Emergency Stabilization and Burned Area Rehabilitation Plan

East Troublesome Fire



East Troublesome Fire from Cottonwood Pass looking North on the evening of Oct 21, 2020

Credit: Andrew Lussie

November 20, 2020

Submitted by: Darla Sidles Date: 20 Nov 2020

Darla Sidles, Superintendent

Approved by: MICHAEL REYNOLDS Digitally signed by MICHAEL REYNOLDS Date: 2020.11.25 13:25:10 -07'00' Date: _____

Mike Reynolds, Regional Director

Approved by: Approval Memorandum On File Date: December 16, 2020

Kenneth Schmid, Acting Chief, Branch of Wildland Fire

UNIT SUMMARY INFORMATION

Unit Name	Rocky Mountain National Park
Unit Identifier	ROMO
NPS Region	Inter Mountain

FIRE SUMMARY INFORMATION

Fire Name	East Troublesome
Fire Number	CO-RMP-001098
Fire Code	NN4T0
Detection Date/Cause	Wednesday Oct 14, 2020 / Unknown
Date Contained	72% AS OF 11/19/20
Acreage	NPS = 22,668 East = 4,898 West = 17,770

ACCOUNT NUMBER(S)

Emergency Stabilization, FY21

Fund	21XP112585
Cost Center	PPIMIMROZD
Functional Area	PF220ES85.RM.0000
WBS	PF.FENN4T021.00.1.

TEAM MEMBERS

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Position	Name & Affiliation
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Wilderness Field Mgr	Tara Vessella, ROMO
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Position	Name & Affiliation
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GIS Specialist	Shawn Wignall, ROMO
Planner	Cheri Yost, ROMO

EXECUTIVE SUMMARY

Introduction

The East Troublesome fire was ignited by an unknown source on October 14, 2020 just north of Hot Sulphur Springs. On October 21, strong winds fueled rapid fire growth that drove the fire into Rocky Mountain National Park (ROMO) near Grand Lake. The fire burned approximately 22,668 total acres in the park, including front country areas and designated wilderness. The total acres included about 4,898 acres burned in the Big Thompson District (BTD) located on the east side of the park, and about 17,770 acres burned in the Colorado River District (CRD) on the west side of the park. The fire affected park housing, offices, entrance station, trails, campsites, privies, bridges, wayfinding signs, the boundary, historic structures and landscapes, archeological resources, fisheries, wildlife, and vegetation.

Policy and Guidance

The plan was developed in accordance with Department of the Interior and National Park Service (NPS) policy and guidance, including:

- Departmental Manual 620, chapter 7, Post Wildfire Recovery.
- Office of Wildland Fire (OWF) Policy Memorandum 2016-01 (Post-Wildfire Recovery Program and Policy Changes);
- Interagency Standards for Fire and Fire Aviation Operations;
- NPS Reference Manual 18 (Chapter 18);
- NPS Wildland Fire & Aviation Management Business Rules;
- Interagency Burned Area Emergency Response Guidebook (Version 4.0)

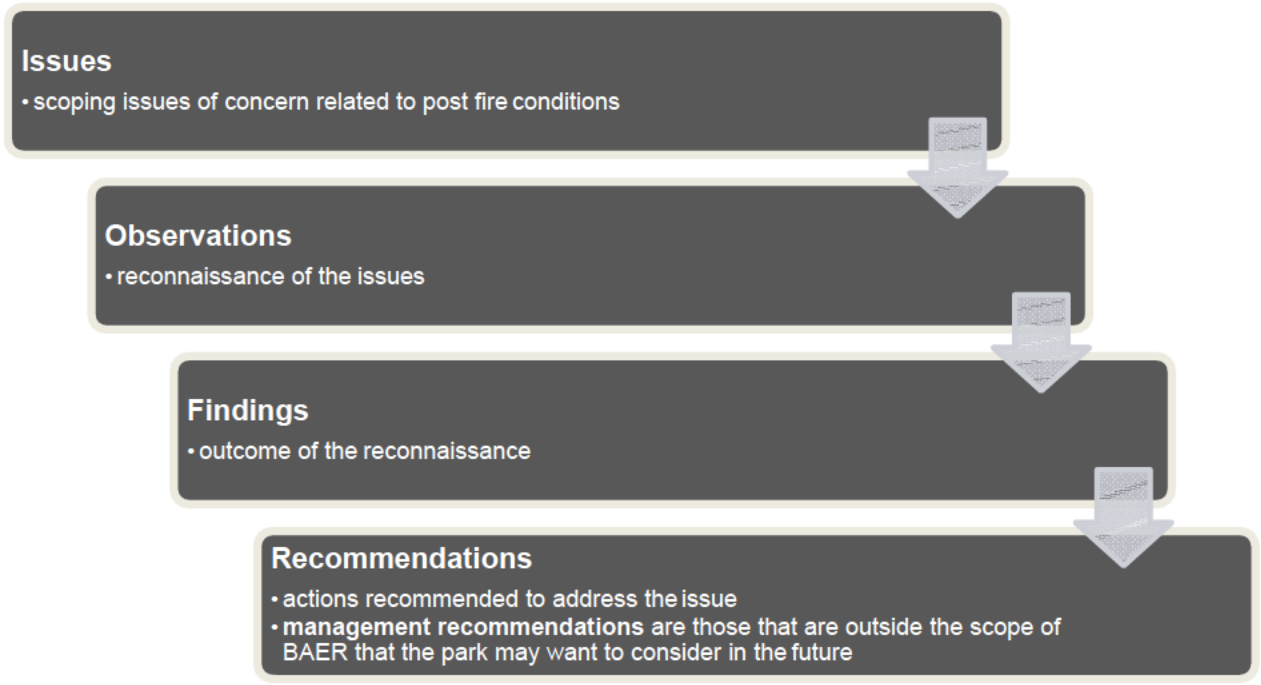
The primary objective of the BAER program is to assess the need for and prescribe cost effective post-fire stabilization measures necessary to protect human life, property, and critical natural and cultural resources. BAER is conducted in accordance with approved land management plans and policies, and all relevant federal, state and local laws and regulations.

BAER is intended to address imminent (<1 year) threats caused by wildfire; it is not responsible for long-term management or rectifying deficiencies that existed prior to the fire. Department of the Interior and NPS BAER policy echoes federal wildland fire policy regarding protection priorities: human safety is first, and property and critical natural and cultural resources are ranked based on the relative values to be protected, commensurate with emergency stabilization costs.

The basis of the BAER assessment process is identifying, evaluating, and protecting, repairing or replacing Values at Risk (VARs)—human safety, properties, capital improvements and natural and cultural resources—located within and downstream of burned areas, and impacted by fire and/or vulnerable to post-fire conditions. When evaluating a given VAR, consideration is given to the significance of the value, probability of further damage occurring, the magnitude of potential consequences, and the feasibility to mitigate.

The BAER business model in developing the BAER Plan is to identify issues of concern, make

observations of those issues, record findings (the assessment) and make recommendations (specifications for treatment) consistent with policy, best management practices and fiscal responsibility.



Issues Scoped

A scoping session was conducted with BAER and park staff that identified issues of concern for the BAER team to address, including the effects of the fire and post-fire events on:

- Headwater streams and river systems and water quality
- Lakes and reservoirs important to water supply and communities (Lake Estes, Grand Lake, Adams Tunnel and other water transport structures)
- Sedimentation and turbidity affecting municipal water supply
- Potential flooding and debris flow in Estes Park and Grand Lake
- Potential debris flow or landslide impacts within park
- Roads: road signage, culverts, and fire-created hazard trees (Trail Ridge Road, Fern Lake Road, Upper Beaver Meadows Road, and others)
- Grand Lake Cemetery (damage to headstones, graves, hazard trees, looting)
- Burned buildings, hazards, and potential for contaminants
- Burned inholdings including private property and structures
- Burned concessions structures (Moraine Park Stable Bunkhouses)
- Trails: multiuse bridges, foot bridges, wooden water bars, trail cribbing, wayfinding signs
- National Scenic Trail – Continental Divide
- Wilderness campsites, ranger camps, signs, and privies
- Boundary monuments, signs, and fence

- Buck-n-rail fence (snowmobile trail, Harbison Meadows, etc.)
- Commercial services, hiking, horse pack and llama packing
- Individual hiking, horse pack and llama packing
- Moraine Park Campground and drinking water wells
- Burned historic structures (Onahu Ranch Lodge, Green Mountain Ranch Cottages, etc.), remains of the chimneys, and potential for looting
- Historic trails
- Burned museum artifacts that were in Betty Dick Garage
- Archaeological sites (approximately 200 within burn perimeter) including cabin/ranch ruins and Native American wood shelters
- Ethnographic resources
- Protection of archaeological sites during BAER activities
- Limber pine – regeneration of burned stands
- Isolated ponderosa pine stand on west side
- Rare plant species on North Inlet and East Inlet Trails.
- Exotic plant proliferation
- Ungulate exclosure fences and wetland vegetation within and outside those fences
- Canada Lynx habitat
- Mexican Spotted Owl nesting habitat
- Downstream threatened and endangered species
- Golden eagle and osprey nest impacts
- Boreal Toad and Wood Frog breeding sites
- Migratory Bird Treaty Act species
- Colorado River Cutthroat Trout populations (observations of fish kill on east and west sides) and their habitat
- Sport Fisheries (observations of fish kill on east and west sides) and their habitat
- Water Quality, Mercury Release and Bioaccumulation
- River Otter and their habitat
- Elk population and effect on winter range
- Moose population and effect on winter and summer range
- Scientific monitoring equipment and long-term monitoring plots

Table 1: Issues and recommendations for specific related Values at Risk.

VAR	ISSUE	Recommendation(s)
Vegetation	Exotic Plants	Control invasive plant species along trails, fire suppression contingency line and fire suppression water drops.
	Limber Pine	Outplant limber pine seeds and seedlings within four known limber pine stands
	Wetland Vegetation	Repair exclosure fences, restore wetland vegetation

Table 1: Issues and recommendations for specific related Values at Risk.		
VAR	ISSUE	Recommendation(s)
Wildlife and Fish	T&E and State Listed Species and Habitat	Non-specification recommendations include determining the number of acres converted to unsuitable lynx habitat, conducting post fire assessments of Mexican Spotted Owl nesting habitat to validate imagery, boreal toad and wood frog sites for occupancy, Colorado River cutthroat trout populations and condition of key habitat features (temperature, spawning outlets, pools) and river otters.
	Watchable Wildlife and Recreational Fishing	Non-specification recommendations include monitoring of eagle and osprey nests, survey and protecting active bird nests during BAER activities, assessing sport fishing populations and habitat including mercury levels for human consumption, studying movement and range shifts of elk, studying changes in moose habitat selection and space use, calving and productivity, post-fire causes of mortality and post-fire carrying capacity estimate.
Trails	Bridges	Replace burned bridges
	Tread Surface	Stabilize surface from erosion due to fire burned side logs
	Hazard Trees	Reduce hazard trees and clear trail of dead and down trees
	Way-finding Signs	Replace way finding/trail signs
Wilderness Camps	Campsites	Close and rehabilitate all campsites, consider relocation of some camp sites
	Ranger Camp	
	Privies	
Moraine Park Campground	Tent pad	Close campsite 151 and rehabilitate
	Hazard trees	Remove hazard trees
	Tire tracks	Restore/reveg area for recovery
	Water Tank Area	Remove hazard trees and inspect tank and weather station in greater detail
Watershed	Increased Watershed Response	Install trash rack on culvert at Green Mountain Trailhead on Trail Ridge Road Storm Patrol on Trail Ridge and Fern Lake Road to remove trees, rocks and other foreign materials on roads and drainage

Table 1: Issues and recommendations for specific related Values at Risk.		
VAR	ISSUE	Recommendation(s)
		features/culverts
	Debris Flow	Monitor trail system for damage due to debris flows. Inform visitors of post fire hazards within the burn scar and along affected streams on web sites and Rec.gov
	Debris Flows	Install hazard warning signs at trail heads Coordinate with USFS and concessioners on reopening of trails
	Municipal Water Supply	Coordinate with USFS on post-fire changes; share information with Towns of Estes Park and Grand Lake and with Water Management Agencies
Cultural Resources	Archeological Sites	While in the presence of an Archeological monitor, fell trees rooted in known archeological sites near or within trail and camp areas to prevent uprooting by wind throw
	Archeological Sites	Discourage looting by increased patrols by Park LE Communicate to LE while vulnerable sites are located
	Archeological Sites	Collect baseline data on sites that may be affected by increased peak stream flows, debris flows
	Historic Structures	Provide for life and safety and discourage looting
	Museum Collections	Rehouse surviving artifacts and document and deaccession destroyed objects
Boundary and Land Survey Monuments	Erosion and Damage	Assess condition of General Lands Office and BLM monuments along NPS boundary line to protect real property assets

Budget Summary of Stabilization and Rehabilitation Activities

Treatment Costs

Rocky Mountain National Park – Emergency Stabilization (ES)		
No.	**Treatment**	**Total**
ES-1	Burned Structure Enclosure	[redacted]
ES-2	Exotic Plant Control	
ES-3	Elk – Moose Exclosure Fence	
ES-4	Trail Stabilization	
ES-5	Wilderness Campsite Safety	
ES-6	Ranger Safety Patrol	
ES-7	Front Country Hazard Trees	
ES-8	Road Storm Patrol	
ES-9	Cultural Resource Compliance	
ES-10	Implementation Leader	
ES-11	Culvert Trash Rack	
ES-12	Burned Snowmobile Fence	
ES-13	Public Safety & Resource Protection Signs	
	Total	

Rocky Mountain National Park – Burned Area Rehabilitation (BAR)		
No.	**Treatment**	**Total**
BAR-1	Exotic Plant Control	[redacted]
BAR-2	Limber Pine Recovery	
BAR-3	Trail Stabilization and Rehabilitation	
BAR-4	Ranger Resource Protection Patrol	
BAR-5	Cultural Resource Compliance	
BAR-6	Implementation Leader	
BAR-7	Monitoring Equipment	
BAR-8	Wetland Vegetation Restoration	
	Total	

Activities Cost Summary

Emergency Stabilization (ES) Activities Cost Summary

Rocky Mountain National Park									
Treatment Specification	**NFPORS Category**	**Unit**	**Unit Cost**	**# of Units**	**Fiscal Year**				**Total**
					2021	**2022**	**2023**	**2024**	
ES-1 Burned Structure Enclosure	Human Life and Safety	Structures	[redacted]	26	[redacted]				[redacted]
ES-2 Exotic Plant Control	Invasive Species	Miles	[redacted]	65	[redacted]				[redacted]
ES-3 Elk – Moose Exclosure Fence	Riparian	Exclosure	[redacted]	1	[redacted]				[redacted]0
ES-4 Trail Stabilization	Asset Repair and Replacement	Trail Network	[redacted]	47	[redacted]				[redacted]
ES-5 Wilderness Campsite Safety	Human Life and Safety	Campsite	[redacted]	37	[redacted]				[redacted]
ES-6 Ranger Safety Patrol	Human Life and Safety	District	[redacted]	2	[redacted]				[redacted]
ES-7 Front Country Hazard Trees	Human Life and Safety	Trees Acres	[redacted] [redacted]	278 21.2	[redacted] [redacted]				[redacted]
ES-8 Road Storm Patrol	Human Life and Safety	Events	[redacted]	4	[redacted]				[redacted]

