular equestrian trail in the Golden Trout Wilderness and serves as a loop connector between Redrock Meadows and Jordan Hot Springs. Log trail tread checks were installed after the McNally Fire and are likely burned in the Indian Fire. The trail will likely channel runoff from burned slopes and concentrate flows that could lead to severe trail incision, off site soil impacts and introduce increased sediment to tributary channels and

to Redrock Creek. Without treatment, the trail could become unstable for stock and hiker use and could lead to the creation of undesirable use trails or multiple trails. The trail is frequently used by stock riders and hikers and if badly degraded could become a safety issue for stock and stock riders. With expected increases of runoff as a result of the fire the trail could be severely impacted and result in increased repair costs if not treated.

Emergency Determination:

Probability of Damage or Loss: Very Likely

Magnitude of consequences: Moderate

Risk Level: Very High

Threats to Natural and Cultural Resources

Cultural Resources: No threat to cultural resources exists due to the post-fire environment. Potential impacts to cultural resources will be evaluated during project implementation.

Water Quality/Aquatic Habitat: Water quality in Redrock and Ninemile Creek could be impacted by ash and sediment post-fire, and may have a slight to moderate impact on wild trout fishery.

Ecosystem Stability and Vegetation Recovery

Invasive weeds:

Inventory: Portions of the Indian Fire were surveyed in 2002, 2010, 2013, and 2015. These surveys followed trail systems and provided monitoring for perennial pepperweed occurrences located adjacent to the Indian Fire. No botanical survey work has been completed in the drainages or along the hillslopes within the fire footprint.

Invasive species with known occurrences within and immediately adjacent to the Indian Fire are *Lepidium latifolium* (perennial pepperweed), *Bromus tectorum* (cheatgrass), *Taraxacum officianale* (common dandelion), and *Verbascum thapsus* (woolly mullein). Perennial pepperweed is a California state-listed Noxious Weed with high environmental impact. This species has a limited extent on the forest with only four known locations, and these infestations are being actively treated with the goal of eradication.

Perennial pepperweed: A known occurrence of perennial pepperweed is located less than 150 m south of the fire perimeter at Jordan Hot Springs. This location was used as a helispot and water source. Two dip points were located in Ninemile Creek just downstream from Jordan Hot Springs. These dip points were located roughly 10 m and 150 m downstream from the occurrence. An additional dip point was located approximately 1.5 miles west of the fire at Soda Flat. This dip site was located ~250 m from a second known perennial pepperweed occurrence. It is possible that viable propagules from this species was in water dropped on the fire during suppression activities and this may be a vector for invasive species introduction to formerly weed-free sites.

A third perennial pepperweed occurrence is located in a drainage 0.25 miles west of Jordan Hot Springs. The fire boundary is located 10 m uphill from this occurrence and fire suppression activities took place within this population. Fire personnel used the drainage to access the fire line, a log was bucked up within the occurrence, and hand line was constructed 10 m upslope from the population. It is possible that viable propagules were introduced along the hand line or where tools used at the site were subsequently used elsewhere on the fire. Clothing is also a vector, and propagules may have been picked up when personnel moved through the site to the fire line.

Cheatgrass: Cheatgrass is located at the dip site in Ninemile Creek ~150 meters south of the fire perimeter. It is possible that viable propagules from this species were in water and dropped on the fire during suppression activities. This may serve as a vector for invasive species introduction to formerly weed-free sites. A second cheatgrass occurrence is located along the Redrock Trail within the Indian Fire. This occurrence was mapped in 2002 and may have since spread

into the McNally Fire footprint. It is unlikely that this second occurrence was impacted or further spread by fire suppression activities.

Common dandelion: Two occurrences of common dandelion are located within 50 m of the eastern fire perimeter along the River Springs Trail. It is possible that these occurrences may have been bisected by hand line. However, very little spread is expected due to the habit requirements of this species. Risk of spread from these occurrences due to fire suppression activities is unlikely to be greater than current risk of spread due to trail use by recreationists.

Woolly mullein: Woolly mullein is located at the dip site in Ninemile Creek just south of the fire perimeter. It is possible that viable propagules from this species were in water dropped on the fire during suppression activities. This may serve as a vector for invasive species introduction to formerly weed-free sites.

Emergency Determination:

Probability of damage or loss: Likely

Magnitude of Consequences: Moderate

Risk Level: High

B. Emergency Treatment Objectives:

Threats to Life and Property

1. Protect and preserve trail infrastructure on FS Trail #3418 by minimizing runoff concentration that can cause soil erosion, trail tread loss, and off-trail soil and water quality impacts and damage to existing trail water control features. Install fire hazard warning signs at trailhead in to the fire area.