ES-9 Cultural Resource Compliance	Cultural and Heritage Resources				[redacted]	[redacted]			[redacted]
ES-10 Implementation Leader	Administration	Fiscal Year	[redacted]	1	[redacted]				[redacted]
ES-11 Culvert Trash Rack	Human Life and Safety	Trash Rack	[redacted]	1	[redacted]				[redacted]
ES-12 Burned Snowmobile Fence	Asset Repair and Replacement	Miles	[redacted]	1	[redacted]0				[redacted]
ES-13 Public Safety & Resource Protection Signs	Human Life and Safety	Signs	[redacted]	16	[redacted]				[redacted]
				Total	[redacted]	[redacted]			[redacted]

Burned Area Rehabilitation (BAR) Activities Cost Summary

Rocky Mountain National Park									
Treatment Specification	**NFPORS Category**	**Unit**	**Unit Cost**	**# of Units**	**Fiscal Year**				**Total**
					2021	**2022**	**2023**	**2024**	
BAR-1 Exotic Plant Control	Invasive Species	Miles	[redacted]	65		[redacted]	[redacted]		[redacted]
BAR-2 Limber Pine Recovery	Forestry					[redacted]	[redacted]	[redacted]	[redacted]
BAR-3 Trail Stabilization and Rehabilitation	Asset Repair and Replacement	Miles	[redacted]	47		[redacted]	[redacted]		[redacted]
BAR-4 Ranger Resource Protection Patrol	Natural Resources					[redacted]	[redacted]	[redacted]	[redacted]
BAR-5 Cultural Resource Compliance	Cultural and Heritage Resources					[redacted]	[redacted]		[redacted]
BAR-6 Implementation Leader	Administration					[redacted]	[redacted]	[redacted]	[redacted]
BAR-7 Monitoring Equipment	Asset Repair and Replacement	Site	[redacted]	49	[redacted]				[redacted]
BAR-8 Wetland Vegetation Restoration	Riparian					[redacted]	[redacted]		[redacted]
				Total	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Plan Organization

This plan includes a narrative summary of the East Troublesome fire, followed by in-depth resource or issue specific burned area assessments, and itemized specifications for BAER treatments and activities. Appendices are found at the end of the plan

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BURNED AREA ASSESSMENTS



East Troublesome Fire, Oct. 16, 2020

Vegetation Assessment

Issues

- Exotic invasive plant seeds have likely been transported through fire suppression activities including construction of dozer line and hand line, preparing defensible space around structures, suppression vehicles and equipment coming in from other areas that may carry seeds in wheel wells and undercarriages.
- Exotic plants have already been present in some areas of the park through horse use and foot traffic. Seed are likely present along trails and will likely spread and proliferate due to increased availability of resources from the fire (more sunlight from open forest canopy, less competition from native plants, possible increased availability of soil nutrients).
- Roadsides can be a major source for vehicles to pick up seeds from invasive species. The fire has burned along Fern Lake Road and Upper Beaver Meadows Road, both of which could be future sources for transport of invasive plant seeds if invasive plants become prevalent in these areas due to the reduced competition from native plants.
- Rare plant populations have likely been impacted by the fire. Of most concern are populations of *M. gemmiparus* along the North Inlet and East Inlet trails on the west side of the park.
- Groves of Limber pine, a keystone species in peril, have been severely impacted by moderate- to high-intensity burns. Of most concern are an isolated stand at Fern Lake, a devastated stand on Castle Rock, and a population of scientifically significant trees exhibiting natural resistance to the invasive White Pine Blister Rust on Steep Mountain. Caches of seeds stored by Clark's nutcracker have also burned, decreasing potential for natural recovery.
- Elk exclosure fences have been damaged due to tree fall and direct exposure to fire. Wetland vegetation such as willows, aspen, alder, and birch within exclosure fences have been adversely impacted and will not recover naturally.
- The Big Meadows fen is a unique natural feature of the park.
- Wetland monitoring plots were burned with a loss of monitoring equipment.

Observations

Exotic Plants

The 2018 Rocky Mountain National Park Exotic Plant Management Plan was consulted on how to respond to the potential spread of exotic invasive plants as a result of the East Troublesome Fire and fire suppression activities. Post fire surveys of the Cow Creek Fire in 2010 were evaluated to learn about how exotic invasive plants previously responded to fire in the park.

The park's geospatial database has good information on the presence of exotic invasive species in front country areas of the park, particularly in several large meadows in the montane zones of the park such as Moraine Park, Upper Beaver Meadows, and Hollowell Park. These areas, as well as trails that lead from them, and roads, trailheads, and campgrounds that were impacted in

the fire were included in the analysis. While data are not as prevalent for the west side of the park, there are known populations of exotic invasive plants there as well. Several of the trails within the burn areas and where suppression activities took place were included in the analysis, as well as Kawuneeche and Green Mountain housing areas, the Kaawuneeche Visitor Center, Trail Ridge Road along Kawuneeche Valley, and the Kawuneeche Valley itself.

In addition to existing geospatial data, post-fire observations were made on 11/5/20 and 11/8/20 in Moraine Park, Upper Beaver Meadows, and the dozer line near the Beaver Meadows park entrance station.

Limber Pine

Limber pine (*Pinus flexilis*) is an ecologically valuable pine that is the subject of an interagency concern and conservation focus. Rocky Mountain National Park's Limber Pine Conservation Strategy and supporting scientific literature were consulted for directives to preserve and protect this keystone species in response to the East Troublesome Fire.

The Park's existing geospatial database has extensive vegetation mapping information regarding the presence and size of forest groves throughout the Park, prominent in sub-alpine ecosystems.

Worldview 3 Satellite Imagery from after the fire was overlaid with the park's vegetation map to evaluate the vegetation burn severity to limber pine groves. Standing burned trees and downed logs were visible in burned stands. In addition, post-fire field observations were made on 11/6/20 on Steep Mountain to verify the satellite observations.

Exclosure Fences and Wetland Vegetation

The primary source of background information on ungulate exclosure fencing was the park's 2007 Elk and Vegetation Management Plan (EVMP). A draft report on the 10-year effects of management activities on wetland vegetation was consulted because it contained an evaluation of impacts from the 2012 Fern Lake fire on vegetation inside and outside the exclosure fences. Published scientific literature was reviewed to understand the importance of wetlands to the park and the influence of herbivory to these plant communities.

Exclosure fences in Moraine Park and Beaver Meadows were assessed for damage on November 8, 2020. Observers walked around the perimeter of each impacted exclosure to assess damage to fence line and vegetation. Photos were taken and written descriptions were recorded explaining notable damage. Damage was quantified when possible (linear feet of fence damaged, number of posts, etc.) UTMs were recorded at the location of each damaged area. Field notes were recorded describing the general condition of exclosures, enclosed vegetation, and the habitat surrounding the exclosures post-fire.

An exclosure fence near the Green Mountain housing area was assessed for damage on November 10, 2020. Observers walked around the perimeter of the exclosure to assess damage to fence line and vegetation. Photos were taken.

As part of the EVMP, park staff have collected a series of photo points documenting exclosure conditions for nearly a decade. These photos are collected twice annually (spring and fall) by park staff. They provide a visual comparison of exclosure and vegetation conditions pre- and

post-fire.

Wetland scientists – including Inventory and Monitoring Staff and research partners with decades of experience in the park – were consulted on the likely impacts of the fire and recovery of wetland vegetation.

Scott Esser (RMNP) and David Cooper (Colorado State University) were consulted on the pre-fire status of Big Meadows fen and the likely impacts from the fire. A BAER team was able to visit this area on November 11.

Monitoring equipment

Barry Sweitzer (Rocky Mountain Inventory and Monitoring Network) and Ed Gage (Colorado State University) overlaid a map of the fire perimeter with known monitoring sites and equipment. BAER staff were also able to visit two monitoring locations – North Inlet and Big Meadows – to evaluate the equipment damage.

Findings

Exotic Plants

The 2018 Rocky Mountain National Park Exotic Plant Management Plan guides the park in how to manage exotic invasive species. It helps prioritize areas of the park where management should take place and many of these areas fall within the footprint of the East Troublesome Fire. Research plots in the park where seeding of native species was used to outcompete exotic invasive species also help guide the practices used to manage invasive plants in certain areas of the park.

Recent fires in the park such as the Cow Creek Fire in 2010 and the Fern Lake Fire in 2012 have shown an increase in exotic plant invasions post fire. Surveys of the Cow Creek Fire footprint in the year following the fire showed that there were very few exotic invasive plant species. However, in subsequent years exotic invasive plants became prevalent in the Cow Creek Fire footprint, including orange hawkweed, common mullein, Canada thistle, musk thistle, and bull thistle. Some areas burned in the East Troublesome Fire are much more accessible so there is a greater opportunity to prevent these invasions.

The following species are known to occur in burned areas within the East Troublesome Fire from previous park mapping efforts:

Location	**Species**
North Inlet Trail	Canada thistle, common mullein
Kawuneeche Valley/ US-34 West Side of Park	Canada thistle, bull thistle, musk thistle, cheatgrass, reed canary grass, common mullein, orange hawkweed

Tonahutu/ Big Meadows Trail	Canada thistle, orange hawkweed
Fern Lake/Cub Lake areas	Canada thistle, common mullein, musk thistle
Moraine Park	Canada thistle, common mullein, musk thistle, bull thistle, knapweeds, orange hawkweed, yellow toadflax, Russian thistle, cheatgrass, houndstongue
Upper Beaver Meadows	Canada thistle, musk thistle, common mullein, leafy spurge, bull thistle
Hollowell Park	Yellow toadflax, Canada thistle, common mullein, musk thistle

Post-fire observations

In Moraine Park, Canada thistle and musk thistle have been present throughout the 500-acre meadow. While most vegetation in the meadow appeared thoroughly charred from the fire, a couple of unburned stands of musk thistle, some with seed heads still on them, appeared to remain mostly unharmed. We also observed a few musk thistle rosettes already present within the burn scar. Canada thistle is a perennial rhizomatous rooted species. Because there was some evidence of native grass and sedges already sprouting from root systems that survived underground, it is very likely that the deep Canada thistle roots systems also have survived and will come back even more aggressively than pre-fire. Other species present in Moraine Park before the fire include mullein particularly along the Cub Lake Trail, cheatgrass mostly present along Fern Lake Road, and yellow toadflax sparsely scattered throughout the meadow. There also had been a patch of orange hawkweed and a patch of reed canary grass along the river that runs through the meadow, but both have been treated and hopefully are no longer present. There were some vehicle tracks in the meadow from suppression operations. Vehicle tracks in meadows are very appealing to visitors and will encourage visitors to do the same if measures are not taken to camouflage the tracks. The fire did burn through the Moraine Park stables which historically has been a source for various exotic invasive weeds. The fire also burned through a portion of D loop in Moraine Park campground. Exotic species have been present in the campground and have the potential to spread aggressively, including spotted knapweed, diffuse knapweed, and houndstongue. In addition to seeing a few musk thistle rosettes, there was some evidence of perennial sedges or grasses already re-sprouting in some burned areas of the meadow.

Beaver Meadows also has been known to have several species of exotic invasive plants present including musk thistle, Canada thistle, mullein, leafy spurge, and cheatgrass. There was some evidence of green re-sprouts already in some areas of the burned area, thus likely Canada thistle too will come back. Leafy spurge is a perennial with a large deep root system and is nearly certain to re- sprout after the fire even if above ground plant material burned. One of the bigger concerns is that closer to Upper Beaver Meadows Road, much of the sagebrush and rabbitbrush

burned completely to the ground. While perennial grasses such as mountain muhly will likely return and do quite well post fire, the spaces opened from the massive reduction in shrubs will likely be converted to cheatgrass. There were also several areas observed where suppression vehicles drove off road and compacted native vegetation.

While observations at Hollowell Park have not been made post fire, several species of invasive plants were known to be present prior to the fire. These include yellow toadflax, mullein, musk thistle, and Canada thistle.

Suppression Activities

Small sections of hand line were built in Moraine Park and Upper Beaver Meadows that were approximately 3 feet wide. Dozer line was constructed in three locations including a 2/3-mile section starting near the Beaver Meadows Entrance, a 1/3-mile section in Upper Beaver Meadows, and along the snowmobile trail near Grand Lake. The Fire Suppression Team did some work to repair these dozer lines, but it was difficult to see what had been done as snow was already covering the ground. Extensive tire tracks likely from suppression vehicles exist on both the south and north sides of Upper Beaver Meadows Road and along Fern Lake Road.

Photos



Green musk thistle rosette in burn area and unburned musk thistle stalks surrounded by charred vegetation in Moraine Park. 11/8/20



Native sedges rebounding from live root systems under burnt duff. 11/8/20



Tire tracks from fire suppression work in Upper Beaver Meadows 11/8/20



Hand line at the east end of Moraine Park 11/8/20



Dozer line at the east end of Upper Beaver Meadows. Feature not covered by snow in dozer line photo is a hand dug water bar. 11/8/20

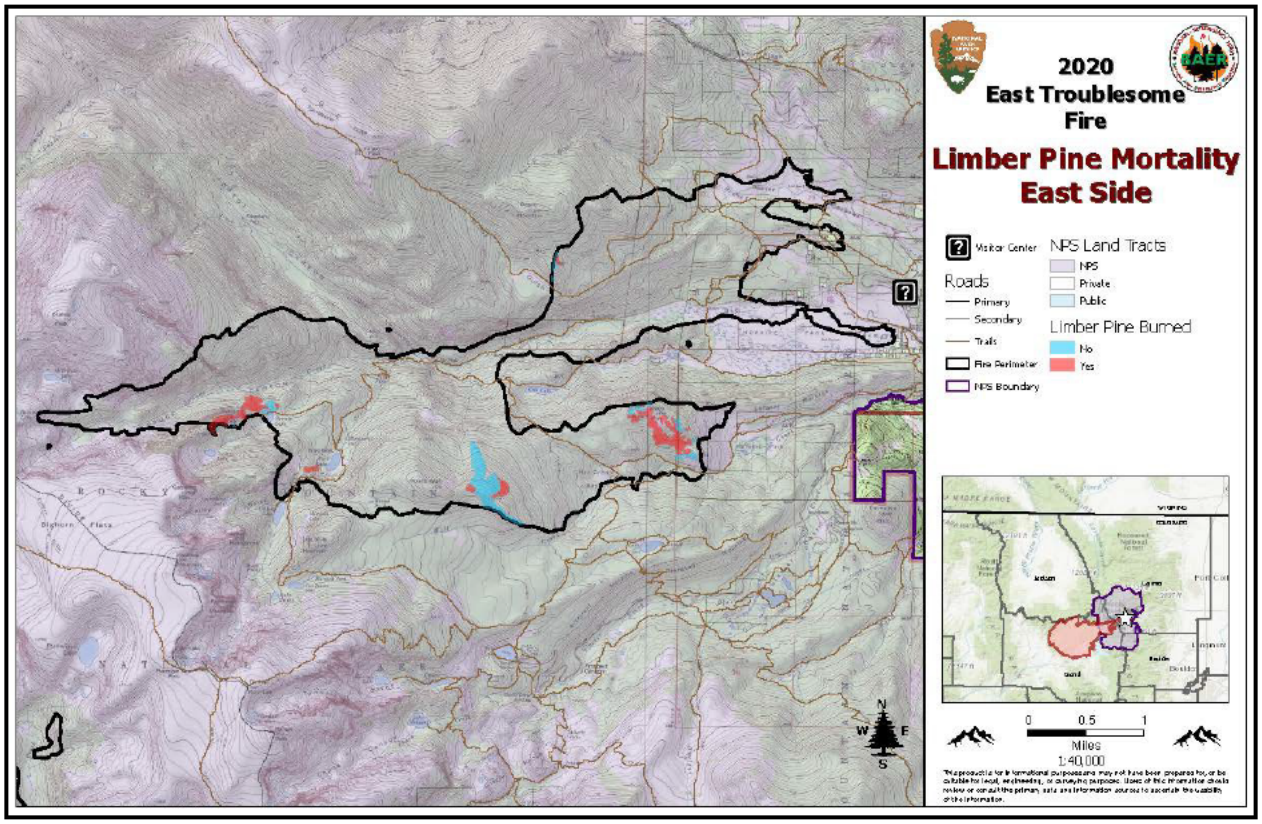
Limber Pine

Limber pine is the only five needle white pine in the park and defines the park's alpine treeline. This keystone tree species plays a valuable role in slope stability, snowpack retention, and food webs. Limber pine has been identified as a species of management concern and is currently in decline due to native bark beetle (*Dendroctonus spp.*) outbreaks, a non-native fungal pathogen (*Cronartium ribicola)* that causes White Pine Blister Rust, limber pine dwarf mistletoe (*Arceuthobium cyanocarpum*), and climate change (Schoettle et al. 2019).

Overlaying post-fire Worldview 3 Satellite Imagery with the park's vegetation map identified five stands of limber pine impacted. Of 240 acres of limber pine stands, approximately 173 acres burned whereas 64 acres did not burn. These burned stands are in areas of moderate and high severity fire. These include stands of trees at Fern Lake, on Mount Wuh, in the talus slopes of Castle Rock, Mount Patterson, and on Steep Mountain. Several other smaller stands of limber pine trees were included in the analysis as well.

Limber pine (*Pinus flexilis*) is an early seral species after wildfire and can outcompete other conifer species. (Donnegan and Rebertus 1999; Webster and Johnson 2000). Limber pine's

response to fires of this magnitude varies. Stands can naturally regenerate, expand, or locally go extinct (Schoettle 2019; Webster and Johnson 2000). This varied response is due to the role of Clark's nutcracker in regeneration. Clark's nutcrackers will cache limber pine seeds from nearby stands in the newly disturbed area so areas with nearby unaffected stands and Clark's nutcrackers can regenerate well. In the case of the East Troublesome fire, the three affected stands comprise some of the largest groves of limber pine in Rocky Mountain National Park although the distance to other limber pine sites is within 3 km, in flight range of a nutcracker caching seeds (Williams 2017). However, the multiple stressors on the trees restricts the ability of these burned limber pine stands to naturally regenerate by reducing the number of seeds that could be brought into the area by Clark's nutcrackers. As a result, the limber pine is likely not to regenerate naturally.



Exclosure Fences and Wetland Vegetation

Background

The wetland ecosystems in Rocky Mountain National Park (ROMO) serve a disproportionate ecological role in comparison to the small amount of land they encompass. They make up only 4% of the park's area but contain 32% of the park's plant species. They also provide vital habitat to 45% of the park's bird species and 20% of its mammals (Schweiger et al., 2016). ROMO wetlands have been subjected to many types of disturbance over the last century. Removal of beavers and top predators from the landscape, browsing impacts from an overabundant elk population, and various other historic ditching and draining have lowered the water table and rendered historic wetlands into dryer meadows.

The Elk and Vegetation Management Plan (EVMP) has guided the monitoring and management of these ecosystems since 2007 using techniques such as native plant restoration and exclosure fencing to protect wetland vegetation from heavy browse impacts. Exclosure fences are in place to protect valuable riparian ecosystems from extensive browse pressure from ungulate species such as elk and moose. Without the protection provided by exclosure fences, willow, aspen, and other riparian species become over browsed and ecosystem integrity degrades over time. This negatively impacts biodiversity and in turn, the visitor viewing experience. A report summarizing willow and aspen monitoring data collected from 2008-2018 found that exclosure fences yielded greater recruitment, height, and cover measurements in both aspen and willow stands than in unfenced areas (NPS Natural Resource Report 2020, unpublished data).

Wetland Response to the Fern Lake Fire

The Fern Lake Fire burned through Moraine Park in 2012. Between 2013 and 2018, the proportion of monitoring plots with at least 1/3 willow cover within suitable willow habitat increased from 7.7% to 38.5% for burned/fenced plots. However, it only increased from 10% to 12.5% in plots that were burned and unfenced (NPS Natural Resource Report 2020, unpublished data). The meadow's impaired hydrologic conditions and lowered water table coupled with ungulate browse pressure on unfenced vegetation are the likely reasons that willows did not respond vigorously after the fire, unlike what would occur in a healthy willow wetland. Additionally, according to a study conducted in Moraine Park after the Fern Lake Fire, 91% of willows, 51% of thin-leaf alders, and 71% of river birch suffered complete canopy loss (Kaczynski & Cooper 2014). Due to this canopy loss, willow seed rain density was reduced by more than 90% within the study area, greatly diminishing the possibility for new plants to establish from seed. Although patches of bare soil were available throughout the valley, extremely low seed rain density likely limited willow establishment in Moraine Park post-fire, (Kaczynski & Cooper 2014). Since burn severity in Moraine Park during the East Troublesome Fire was higher than that of the Fern Lake Fire (Kaczynski & Cooper 2014, 2020 BARC imagery), it is reasonable to expect that canopy loss will again contribute to reduced seed rain density. Coupled with impaired hydrology and low water table, reduced seed rain density will cause willow, alder, and birch to struggle to reestablish on their own and fire impacts will negatively impact the long-term recovery of wetland vegetation.

Because of the mortality and the failure of willows to recover naturally, ROMO natural resource specialists have conducted active planting projects inside of exclosure fences that were burned in the Fern Lake Fire to help recover these areas. The East Troublesome Fire appeared to burn hotter than the Fern Lake Fire (see vegetation notes and photos below). As a result, these areas are unlikely to naturally recover on their own.

Exclosure Damage and Vegetation Condition

Thirteen fence exclosures were identified as being partially or fully inside of the East Troublesome Fire footprint: six in Moraine Park, six in Beaver Meadows, and one near Green Mountain Housing (Table 1).

Table 1: Exclosure fences within E. Troublesome Fire footprint		
Location	**Fence ID**	**Material**
Moraine Park	MP20, MP50, MP60, MP65, MP70, E12	Woven wire/metal posts
Beaver Meadows	BM40, BM45, BM49, BM60, BM65	Woven wire/metal posts
Beaver Meadows	BM50	Woven wire/wooden posts
Kawuneeche Valley	Green Mountain	Wire panels/wooden posts

Of the thirteen exclosures impacted by the fire, five of them sustained structural damage. The exclosures specifically protecting aspen sustained more damage due to higher fuel density and the presence of larger trees that fell across the fence. These aspen exclosures also are located at the west end of Moraine Park on the Fern Lake Corridor, where fire impacts were quite concentrated. Two exclosures were constructed as research plots to study the effect of ungulates on vegetation and the effectiveness of exclosures. These older research exclosures used wooden posts instead of modern metal pipe and t-posts.

Burn severity varied across locations. Coordinates were recorded for each damaged fence site corresponding to the notes below. The majority of the exclosures in the fire footprint sustained burn impacts to vegetation.

Moraine Park: Exclosure MP60 (woven wire/metal posts)

General notes: Birch and alder trees are moderately to extremely scorched. Willows largely scorched at the base. Area burned on the north side of the river on high and dry ground. Dry divots (1-2 ft deep) were exposed between burned willows.

Fence damage notes:

- Two low fence patches burned, partially broken.
- Posts leaning into exclosure affecting three fence panels (20 ft). Ground looks thoroughly burned; posts may have loosened in damaged soil.

Moraine Park: Exclosure MP65 (woven wire/metal posts)

General notes: Many willows still standing, some with base scorching. Some burned herbaceous ground cover.

Fence damage notes:

- Two signs ("nearest gate", "do not climb on fence") burned and melted. Illegible.
- Once section of fence fabric was damaged. No t-posts damaged.
- Burned snag fell. Root ball right next to fence encroaching on fence. Fence fabric is out of place.

Moraine Park: Exclosure MP70 (woven wire/metal posts)

General notes: Many aspen trees down inside the exclosure. Natural suckering should compensate for currently morality. Willows in center of exclosure are burned. Many older (>25ft) aspen have burned and fallen. Most of the younger (10-15ft) aspen are charred at base but are currently alive.

Fence damage notes:

- Several large aspens fell on fence in multiple locations. Fence crushed and detached from t-posts and line boss posts. T-posts bent.
- Several exclosure signs partially or completely destroyed by fire, not legible.
- Tree fell on fence, fence split open where two different rolls of fabric were joined at time of construction. Adjacent to split, 15ft of bent fence, partially detached from t-posts.
- Tree fell on fence, bent at corner bracing. Some fence material broken at bracing.
- Large break in the fence. One t-post destabilized. 3 sections of fence fabric damaged.
- Top patch on fence loose.
- Large break in the fence. At least 5 panel sections damaged. 4 t-posts damaged. Fence cut open by fire crews, also a large tree fell on it.
- Some small fallen aspens pushing down on and damaging the fence.



Fence line crushed by fallen aspen, MP70.

Beaver Meadows: Exclosure BM50 (woven wire/wooden posts)

General notes: Wooden posts around the entire fence are burned with long term integrity in question. Sagebrush and herbaceous ground cover burned to the ground. Aspen stand sustained some base scorching, but vast majority are still alive and upright.

Fence damage notes:

- Ponderosa pine branch landed on fence and crushed fence material/barbed wire on two

panels.

- Twenty posts severely burned at base on south fence line. Some only have ~1" of wood left at base, could collapse soon. Some burned all the way through.
- Burned aspen leaning on the fence; will eventually cause fence to lean/topple.
- Twelve burned posts on north and east fence line, standing but damaged.



Posts unstable and severely damaged, BM50.

Kawuneeche Valley: Green Mountain Exclosure

General notes: Eight wooden posts around the entire fence are burned, a few are broken, long term integrity in question. Dense, tall willow stands were reduced to stubs.

Fence damage notes:

- Eight wooden posts were burned and have lost integrity. Wooden corner posts also impacted.



Fence post burned in half, Green Mountain Exclosure.

The remaining eight exclosures did not sustain damage to the structure of the fence. General notes were taken on the condition of the vegetation.

Exclosures with No Observed Damage to Fence - **Beaver Meadows**

- BM40: No fence damage. Many larger birch/alders completely scorched and collapsed, surrounded by ash. Herbaceous ground cover blackened.
- BM45: No fence damage. All the vegetation inside appears to have base scorching.
- BM49: No fence damage. Many willows burned all the way to the ground.
- BM60: No fence damage. Younger aspen (10-15ft) very minimal scorching on bottom. A few large, older aspen dropped due to fire damage. Herbaceous ground cover blackened.
- BM65: No fence damage. Some willows completely torched. Some with base scorching and top half of the plant currently alive.

Exclosures **with No Observed Damage to Fence – Moraine Park**

- MP20: No fence damage. Willows in the southern third of the exclosure are scorched, but not many entirely torched plants visible. Herbaceous ground cover blackened.
- MP50: No damage observed. Fire only reached very small portion of NW corner.
- E12: No fence damage. This is a smaller fence inside of MP65. No notable damage to vegetation.

Photos



The fire reveals willow hummocks between depressions in MP60. Willows in the foreground are completely consumed. The ones in the background have severely burned root crowns. 11/8/20.



A softwood was reduced to white ash in BM50. 11/8/20

Big Meadows Fen

Big Meadows is a sedge dominated fen. This fen started peat accumulation 12,000 years ago, so it is one of the oldest known ecosystems in the region. When the area was homesteaded in the late 1800s, the landowner dug a series of ditches to dry out the meadow to make it easier to cut hay for livestock. This ditch drained the meadow and was causing the loss of the 12,000 year old peat body. In 1989, Working with RMNP staff (Jeff Connor), David Cooper's team blocked the main ditch beginning in 1989 with sheet metal structures. About 25 sheet metal plates were used to block the ditch and their persistence is needed to keep the meadow in a healthy and functioning condition. The goal was to restore the meadow hydrologic regime to reinitiate peat

formation, and to make the meadow more resilient to fire. The peat is highly flammable when dry, but when wet is resistant to burning.

Wetland monitoring equipment

There are 241 long term wetland monitoring sites in the park. Over the past several decades, they provided the scientific basis for the park's Elk and Vegetation Management Plan EIS and implementation. Of these, 49 were in the burned area. They all contain groundwater wells made of PVC pipe, confirmed by BAER staff to be destroyed a the two sites they were able to safely visit during the assessment: Big Meadows and the North Inlet. Given that the burn intensity of Big Meadows was low and the sensitivity of PVC pipe to heat, the other wells are likely destroyed as well. Fortunately, only 5 of them contain data loggers. The location of the wells is in the table below:

Wetland Monitoring Sites		
Valley	**Inside Fire Perimeter**	**Outside Fire Perimeter**
Moraine Park	28	34
Upper Beaver Meadows	11	21
Kawuneeche Valley	9	9
Hollowell Park	1	20
Total	**49**	**84**

There were seven **stream monitoring sites within the burned zone. Only two – the Big Thompson and Baker Creek – had instrumentation: HOBO temperature loggers.**



A melted groundwater well at the Big Meadows wetland monitoring site.

Recommendations

Exotics

Following the park's approved 2018 Exotic Plant Management Plan, it is recommended that survey and treatment for exotic invasive plants occur along all formal Park trails within the burned area and along the social trail network throughout major meadows such as Moraine Park and Upper Beaver Meadows if possible. Additionally, any handline or dozer line should also be monitored and treated for exotic invasive plant species. Any clearing around structures would also need to be monitored for invasive species and would be treated as necessary to limit further spread. It is critical that surveys and subsequent treatment occur in these locations as we have seen from past fires that failure to act quickly to survey and treat these species could result in substantial natural resource degradation and potential soil loss and erosion.