Threats to Ecosystem Stability

1. Determine if invasive species have been introduced or are expanding along hand lines, trails, drainages, or Redrock Creek due to fire disturbance and/or suppression activities.

C. Probability of Completing Treatment Prior to Damaging Storm or Event:

Land 80 % Channel % Roads/Trails 80 % Protection/Safety 80 %

D. Probability of Treatment Success

	Years after Treatment		
	1	3	5
Land	80	90	100
Channel			
Roads/Trails	90	90	100
Protection/Safety	90	90	100

E. Cost of No-Action (Including Loss): \$43,200, including potential loss of habitat due to noxious weed spread and excessive soil loss due to multiple fires in a short time-frame.

F. Cost of Selected Alternative (Including Loss): **\$39,040**

G. Skills Represented on Burned-Area Survey Team:

<input checked="" type="checkbox"/> Hydrology	<input checked="" type="checkbox"/> Soils	<input type="checkbox"/> Geology	<input type="checkbox"/> Range	<input type="checkbox"/>
<input type="checkbox"/> Forestry	<input type="checkbox"/> Wildlife	<input type="checkbox"/> Fire Mgmt.	<input checked="" type="checkbox"/> Engineering	<input type="checkbox"/>
<input type="checkbox"/> Contracting	<input type="checkbox"/> Ecology	<input type="checkbox"/> Botany	<input checked="" type="checkbox"/> Archaeology	<input type="checkbox"/>
<input type="checkbox"/> Fisheries	<input type="checkbox"/> Research	<input type="checkbox"/> Landscape Arch	<input checked="" type="checkbox"/> GIS	

Team Leader: Casey Shannon, Inyo National Forest

Email: cshannon@fs.fed.us Phone: 760-873-2407 FAX: 760-873-2458

H. Treatment Narrative:

(Describe the emergency treatments, where and how they will be applied, and what they are intended to do. This information helps to determine qualifying treatments for the appropriate funding authorities. For seeding treatments, include species, application rates and species selection rationale.)

Land Treatments:

Invasive weed early detection and rapid response: At minimum, survey 1 mile of hand line, 4 miles of drainages, the Redrock Creek riparian area, 0.5 miles of River Springs Trail, 0.75 miles of Blackrock-Kern Trail, and the Jordan Hot Springs and Soda Flat helispots.

Small, isolated infestations will be eradicated by hand pulling. Fruiting individuals will be disposed of in garbage bags taken off site. Perennial pepperweed, a rhizomatous species, is most effectively controlled using herbicide. The *Perennial Pepperweed Eradication on Blackrock-Kern and Wildrose Trails Environmental Assessment*, completed in 2010, allows for herbicide treatment of perennial pepperweed populations located in the Golden Trout Wilderness along the Blackrock-Kern and Wildrose trail systems. Occurrences within the 2010 EA analysis area, including Jordan Hot Springs, the Blackrock-Kern Trail, and Soda Flat, can be treated using the herbicide methods outlined in the EA. Any perennial pepperweed occurrences outside of the EA analysis area will be treated by hand pulling and/or cutting only.

Weed Surveys and Rapid Response Costs				
Item	Unit	Unit Cost	# of Units	Cost
1 GS-11 botanist	Day	\$355	4	\$1420
1 GS-7 weed technician	Day	\$196	4	\$784
Supplies	Each	\$500	1	\$500
Vehicle gas mileage	Miles	\$0.50	700	\$350
Animal Packing/Packer	Day	\$900	2	\$1800
Travel/Per Diem	Day	\$55	8	\$440
Total Cost				\$5294

Channel Treatments:

Channel Treatments are not recommended.

Roads and Trail Treatments:

FS Trail # 3418 Redrock to Jordan Trail

FS Trail # 3418: Stormproofing and stabilization: Improve drainage characteristics on the trail to improve water control efficiency, remove outside berms to reduce flow concentration to the trail, maintain all existing water control features (rock waterbars, checks, outside drains, etc.) for best efficiency over 4.5 miles of trail in moderate and high burn area with steep slopes, and install additional drainage dips and checks on trail to increase drainage and reduce erosion

3. *Data collection techniques consistent with appropriate protocols;* Photos and on the ground observations, ensure erosion control structures are functioning properly
4. *Analysis, evaluation, and reporting techniques;* evaluate whether the erosion control treatments were effective in preserving trail tread and reducing the amount of rill and gully erosion on the trail
5. *Monitoring report timeframes.* Within 30 days of monitoring field trip