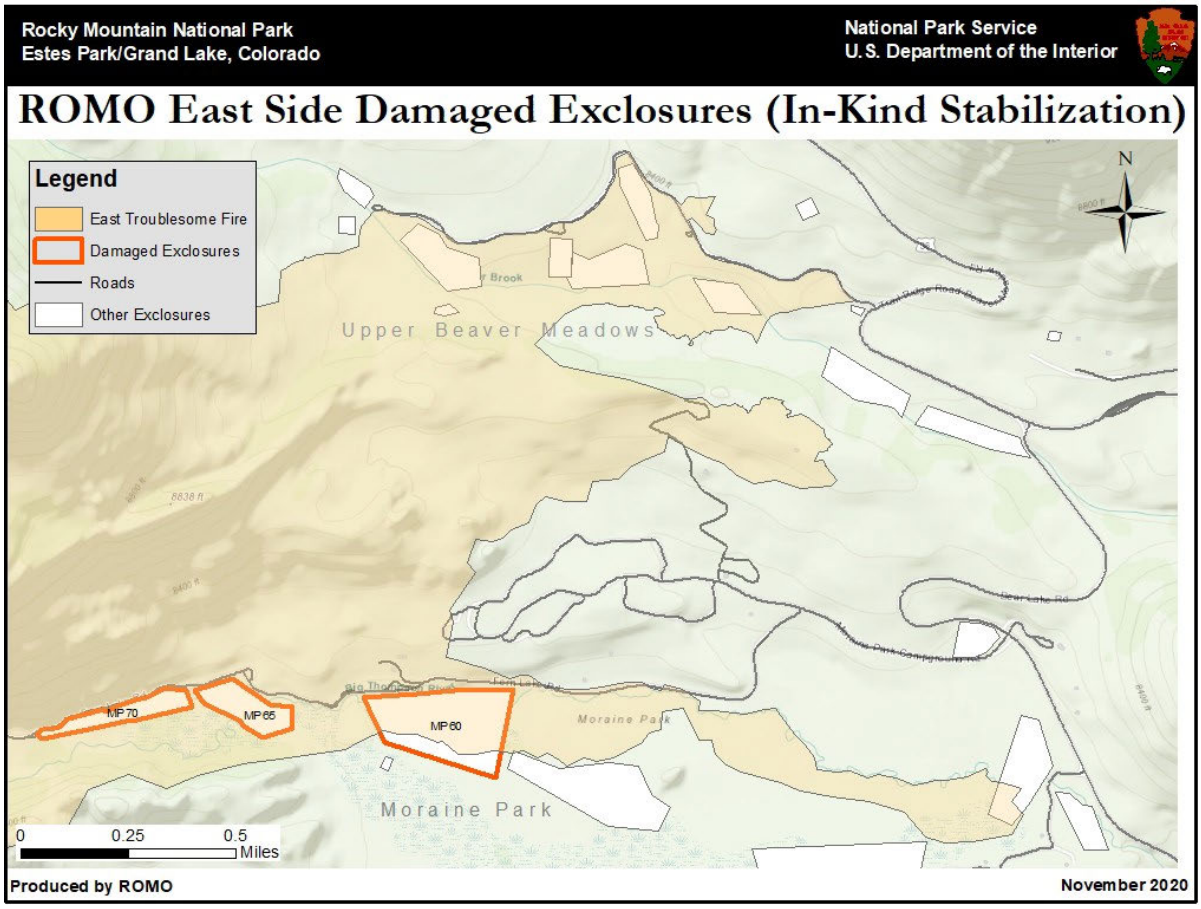
Portions of Upper Beaver Meadows in more upland zones where sagebrush and rabbit brush burned would benefit from seeding and possibly outplanting to suppress invasion of exotic plants. Some perennial grasses may come back on their own, but the sagebrush and rabbitbrush will not likely naturally recover given the lack of unburnt seed sources nearby.

Limber Pine

Limber pine stands are not likely to naturally recover due to the limited seed sources. Outplanting of limber pine seedlings is recommended. The park has a limited quantity of limber pine seed as part of the conservation strategy, and new seed collection will occur including root stock outplanting. The recommended rate of seeding is at 3,636 seeds per acre or planting 266 seedlings per acre for a target density of 200 trees per acre (Schoettle et al. 2019). Other recommended guidelines for direct sowing can be found in the Proactive Limber Pine Conservation Strategy for the Greater Rocky Mountain National Park Area (Schoettle et al. 2019). The park's nursery currently has approximately 50 small limber pine trees that could be opportunistically outplanted and proposes propagating approximately 8,250 seeds currently in storage, collecting additional seed from adjacent limber pine groves, and continuing propagation for up to 3 years with BAR support. These actions are consistent with the park's programmatic categorical exclusion for forestry operations.

Exclosure Fences

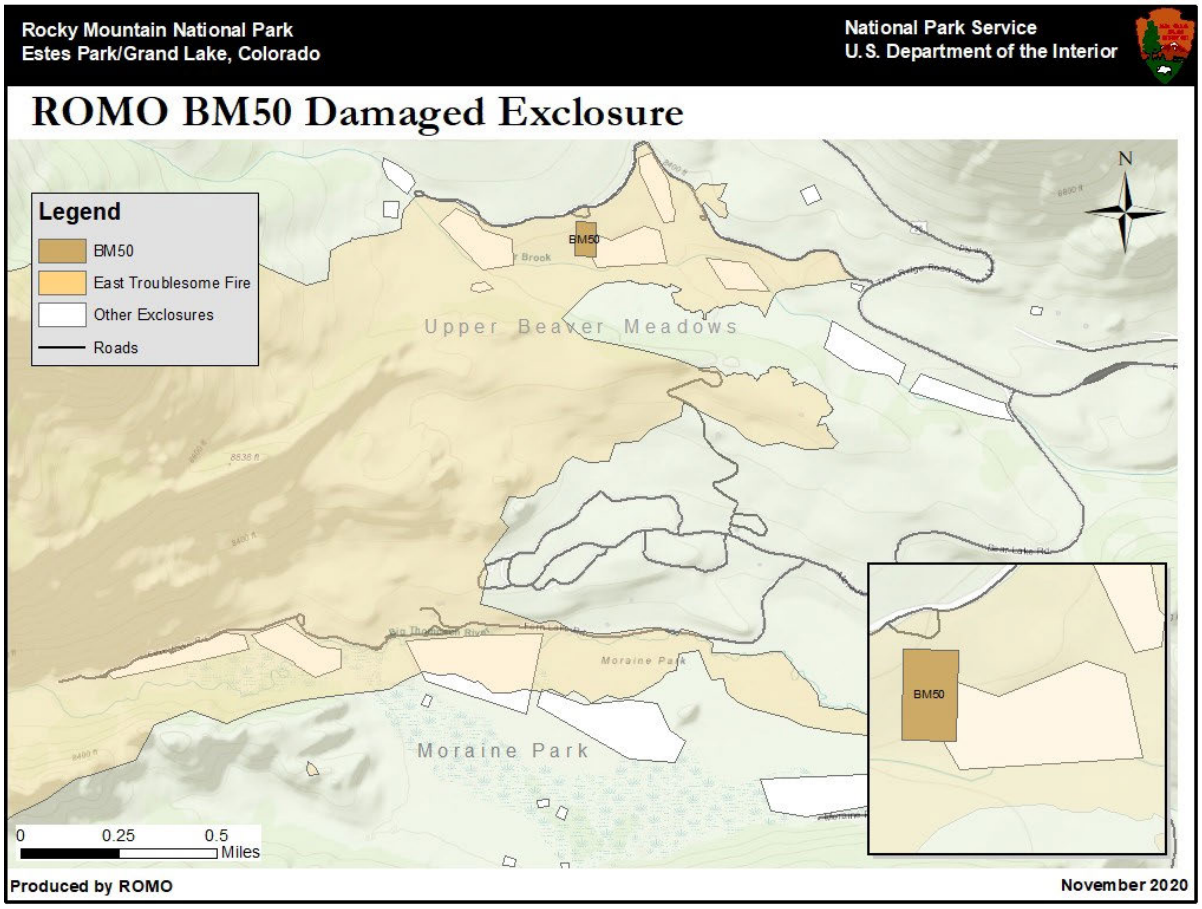
Damaged metal exclosures should be repaired to their original state pre-fire to continue to protect enclosed wetland vegetation from ungulate browse impacts. Most of the damage sustained to exclosures in Moraine Park (MP60, MP65, MP70) are from trees falling on fence line, which causes fence fabric to crumple or break and detach from supporting posts. Some posts are damaged and bent and will need to be replaced. Patches of new fence fabric will need to be attached in some of the locations where fallen trees damaged the fence beyond the point of reforming the material to its original state. Damaged informational signs stating, "Nearest Gate" and "Do Not Climb on Fence" will need to be replaced. These repairs will be completed in-kind by ROMO Resource Stewardship staff.



The damage sustained to the Green Mountain exclosure is also severe. It should be stabilized immediately. This small exclosure (598 linear feet) was originally designed as a research plot. It has provided decades of information that informed the park's Elk and Vegetation Management Plan. The Kawuneeche Valley has been identified as a priority for restoration and an interagency team has just started initial scoping for restoration inside and outside of the burn zone. Data on how vegetation in this valley can recover from fire without the pressure of herbivory will be critical to designing large scale projects. The existing fence should be stabilized with fire-resistant metal t-posts according to modern design. The water table is higher in the Kawuneeche Valley so it is more likely that the willows inside of that exclosure will respond naturally. These repairs will be completed in-kind by ROMO Resource Stewardship staff. The value of this fence is $40,000, based on a 2020 fence project at the park.

Damage sustained to the wooden support posts on the BM50 exclosure in Upper Beaver Meadows is severe on the section enclosed by the newly added fence. Exterior posts were scorched and have been compromised, two posts have been burned through. The majority of the posts sustained some level of fire damage, and some posts are burned to the point where they are barely standing with about one inch of post intact at ground level. Others have burned completely through. The burned posts have compromised the integrity of the entire fence, which poses a human safety hazard. This fence is located about 10ft from a popular picnic area and can

be accessed easily by the public. The fence should be stabilized as soon as possible. The damaged and destroyed fence posts should be stabilized by pounding steel t-posts in adjacent to the damaged posts and attaching the steel t-posts to the fence with wire clips. Stabilization work should be performed by park staff which will be more cost efficient than a construction contract. This fence has a replacement value of [redacted] based on a 2020 fence construction contract at the park.



Wetland Vegetation

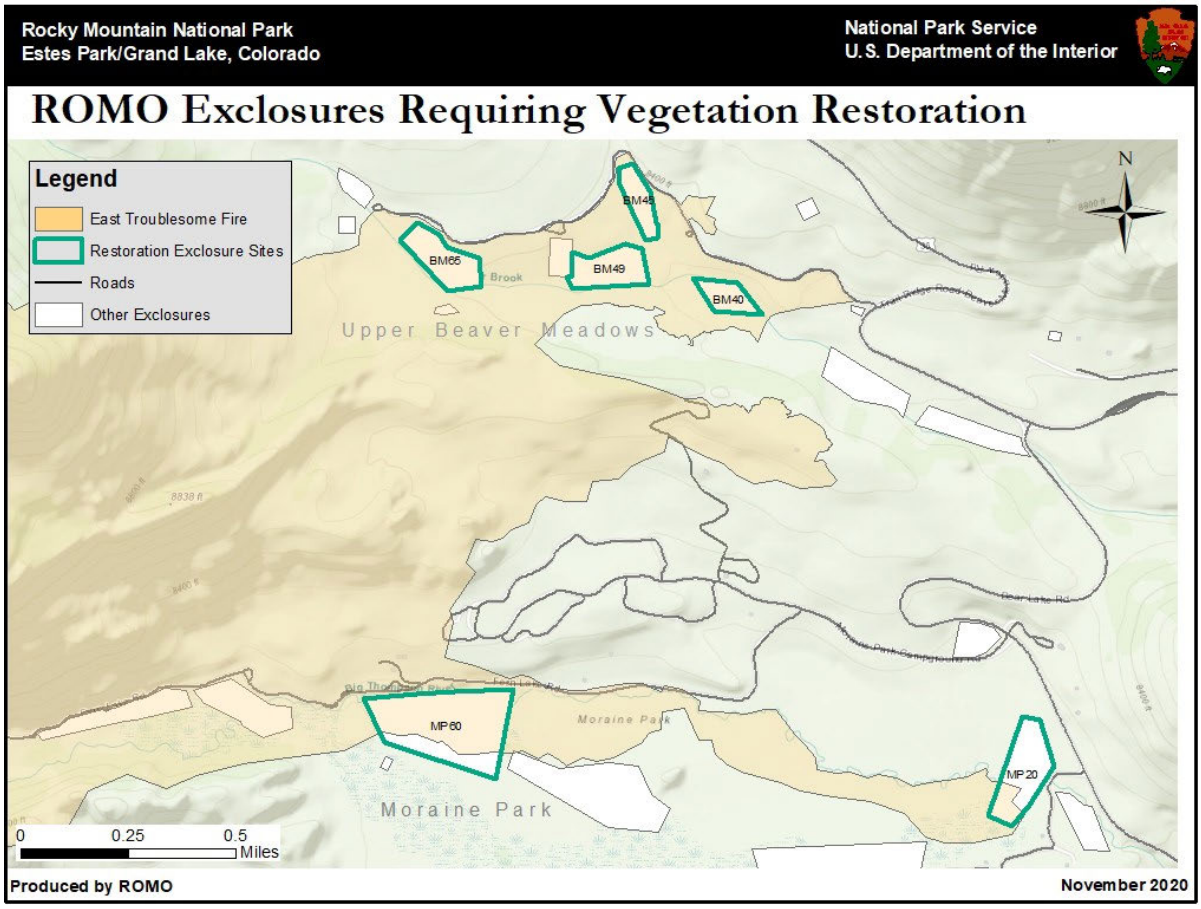
Wetland vegetation within exclosure fences sustained varying degrees of damage from the fire. Some notable species lost include mature willow, alder, and birch. Many of these trees and shrubs were reduced to piles of charred branches and ash with no potential for new growth to sprout from the roots. Additionally, many of these older woody plants that burned in the fire originally became established decades ago when the water table in Moraine Park and Beaver Meadows was higher than it is currently. Their established root systems were able to reach deeper ground water, but due to hydrologic changes over time, new plants will not be able to reestablish naturally from seed dispersal alone.

Due to the factors mentioned above, it is very unlikely that wetland vegetation will reestablish

naturally post-fire. Active restoration efforts are needed to initiate this process. Willow stakes and birch and alder nursery stock saplings should be planted in some of the wetter areas within the affected exclosures where ground water levels are high enough to reach plant roots. Wetland ecosystems with a healthy population of willow, birch, and alder provide the necessary resources for beaver to reestablish on the landscape, which has been observed in several healthy exclosures in the park over the past 5 years (staff observations and unpublished photos, 2020). Beavers are ecosystem engineers and through damming can alter hydrologic regime to change a dryer landscape into a wetland with a higher water table, thus creating a self-regulating wetland ecosystem. Healthy wetlands provide many beneficial ecosystem services such as fire break and flood mitigation, as well as increased biodiversity and an improved visitor viewing experience. These critical benefits will be lost or diminished if active restoration efforts are not implemented to replace vegetation destroyed in the East Troublesome Fire.

Restoration projects will be implemented through a standing cooperative agreement with Wildlands Restoration Volunteers (WRV). WRV is a Colorado-based nonprofit organization specializing in native plant restoration. ROMO has a well-established relationship with WRV and has worked with them for many years on several different restoration projects with successful outcomes. Field work is performed by volunteer groups of approximately 50 people at a time. WRV staff, comprised of experienced habitat restoration professionals, works with ROMO Resource Stewardship staff to plan and coordinate projects. WRV trains and supervises volunteers as well as provides projects supplies and equipment. If these planting projects were performed by paid seasonal staff, they would cost over [redacted] per day in labor alone. Working with WRV is a very cost-efficient way to accomplish high quality restoration work.

Aspen is a fire-adapted species capable of prolific self-regeneration after exposure to fire (Shinneman et al. 2013). Fire can stimulate production of aspen suckers (Bartos et al. 1994). The EVMP 10 Year Review report states that after the Fern Lake Fire of 2012, aspen stem counts increased in stands protected by exclosures (NPS Natural Resource Report 2020, unpublished data). Due to the ability of this species to regenerate successfully post-fire, active aspen restoration efforts within fire-impacted exclosures will not be pursued.



Wetland monitoring equipment

The damaged NPS wetland monitoring equipment should be replaced so that long term monitoring of these sites can continue and the effects of the fire can be evaluated.

Specifications

ES-02 Exotic Plant Control

BAR-01 Exotic Plant Control

BAR-02 Limber Pine Recovery

ES-03 Elk Moose Exclosure Fence

BAR-08 Wetland Vegetation Restoration

BAR-07 Monitoring Equipment

Non-specification Management Recommendations

- Use the park's Weed Warrior volunteer team to help survey front country areas.
- During the growing season, survey to evaluate how known populations of *M. gemmiparus* responded to fire (North Inlet Trail) and if it was impacted by contingency line creation (East Inlet Trail).
- Use non-BAER funds to repair the minor damage on the three fences in Moraine Park
- Use non-BAER funds to immediately stabilize the Green Mountain Exclosure because the repairs need to be made before BAER plan is finalized.
- Lock the gates to the damaged exclosures to prevent public access that could lead to injury before they are repaired.
- Evaluate the condition of the water control features in the Big Meadows fen during spring 2021.

References

Barr, Stephanie; Jonas, Jayne L.; Paschke, Mark W. 2017. Optimizing Seed Mixture Diversity and Seeding Rates for Grassland Restoration. Restoration Ecology 25(3): 396-404.

Bartos DL, Brown JK, Booth GD (1994) Twelve years biomass response in aspen communities following fire Rangeland Ecology & Management/Journal of Range Management Archives 47:79-83

Donnegan, J.A. and Rebertus, A. J. 1999. Rates and mechanisms of subalpine forest succession along an environmental gradient. Ecology 80(4): 1370-1384.

Kaczynski, K. M., & Cooper, D. J. (2015). Post-fire response of riparian vegetation in a heavily browsed environment. Forest Ecology and Management, 338, 14-19.

NPS Natural Resource Report. 2020. Monitoring of Vegetation Response to Elk Population and Habitat Management in Rocky Mountain National Park: Analysis of Elk Vegetation Management Plan monitoring data: 2008–2018.

NPS 2018. Exotic Plant Management Plan Environmental Assessment Rocky Mountain National Park.

Quinn, Lauren D.; Quinn A.; Kolipinski, M.; Davis, B.; Berto, C.; Orcholski, M.; Ghosh, S. 2010. Role of Horses as Potential Vectors of Non-native Plant Invasion: an Overview. Natural Areas Journal 30(4): 408-416.

Schoettle, Anna W.; Burns, Kelly S.; Cleaver, Christy M.; Connor, J. Jeff. 2019. Proactive Limber Pine Conservation Strategy for the Greater Rocky Mountain National Park Area. Gen. Tech. Rep. RMRS-GTR-379. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Schweiger, E. W., Grace, J. B., Cooper, D., Bobowski, B., & Britten, M. (2016). Using structural equation modeling to link human activities to wetland ecological integrity. Ecosphere, 7(11).

Shinneman, D. J., Baker, W. L., Rogers, P. C., & Kulakowski, D. (2013). Fire regimes of quaking aspen in the Mountain West. Forest Ecology and Management, 299, 22-34.

Webster, K.L. and Johnson, E.A. 2000. The importance of regional dynamics in local populations of limber pine (*Pinus flexilis*). Ecoscience 7(2): 175-182.

Williams, T.J. 2017. Clark's Nutcracker Seed Use and Limber Pine Metapopulation Structure In Rocky Mountain National Park. Master's Thesis. University of Colorado-Denver.

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Hazard Tree Assessment

Issues

- Hazard trees present a threat to life, safety, and infrastructure

Observations

Starting on November 7th tree hazards in high visitor use areas, administrative sites, and road corridors on CRD were assessed. The high use area visited included: North Inlet Trailhead, Grand Lake Cemetery, Kawuneeche Visitor Center, Facilities shop, maintenance yard, corrals, dry storage shop, employee housing, Green Mountain employee housing, Green Mountain Trailhead, Onahu Creek Trailhead, and Coyote Valley Trailhead and picnic area. The primary road through the CRD is US HWY 34; this road and associated access roads were surveyed.

On the East Side District, hazard trees were inspected in front country areas including Moraine Park Campground, Moraine Park Stables, Fern Lake Road, and Fern Lake Trailhead.

Findings

Hazard trees were found at several CRD areas:

Area	# Trees	Description
North Inlet Trailhead	7	Group of aspen near toilet
Grand Lake Cemetery - Imminent	8	Lodgepole pine, have been recorded with GPS
Corral by Facilities shop	3	Lodgepole
Dry Storage Building	3	Lodgepole
Green Mtn Trailhead	40	100ft buffer
Green Mountain Housing - Imminent	10	Trees are adjacent to the two unburned houses.
Green Mountain Housing	60	100ft buffer around area.
Onahu Creek Trailhead	3	In a clump adjacent to parking area
US HWY 34, Trail Ridge Road	3,600	Buffer 100ft - one mile length starting at Green Mtn Trailhead and extending south. Large mixed conifer trees

US HWY 34, Trail Ridge Road	50	Two small areas identified in collector – 30 at one site and 20 at the other.

Hazard trees were found at several ESD areas:

Area	# Trees	Description
Moraine Park Stables	4	4 large beetle-killed ponderosa burned at the base adjacent to parking lot
Fern Lake Road & Trailhead	150	Dense aspen with burned boles and roots along road corridor; large diameter cottonwood with burned boles and roots at trailhead.

Recommendations

The Colorado River District has large front country areas impacted by fire activity. The 10 trees in Green Mountain Housing should be mitigated as soon as possible using park staff. In accordance with the 1997 Permit issued by Rocky Mountain National Park, the mitigation of hazard trees at Grand Lake Cemetery is the responsibility of the Town of Grand Lake, however several hazard trees exist adjacent to the park road which transects the cemetery. The hazard trees at North Inlet Trailhead, Kawuneeche corral and cold storage building, and Onahu Creek Trailhead should be mitigated by park staff before the areas are open to the public. The 100ft hazard tree buffer at Green Mountain Trailhead, Green Mountain Housing, and along US HWY 34 should be mitigated by contract, utilizing mechanical equipment.

On the East Side District, fire has damaged trees at Moraine Park Campground, Moraine Park Stables, Fern Lake Road and Fern Lake Trailhead. Park personnel should mitigate imminent hazards at Moraine Park Stables before the area is opened to the public. Trees at Moraine Park Campground should be monitored through the winter and inspected prior to reopening of the campground on Memorial Day weekend; if condition has degraded, Park personnel should mitigate hazards prior to adjacent campsite occupancy. The Fern Lake Road and Trailhead should remain closed during the winter, accessible via foot-travel in Trail status. Trees along the Fern Lake Road and Trail corridor should be monitored through the winter; prior to reopening in summer of 2021, hazards should be mitigated by Park sawyers.

Specifications

ES-08 Front Country Hazard Trees

Management Recommendations

- Support the Town of Grand Lake and the Grand Lake Cemetery Committee efforts to mitigate hazards at the Grand Lake Cemetery; maintain closure until hazards are mitigated.

References

NPS 2011. Rocky Mountain National Park Standards and Protocols for Front country Hazard Tree Management.

Preparers

- Eric Rhodenbaugh, Forester
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Watershed Assessment

Issues

- Flooding in Estes Park and Grand Lake
- Water quality/sediment impacts to Estes Lake
- Water quality impacts such as sediment, nutrient loading, and heavy metals to Grand Lake
- Culverts and increased runoff associated with NPS roads including Trail Ridge Rd, County, Betty Dick Access Rd, Fern Lake Rd, Cub Lake Rd
- Sedimentation and turbidity in North Fork Colorado River
- Moraine Park Campground and potential for flooding

Observations

The purpose of a burned area assessment is to determine potential values at risk resulting from post-fire emergency watershed conditions. Identification of values at risk occurs through consultation with individuals, state and federal agencies, and through field investigation. Not all values initially identified are determined to be at risk. If emergency watershed conditions are found, and values at risk are identified and confirmed, then the magnitude and scope of the emergency is mapped and described, values at risk and resources to be protected are analyzed, and treatment prescriptions are developed to protect values at risk. A significant factor leading to emergency watershed conditions is loss of ground cover, which leads to erosion and changes in hillslope hydrologic function in the form of decreased infiltration and increased runoff. Such conditions lead to increased flooding, sedimentation, and deterioration of soil condition. Values at risk are human life, property, and critical natural and cultural resources located within or downstream of the fire that may be subject to damage from flooding, ash, mud and debris deposition, and hillslope erosion.

BAER Team watershed specialists conducted field visits to review resource conditions starting on November 5 and continuing through November 7, November 11, and November 15, 2020. The main objectives of the field visits were to 1) evaluate soil burn severity and watershed response in order to identify potential flood and erosion source areas as well as debris flow hazards; 2) identify and inventory values at risk, 3) identify the physical and biological mechanisms that are creating risks; 4) review channel morphology and riparian conditions; 5) inspect hillslope conditions; and 6) determine needs for emergency stabilization.

Findings

Soil Burn Severity

Soil burn severity mapping is intended to reflect the degree of effects caused by the fire to soil characteristics that affect soil health and hydrologic function, and hence erosion rate, and runoff potential. It is not a map of vegetation consumption.

Satellite image-derived maps called Burned Area Reflectance Classification (BARC) help to

map soil burn severity classes throughout the burned landscape. A BARC is a map of the degree of post-fire changes in spectral reflectance. The BARC is created by comparing near infrared and shortwave infrared reflectance values and measuring the difference between pre-fire (image collection date: 10/13/2020) and post-fire (image collection date: 11/02/2020) satellite images. Since vegetation condition is the primary factor affecting post-fire spectral response in remotely sensed images, the BARC must be adjusted to fit ground observations before it can accurately be referred to as a soil burn severity map. Field observations provide the data necessary to adjust the BARC to create the map of soil burn severity classes.

BARC Adjustment

We collected 52 field data/observations of soil and ground conditions (Ground Cover, Ash Color and Depth, Root Structure, Soil Structure, Water Repellency) using the AGOL Collector application. Data points were overlaid with the BARC image to see how closely the BARC classes match collected data. Reclassification of the initial thresholds was conducted to more closely match observed soil burn severity conditions. The initial and adjusted thresholds are shown in the following table:

Table 1. BARC Reclassification Thresholds

Classification	Initial BARC	Reclassified BARC
	Thresholds	Thresholds
Unburned	0-62	0-62
Low	63-118	63-140
Moderate	119-189	141-230
High	190-255	231-255

BARC Inconsistencies (Cloud/Snow)

Large areas of inconsistency were evident on the initial BARC image which were reflective of cloud cover and from a recent snow event over the fire area on October 24th. To address these inconsistences, we used the following information to make soil burn severity determinations for these areas:

- Used collected field data/observations from areas with snow/cloud cover to assign soil burn severity class
- Used SSURGO data from known soil burn severity sites to help classify snow/cloud cover areas which showed as unburned with same soil types
- Used soil burn severity data from known vegetation types to support soil burn severity determinations in areas of similar vegetation types within the snow/cloud cover areas which showed as unburned
- Used High Resolution, Post- Fire Worldview 3 Imagery to support the above data sources and soil burn severity determinations. Worldview 3 image of the Park was partially obscured by clouds

Assumptions

Using the above data/image products we made the following assumptions to address the areas of inconsistency in the BARC image:

- Forested areas (lodgepole, sub-alpine mixed conifer, aspen) were assigned moderate soil burn severity up to the continental divide.
- Meadow areas were assigned low soil burn severity
- Areas above 10,200 feet to 11,400 feet with minimal vegetation and soil types with higher percentage of rock content were assigned low soil burn severity

The final product, the soil burn severity map, is not what is typically produced in which there is representative data collected across the fire area. However, it is a conservative approach given the limitations of data collection, quality of the BARC imagery and high-resolution imagery. Field observations showed that pre-fire vegetative communities and effective ground cover was largely consumed. The high amount of consumption is indicative of the extremely low fuel moistures occurring in the area prior to the fire. Ash was black in color with some small areas of white ash in higher pre-fire vegetative microsites. Ash layers were predominately thin due to a recent wind event and subsequent wind erosion of the ash layer and a snow event. Recognizable fine fuels, in general, when they occurred, were at the contact with the soil surface, beneath consumed ash layers. In the forested areas, where deadfalls and dead stumps directly contacted the soil, soil burn severity was high at the point of contact. This resulted in microsites where the organic matter had been completely consumed, resulting in a white to reddish cast. In meadows and wetland areas ash color was generally black excepting a few small areas in the peat, where the fire did burn into the organic layer. In these instances, the peat was consumed, resulting in a reddish cast post fire burn. Many post fire areas showed little or no damage to fine roots. In the areas where soil burn severity determination was moderate, some fine roots showed charring in the first 0.5-inch depth and the majority of the areas showed minimal fine root damage below an inch in depth. In addition, there was minimal medium and large root damage charring. Soil structure and soil surface horizon integrity were largely intact across the burn area. Low soil humidity conditions at the time of the fire may have also contributed to the fire's minimal effects on the soil structure. Water repellency as a result of the fire was inconsistent across sampled areas. Naturally dry soil conditions and soil texture demonstrated naturally occurring hydrophobic properties at depths of several inches. Some of the water repellency appeared to be as a result of natural drought and not as a result of the fire. The following table shows the acres of soil burn severity by class and NPS area (Table 2) with visual display in Figures 1 and 2.

Table 2. Soil Burn Severity (SBS) Acres for NPS ownership Colorado River and Big Thompson Districts, East Troublesome Fire.

NPS District	Unburned Acres	% of Total	Low SBS Acres	% of Total	Moderate SBS Acres	% of Total	High SBS Acres	% of Total	Total Acres
Colorado River	975	5.5	7,030	39.5	9,763	55	2	0.01	**17,770**
Big Thompson	307	6.3	2,164	44.2	2,047	49.2	19	0.3	**4,897**
Total	**1,282**	5.7	**9,194**	40.6	**12,170**	53.7	**21**	0.09	**22,667**

Figure 1. East Troublesome Fire Soil Burn Severity Map, Colorado River District.