Part VI – Emergency Stabilization Treatments and Source of Funds

Interim #

Subtotal Land Treatments				\$5,294	\$0		\$0		\$0	\$5,294
B. Channel Treatments										
				\$0	\$0		\$0		\$0	\$0
				\$0	\$0		\$0		\$0	\$0
				\$0	\$0		\$0		\$0	\$0
<i>Insert new items above this line!</i>				\$0	\$0		\$0		\$0	\$0
Subtotal Channel Treat.				\$0	\$0		\$0		\$0	\$0
C. Road and Trails										
FS Trail # 3418	mile	5,157	4.5	\$23,208	\$0		\$0		\$0	\$23,208
				\$0	\$0		\$0		\$0	\$0
				\$0	\$0		\$0		\$0	\$0
<i>Insert new items above this line!</i>				\$0	\$0		\$0		\$0	\$0
Subtotal Road & Trails				\$23,208	\$0		\$0		\$0	\$23,208
D. Protection/Safety										
Trail Hazard Signs		865	1	\$865	\$0		\$0		\$0	\$865
				\$0	\$0		\$0		\$0	\$0
				\$0	\$0		\$0		\$0	\$0
<i>Insert new items above this line!</i>				\$0	\$0		\$0		\$0	\$0
Subtotal Structures				\$865	\$0		\$0		\$0	\$865
E. BAER Evaluation										
BAER Team Assess				\$5,580			\$0		\$0	\$0
<i>Insert new items above this line!</i>				---	\$0		\$0		\$0	\$0
Subtotal Evaluation				\$5,580	\$0		\$0		\$0	\$0
F. Monitoring										
Trail	Days	357	3	\$2,120	\$0		\$0		\$0	\$2,120
<i>Insert new items above this line!</i>				\$0	\$0		\$0		\$0	\$0
Subtotal Monitoring				\$2,120	\$0		\$0		\$0	\$2,120
G. Totals				\$31,487	\$0		\$0		\$0	\$31,487
Previously approved										
Total for this request				\$31,487						

PART VII - APPROVALS

1. Diana Pietrasanta
acting Forest Supervisor (signature)

9/8/2017
Date

2. Bonnie T. Grant
Regional Forester (signature)

9/18/2017
Date

potential. A watershed specialist will be present with trail crew during implementation to ensure adequate prescriptions are met, and for follow up monitoring. **Note:** It takes nearly a full day to access this trail from Bishop and Lone Pine, therefore operational costs are higher than trails that are closer to Forest offices.

FS System Trail # 2603 Stormproofing and Stabilization				
Item	Unit	Unit Cost	# of Units	Cost
5 person trail crew (Contract/Agreement Crew)	Day	\$1850	7	\$12,950.00
Watershed Specialist Project Coordination	Day	\$325	5	\$1,625.00
Crew Overhead (travel, tools, vehicles, admin)	1	\$1443	1	\$1,443.00
Vehicle gas mileage for FS Specialists	Miles	\$0.75	1400	\$1,050.00
Travel Per Diem for FS Specialists	Day	\$55.00	8	\$440.00
Animal Packing/Packer - Transport	Day	\$950	6	\$5,700.00
Total				\$ 23,208.00

Protection/Safety Treatments:

Install fire area hazards signs on the Redrock Trail # 3418 at entrances to the fire area and at the Blackrock trailhead into the Golden Trout Wilderness.

Caution Signs FS System Trail # 3418				
Item	Unit	Unit Cost	# of Units	Cost
1 GS-9 Hydro	Days	2	1	\$640.00
Signs	Each	\$50	2	\$100.00
Posts	each	\$25	2	\$50.00
Vehicle gas mileage	Miles	\$0.75	100	\$75.00
Total				\$865.00

I. Monitoring Narrative:

(Describe the monitoring needs, what treatments will be monitored, how they will be monitored, and when monitoring will occur. A detailed monitoring plan must be submitted as a separate document to the Regional BAER coordinator.)

Forest personnel will conduct a Level 1 Effectiveness monitoring of the trail treatments to check that treatments are present and functioning properly. The purpose is to ensure the action is meeting site-specific objectives or if there is a need for follow-up or re-treatment. Monitoring will be conducted after storm events. The report would include photographs and a recommendation on whether additional treatments are necessary. If the monitoring shows the treatment to be ineffective at stabilizing the trail and there is extensive loss of trail bed or infrastructure an interim report will be submitted. A monitoring report would be completed after the site visit. **Note:** Monitoring costs are reflective of the remote nature of the fire and the logistics of getting to the trail system.

FS System Trail # 2603 Monitoring				
Item	Unit	Unit Cost	# of Units	Cost
Hydrologist - Documentation	Day	320	5	\$1600.00
Travel Per Diem	Day	55	4	\$220.00
Vehicle gas mileage for FS Specialists	Miles	\$0.75	400	\$300.00
Total				\$2120.00

1. *Monitoring questions;* Did the treatments effectively mitigate post-fire runoff damage?
2. *Measurable indicators;* Rills and gully's on the trail, sediment deposition within the lead-off ditch