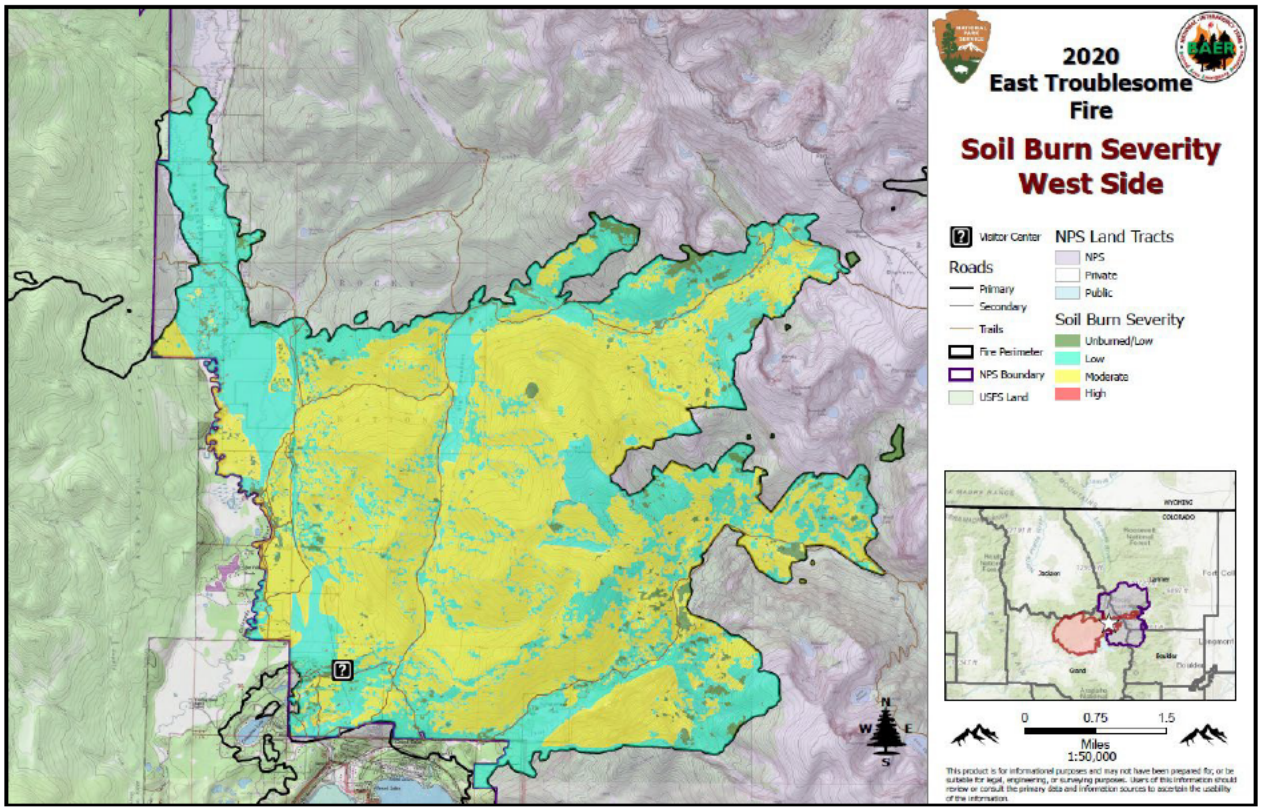
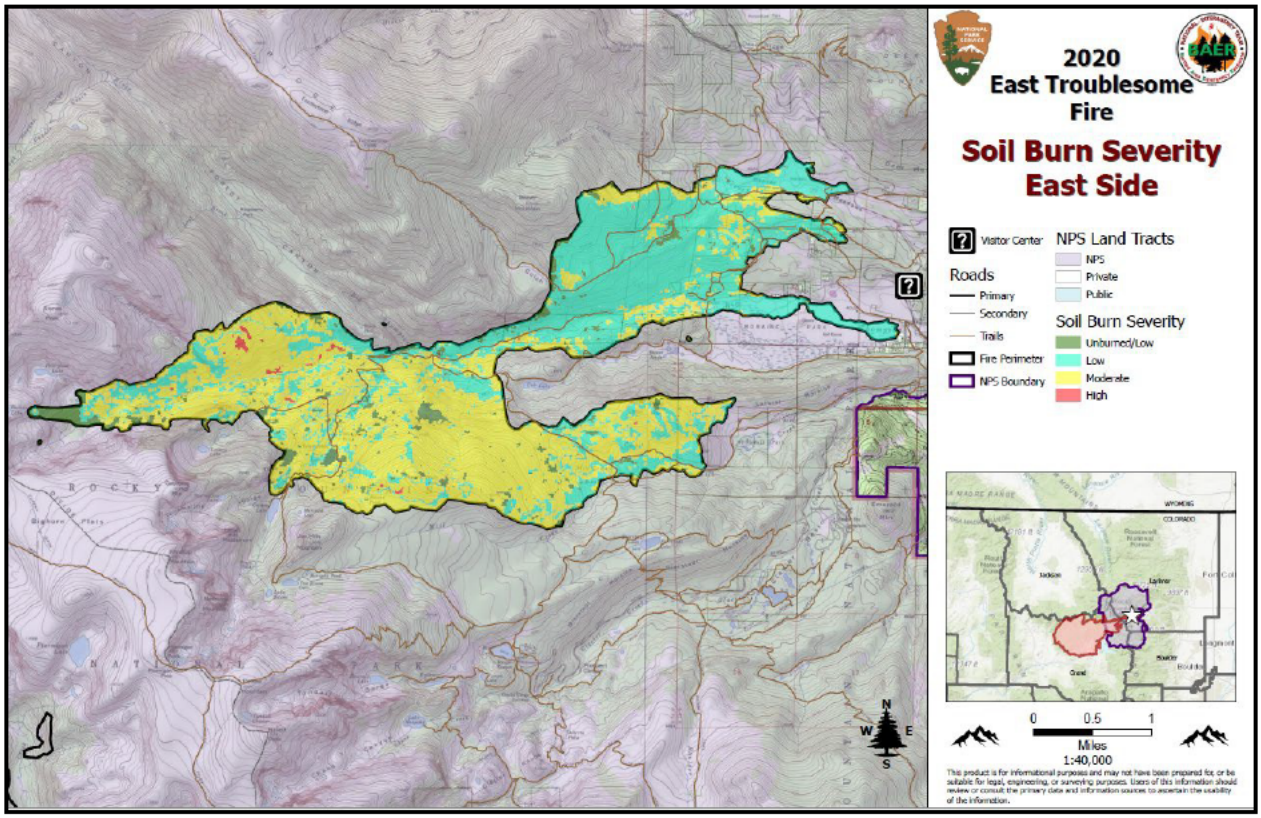


Figure 2. East Troublesome Fire Soil Burn Severity Map, Big Thompson District.



Watershed Response

The primary watershed response from the effects of the East Troublesome Fire are expected to include: 1) initial flush of ash with normal precipitation; 2) gully and rill erosion on steep slopes in drainages with moderate soil burn severity with normal precipitation; 3) debris flows initiated by high intensity precipitation with sediment deposition where stream gradients flatten and/or at tributary mouths; and 4) increases in average winter storm runoff. Elevated soil erosion, sedimentation, runoff, and stream flows are expected to decrease rapidly after the first year and return to the natural hydrological watershed function in five to seven years after the fire once vegetation has sufficiently recovered to restore the surface soil-hydrologic function and processes within the watersheds that burned at moderate and high severity.

Watershed modeling is used to estimate post-fire runoff response. Storm runoff and erosion modeling is a tool used by BAER teams to illustrate risk to life, infrastructure, and natural and cultural resources.

The AGWA/KINEROS2 modeling framework uses readily available geospatial datasets to provide model inputs for rapid assessment model runs. This tool uses a Digital Elevation Model (USGS-DEM) to break a watershed into modeling elements, which are then intersected with soil (SSURGO/STATSGO) and land cover (MLRC-NLCD) geospatial layers to derive requisite model input parameters (Goodrich et al, 2005). Once parameters are assigned, the KINEROS2 runoff and erosion model determines storm runoff response for both an unburned and a burned

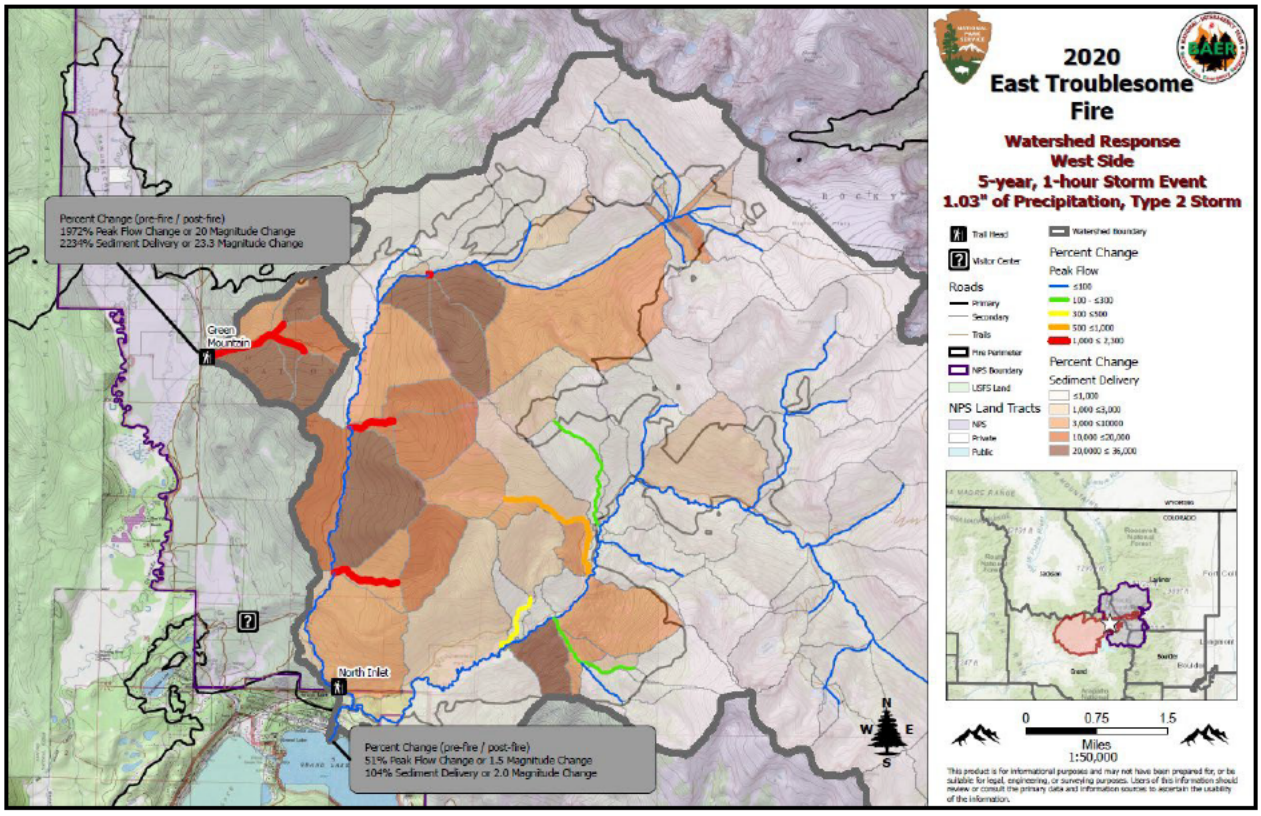
condition to get a sense of the anticipated change. AGWA is designed to provide rapid qualitative estimates of runoff and erosion relative to landscape change. It cannot provide reliable quantitative estimates of runoff and erosion without careful calibration. It is also subject to the assumptions and limitations of its component hydrologic models (Goodrich et al, 2005).

Colorado River District

Most of the burned area on NPS managed land exhibited low and moderate soil burn severity characteristics. Much of the soil contains large rock fragments which mitigates changes in pre- and post-fire peak flows making them much less pronounced. In addition, much of the ground cover is classified as cap rock that is unaffected by fire.

Modeled watersheds using AGWA on the Colorado River District were Green Mountain Creek which crosses under Hwy. 34 and Tonahutu Creek which flows into the town of Grand Lake and included the North Inlet watershed. The results of the AGWA modeling are summarized visually showing the percent increase in streamflows and sediment yield from pre-fire conditions (Figure 3).

Figure 3. AGWA Watershed Response for the East Troublesome Fire, Colorado River District.



Green Mountain Creek

Approximately 89% of the Green Mountain watershed that burned had moderate soil burn severity. The greatest modeled change was at Green Mountain Trailhead showing a 1,972% peak

flow increase, or a magnitude change of 20.7, from a 5-year, 1-hour storm event (Table 3). This is an extreme peak flow increase as a result of the very high amount of moderate soil burn severity in the watershed, the small size of the watershed, and the topographic relief of the watershed. The stream draining this watershed has the potential to deliver floatable debris to the 48" culvert on Hwy. 34 (Trail Ridge Road) and degrade the culverts ability to move water and impact the highway (Figure 4).

Table 3. Green Mountain Trailhead Post-Fire Watershed Response.

		% Change	Magnitude Change
5-year return period	peak flow (cfs)	1972	20.7
	sediment delivery (lbs)	2234	23.3
10-year return period	peak flow (cfs)	1422	15.2
	sediment delivery (lbs)	1267	13.7
25-year return period	peak flow (cfs)	1053	11.5
	sediment delivery (lbs)	593	6.9

Figure 4. Culvert under Hwy. 34 near Green Mountain Trailhead.



Rust line in culvert is below top of boot



Debris directly upstream of culvert

Tonahutu Creek

The Tonahutu Creek watershed drains directly into the town of Grand Lake. Model results from a 5-year, 1-hour storm event shows a 51% peak flow increase (Table 4). Approximately 58% of the Tonahutu Creek watershed that burned had moderate soil burn severity. West Portal Road and Grand Avenue Bridges in Grand Lake should be unaffected by post-fire streamflows (Figure 5). Typically, bridges are designed to withstand a 50 to 100-year flood event which would be greater than the modeled post-fire peak flow at this location.

Figure 5. Bridges on Tonahutu Creek in the town of Grand Lake.



West Portal Road bridge looking upstream



Grand Avenue bridge looking upstream

Table 4. Tonahutu Watershed Post-Fire Watershed Response.

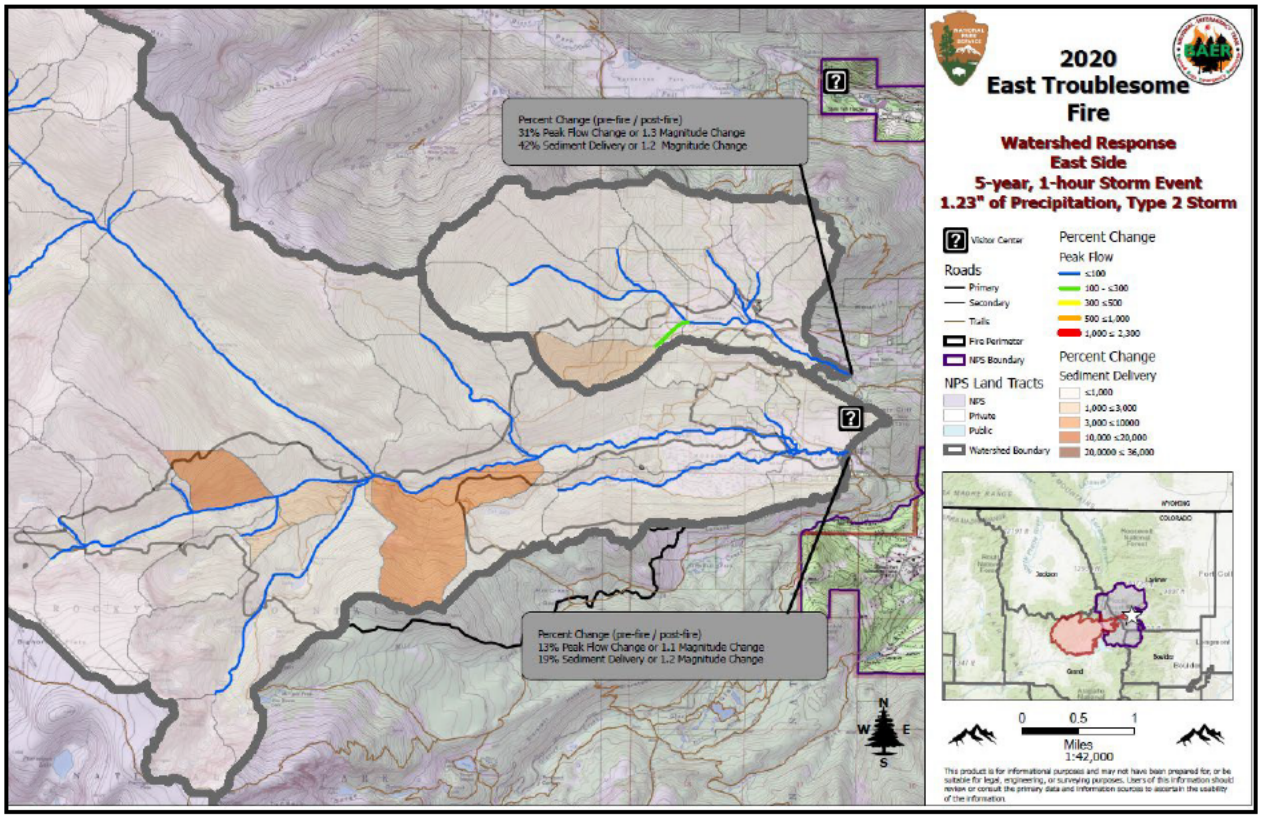
		% Change	Magnitude Change
5-year return period	peak flow (cfs)	51	1.5
	sediment delivery (lbs)	104	2.0
10-year return period	peak flow (cfs)	45	1.4
	sediment delivery (lbs)	101	2.0
25-year return period	peak flow (cfs)	36	1.4
	sediment delivery (lbs)	80	1.8

Big Thompson District

Most of the burned area on NPS managed land exhibited low and moderate soil burn severity characteristics. Much of the soil contains large rock fragments which mitigates changes in pre- and post-fire peak flows making them much less pronounced. In addition, much of the ground cover is classified as cap rock that is unaffected by fire.

Modeled watersheds using AGWA on the Big Thompson District were Beaver Brook and Big Thompson River. The results of the AGWA modeling are summarized visually showing the percent increase in streamflows and sediment yield from pre-fire conditions (Figure 6).

Figure 6. AGWA Watershed Response for the East Troublesome Fire, Big Thompson District.



Beaver Brook

Beaver Brook is a tributary to the Big Thompson River. This stream was modeled to the fire perimeter using a 5-year, 1-hour storm event. Results for Beaver Brook show a 31% increase, or a magnitude change of 1.3 times, from this storm event (Table 5). The minor increase in post-fire watershed response is the result of a significant portion of the area burned had low soil burn severity (76%) while only 17% of the Beaver Brook watershed that burned had moderate soil burn severity.

Table 5. Beaver Brook at Bear Lake Road Post-Fire Watershed Response.

		% Change	Magnitude Change
5-year return period	peak flow (cfs)	31	1.3
	sediment delivery (lbs)	42	1.4
10-year return period	peak flow (cfs)	27	1.3
	sediment delivery (lbs)	37	1.4
25-year return period	peak flow (cfs)	22	1.2
	sediment delivery (lbs)	24	1.2

The modeled results indicate that there is not an issue at the Beaver Brook culvert on the Bear Lake Road downstream of the fire perimeter (Figure 7).

Figure 7. Culvert, 24", on Beaver Brook under Bear Lake Road.



Big Thompson River

The Big Thompson River is the primary drainage in the portion of the East Troublesome Fire

within the eastern area of Rocky Mountain National Park. This river was modeled to the South Lateral Moraine Road just outside of the fire perimeter using a 5-year, 1-hour storm event. Results for Big Thompson River show a 13% increase, or a magnitude change of 1.1 times over pre-fire conditions, from this storm event (Table 6). The minor increase in post-fire watershed response is the result of much of the area burned had low soil burn severity (43%) while only 50% of the Big Thompson River watershed that burned had moderate soil burn severity. In addition, the lower portion of the Big Thompson River within the fire perimeter flows through a wide valley bottom where the stream channel is low gradient and becomes braided which dissipates stream energy.

Table 6. Big Thompson at South Lateral Moraine Road Post-Fire Watershed Response.

		% Change	Magnitude Change
5-year return period	peak flow (cfs)	13	1.1
	sediment delivery (lbs)	19	1.2
10-year return period	peak flow (cfs)	13	1.1
	sediment delivery (lbs)	21	1.2
25-year return period	peak flow (cfs)	14	1.1
	sediment delivery (lbs)	22	1.2

The modeled results indicate that there is not an issue at either of the bridges on Big Thompson River downstream of the fire perimeter (Figure 8).

Figure 8. Bridges on Big Thompson River downstream of the East Troublesome Fire Perimeter.



Bridge over Big Thompson River on South Lateral Moraine Road



Bridge over Big Thompson River on Bear Lake Road

Soil Erosion/Sediment Delivery

Soil erosion potential following a fire is generally increased over pre-fire potential. This is largely due to loss of soil cover (forbs, grass, leaf, and needle litter), surface horizon soil organic matter responsible for structural stability, and in some cases, increased water repellency at or near the soil surface. The amount of increase over pre-fire condition is related to the degree of soil changes. The degree of soil alteration influences the potential of post-fire soil erosion and debris flow process.

The Rapid Response Erosion Database (RRED) and Geospatial Application of the Water Erosion Prediction Project (WEPP) in the QGis platform uses geospatial datasets to provide model inputs for rapid assessment model runs (Flanagan and Nearing, 1995). This tool uses a Digital Elevation Model (USGS-DEM) to break a watershed into modeling elements, which are then intersected with soil (SSURGO/STATSGO) and land cover (MLRC-NLCD) geospatial layers to derive requisite model input parameters (Flanagan and Nearing, 1995). Once parameters are assigned, the WEPP erosion model determines erosion for both an unburned and a burned condition. Model output include display of modeled hillslopes which can be viewed to illustrate changes in sediment. Test files are created which contain summary data and data by hillslope. Hillslope data can be examined in area of concern.

Colorado River District

Modeled watersheds using WEPP on the Colorado River District were Green Mountain Creek which crosses under Hwy. 34 and Tonahutu Creek which flows into the town of Grand Lake. The results of the WEPP modeling runs are summarized in the tables below showing the percent increase in sediment yield from pre-fire conditions.

USFS Watershed

Erosion conditions were evaluated in a watershed that drained off Forest Service land on the west side of the park. This watershed drains to the North Fork of the Colorado River. The following figure shows changes between pre-fire conditions and burned conditions (Figure 9 and Table 7).

Figure 9. Post-fire erosion potential in a small tributary on USFS that drains into NFK Colorado River.

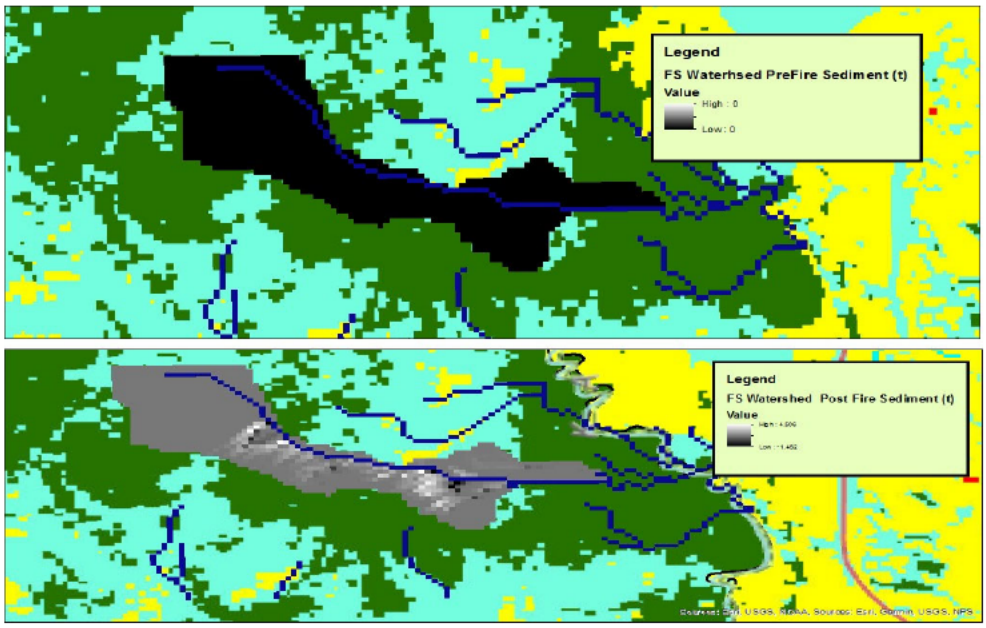


Figure 9 displays the pre- fire conditions on top and burned conditions on the bottom. Both runs indicate deposition and erosion will occur. Table 7 shows there could be 1.2 to 9.9 magnitude change depending on the storm intensity return period.

Table 7. Post-fire erosion potential increases on small drainage into NFK Colorado River.

USFS Watershed			
		% Change	Magnitude Change
5-year return period	sediment delivery (t)	17	1.2
10-year return period	sediment delivery (t)	859	9.6
25-year return period	sediment delivery (t)	888	9.9

Green Mountain Trailhead

Erosion conditions were evaluated at the Green Mountain Trailhead. This watershed drains to the North Fork of the Colorado River. The following figure shows changes between pre-fire conditions and burned conditions (Figure 10 and Table 8).

Figure 10. Post-fire erosion potential in Green Mountain Creek, Colorado River District.

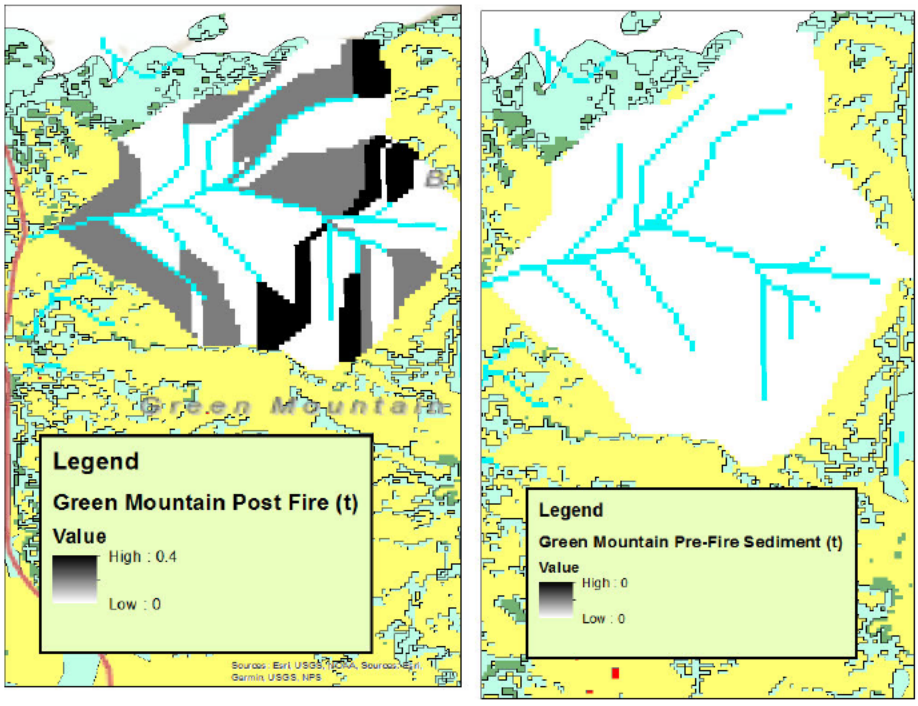


Figure 10 displays the pre- fire conditions on the right and burned conditions on the left. Large changes in erosion are possible. This watershed is very flat in the head waters and steep near the outlet. An old stockpond is located on the west side of Hwy 34 and increased sediment is expected to decrease capacity over time. Table 8 shows there could be 19.3 to 26.1 magnitude change depending on the storm intensity return period.

Table 8. Post-fire erosion potential increases on Green Mountain Creek, Colorado River District.

Green Mountain Traihead			
		% Change	Magnitude Change
5-year return period	sediment delivery (Tonne)	1830	19.3
10-year return period	sediment delivery (Tonne)	2299	24.0
25-year return period	sediment delivery (Tonne)	2508	26.1

Tonahutu Creek/North Inlet

Erosion conditions were evaluated at the Tonahutu/North Inlet Drainage above the town of Grand Lake. This watershed drains to Grand Lake. Figure 11 shows change between pre-fire conditions and burned conditions (Figure 11 and Table 9).

Figure 11. Post-fire erosion potential in Tonahutu Creek/North Inlet, Colorado River District.

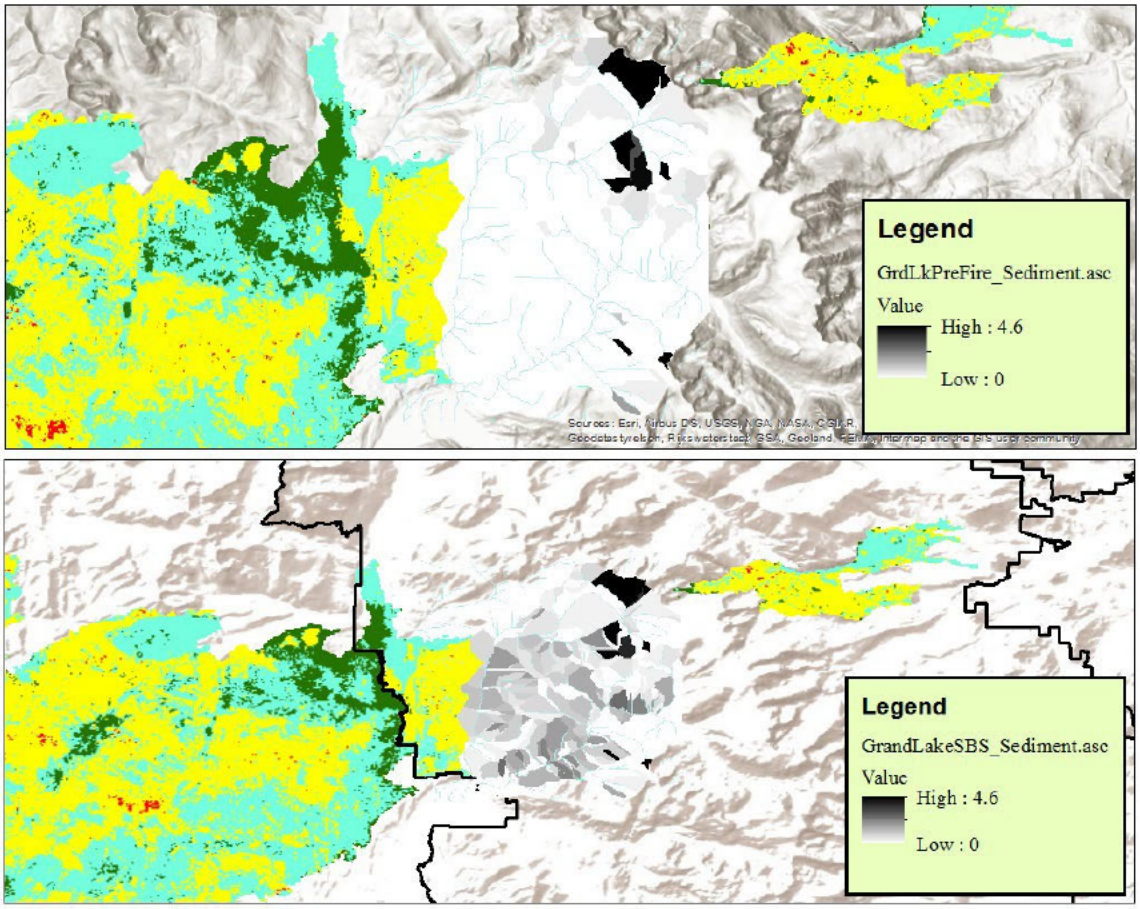


Figure 11 displays the pre- fire conditions on top and burned conditions on the bottom. Erosion is expected to increase, but due to the long, wide, and flat alluvial valley that drains the two areas acute impacts will be minimal. Table 9 shows there could be 3.7 to 4.8 magnitude change depending on the storm intensity return period.

Table 9. Post-fire erosion potential increases on Tonahutu Creek/North Inlet, Colorado River District.

Tonahutu at Grand Lake			
		% Change	Magnitude Change
5-year return period	sediment delivery (t)	307	4.1
10-year return period	sediment delivery (t)	380	4.8
25-year return period	sediment delivery (t)	266	3.7

Big Thompson District

Modeled watersheds using WEPP on the Big Thompson District were Beaver Brook at Bear Lake Road and Upper Big Thompson River below the confluence with Fern Creek. The results of the WEPP modeling runs are summarized in the tables below showing the percent increase in sediment yield from pre-fire conditions.

Beaver Brook at Bear Lake Road (East)

Erosion conditions at the Beaver Brook culvert were modeled and Figure 12 displays no change in hillslope erosion.

Figure 12. Post-fire erosion potential in Beaver Brook, Big Thompson District.

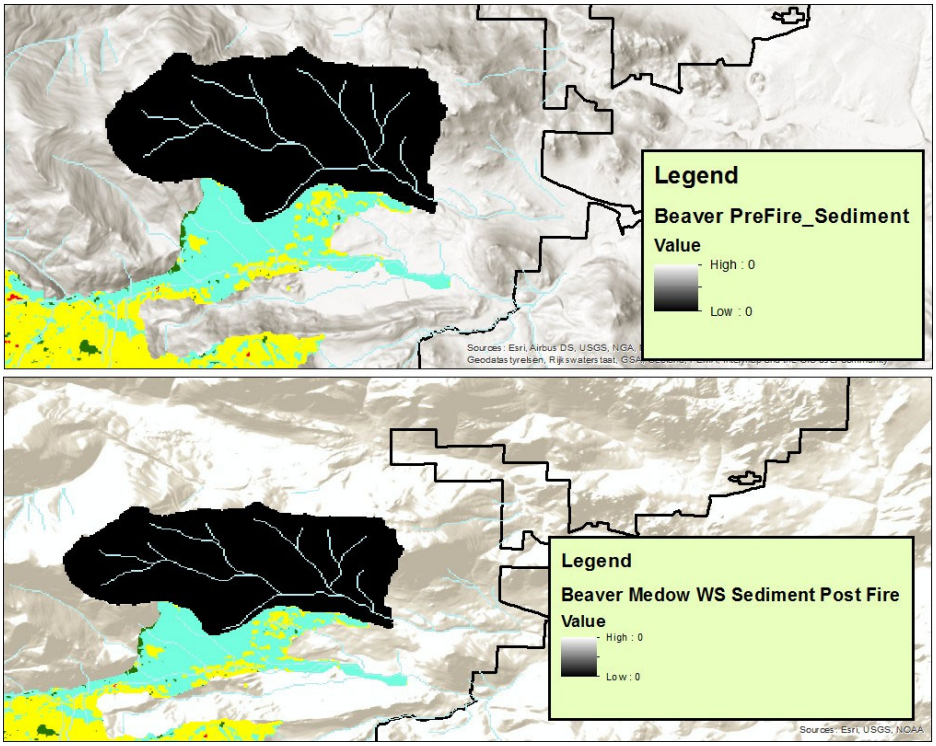


Figure 12 displays the pre- fire conditions on top and burned conditions on the bottom. Erosion is not expected to increase due to the limited amount of burn area and highly vegetated alluvial valley. Table 10 shows there could be 1.0 to 2.8 magnitude change depending on the storm intensity return period.

Table 10. Post-fire erosion potential increases on Beaver Brook, Big Thompson District.

Beaver Brook at Bear Lake Road			
		% Change	Magnitude Change
5-year return period	sediment delivery (t)	107	2.1
10-year return period	sediment delivery (t)	183	2.8
25-year return period	sediment delivery (t)	0	1.0

Upper Big Thompson

Erosion conditions were evaluated at the Upper Big Thompson Watershed and were modeled. Figure 13 displays change in hillslope erosion, but changes in sediment delivery will increase due to increases in flow. These areas have a high pre-fire erosion condition that may be masking the usual increases in erosion.

Figure 13. Post-fire erosion potential in Upper Big Thompson River, Big Thompson District.

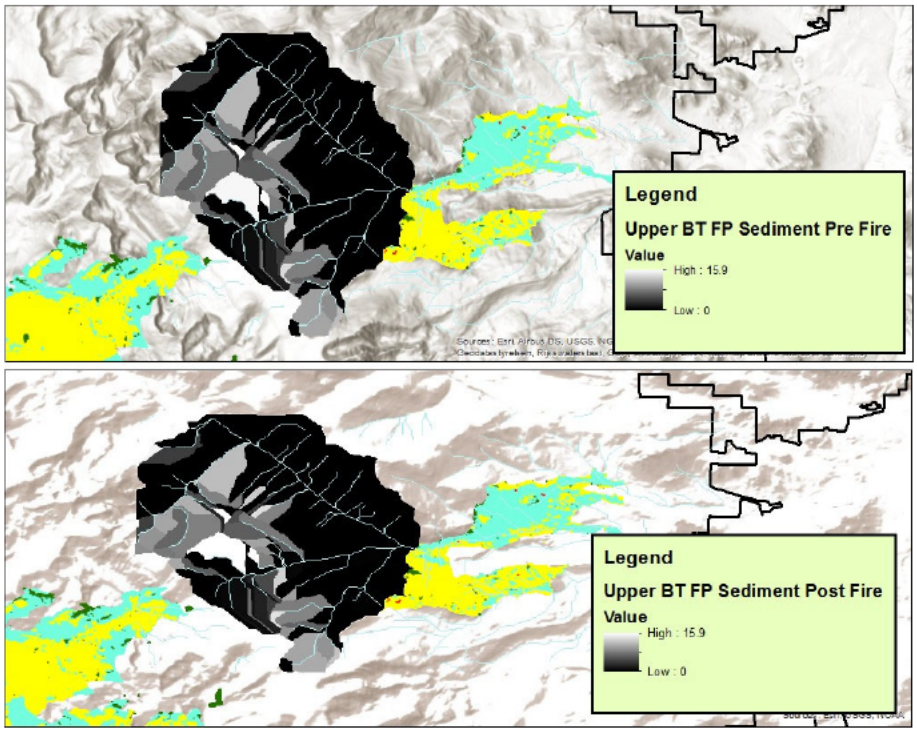


Figure 13 displays the pre- fire conditions on top and burned conditions on the bottom. Table 11 shows there could be 5.6 to 23.6 magnitude change depending on the storm intensity return

period.

Table 11. Post-fire erosion potential increases on Upper Big Thompson River, Big Thompson District.

Upper Big Thompson			
		% Change	Magnitude Change
5-year return period	sediment delivery (t)	489	5.9
10-year return period	sediment delivery (t)	459	5.6
25-year return period	sediment delivery (t)	2258	23.6

Debris Flows

Debris flow potential was assessed using a combination of modeling outputs and field observations in the vicinity of identified Values at Risk. Modeled debris flow hazard was provided by the U.S. Geological Survey's post-fire debris flow hazard model (Staley *et al,* 2016).

The USGS provided estimates of debris-flow likelihood, volume, and combined hazard for several design storms with a range of peak 15-minute intensities within the geodatabase. Peak 15-minute intensities range from 12 mmh^{-1} to 40 mmh^{-1} in 4 mmh^{-1} increments. Estimates are calculated at two scales: the stream segment scale (segment of stream with a maximum length of 200m) and for drainage basins (at algorithm-defined pour points). The maximum drainage area size for calculation of the predictions is 8 square kilometers, the largest basin area the USGS has identified as producing a debris flow in their empirical database. Flooding is far more of a concern in drainage basins exceeding 8 square kilometers in contributing area. Streams that exceed an upslope area of 8 square kilometers yet are still susceptible to flood and possibly debris-flow hazards, are included in the geodatabase as "watch streams." The USGS also provided estimates that can be used to guide the initial establishment of rainfall intensity-duration thresholds for storm peak intensities of 15-, 30-, and 60-minute durations. The USGS Debris Flow model utilizes data regarding topography (using 10m DEMs), soil burn severity, soil properties (STATSGO), and rainfall.

The model-estimated rainfall thresholds (basin-scale) are as follows:

- 15-minute: 38 mm/h, or 0.4 inches in 15 minutes
- 30-minute: 29 mm/h, or 0.6 inches in 30 minutes
- 60-minute: 26.5 mm/h, or 1.0 inches in 60 minutes

In general, across the fire area the likelihood of post-fire debris flows occurring on NPS lands after approximately 1 inch of rainfall ranges from 0-40%. A few small drainages near the following locations have a higher level of likelihood of debris flow hazards in the 40-60% and 60-80% range. These locations include the Summerland Park and Twinberry areas along the

North Inlet trail, the North Inlet trail, small first order tributaries in Tonahutu Creek, and above Spruce Creek in the Big Thompson watershed.

Figure 14. USGS Debris Flow Estimates for the East Troublesome Fire, Colorado River District.

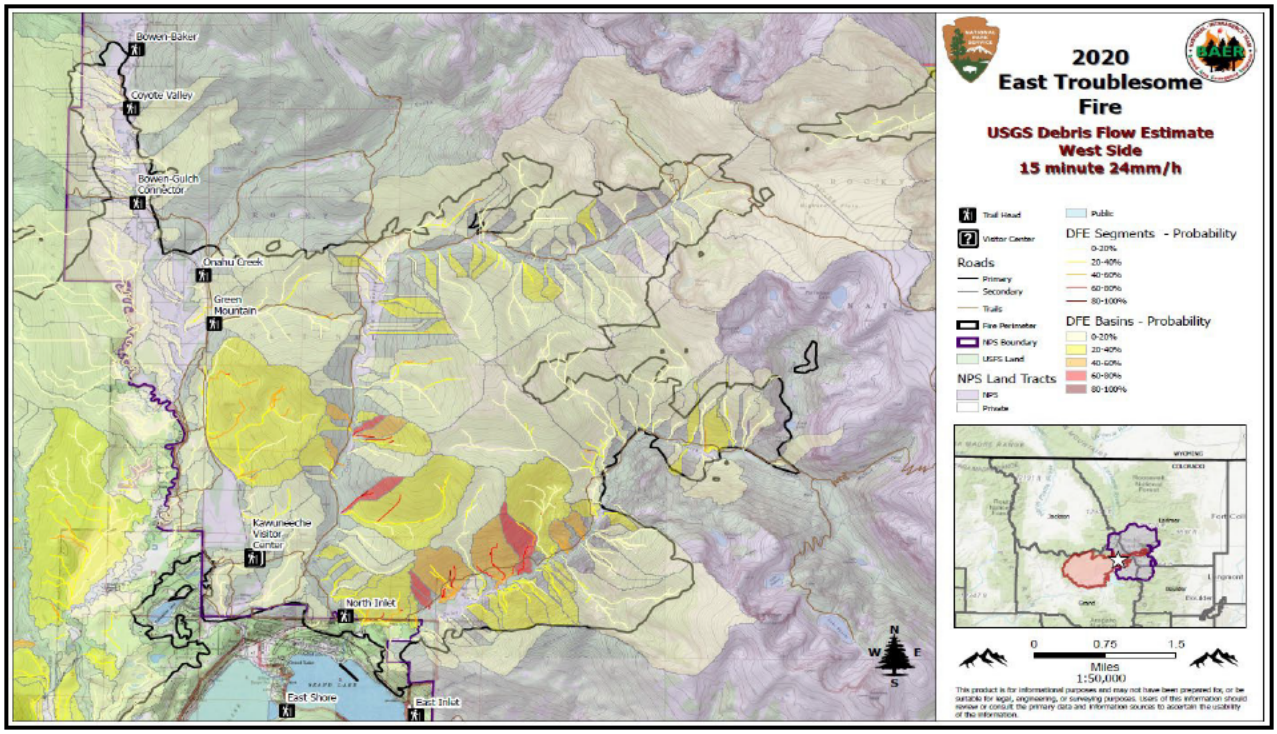
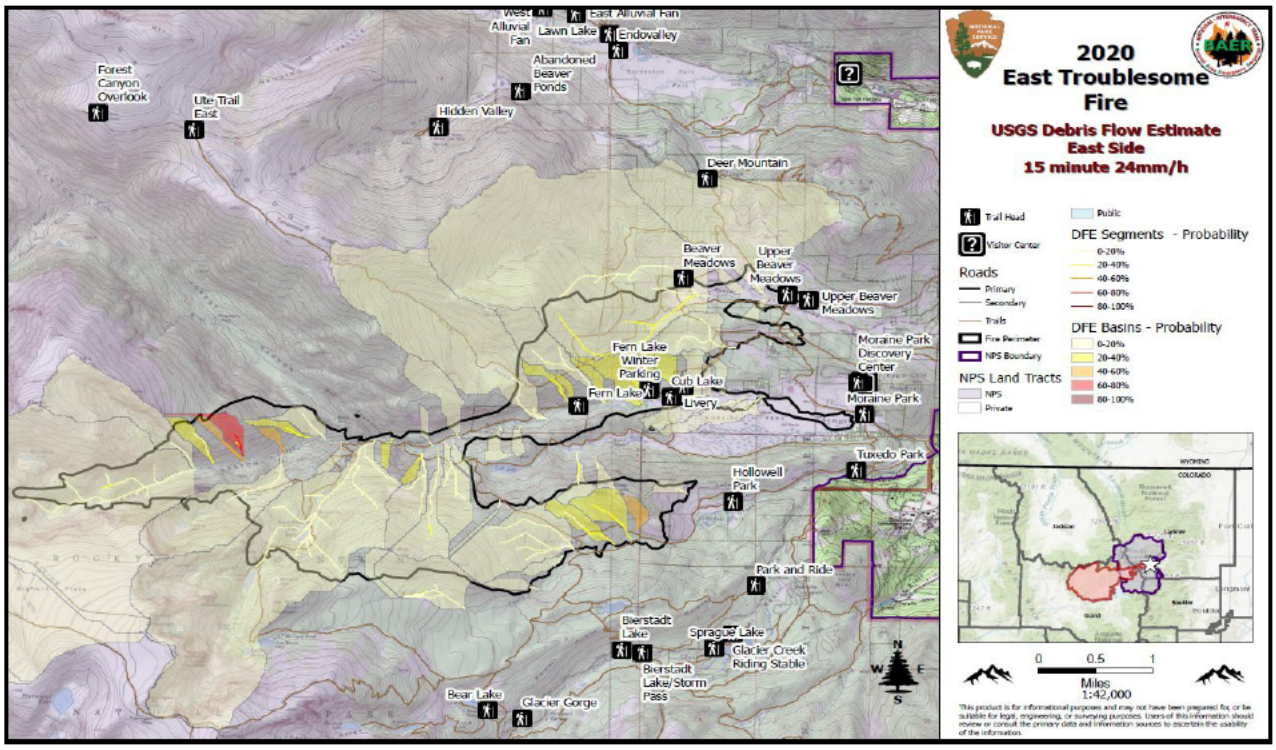


Figure 15. USGS Debris Flow Estimates for the East Troublesome Fire, Big Thompson District.



Recommendations

Share the results from watershed modeling (AGWA, RRED and USGS Debris Flow) with cooperators and partners to help inform them about the potential watershed response from NPS lands to the North Fork Colorado River, Colorado River, Big Thompson River, Grand Lake, and Estes Lake.

Communicate with the Town of Grand Lake about potential sediment delivery to the North Inlet, Tonahutu Creek, North Fork Colorado River and Grand Lake from NPS lands.

Communicate with the Town of Estes Park about potential sediment delivery to the Big Thompson River from NPS lands.

Specifications

ES-09 Storm/Road Patrol

ES-12 Culvert Trash Rack

Non-Specification Management Recommendations

To reduce springtime flooding of campsite in Moraine Park Campground, loop A, more drainage is needed under the road below the sites. It is recommended that graveled drainage or a French drain be installed under the road.

References

Flanagan, D.C., and M.A. Nearing (eds.). 1995. USDA-Water Erosion Prediction Project (WEPP) Hillslope Profile and Watershed Model Documentation. NSERL Report No. 10, National Soil Erosion Research Laboratory, USDA-Agricultural Research Service, West Lafayette, Indiana.

Goodrich, D.C., H.E. Canfield, I.S. Burns, D.J. Semmens, S.N. Miller, M. Hernandez, L.R. Levick, D.P. Guertin, and W.G. Kepner, 2005. Rapid post-fire hydrologic watershed assessment using the AGWA GIS-based hydrologic modeling tool. In: Proceedings, ASCE Watershed Management Conference, Williamsburg, VA, July 19-22, 2005.

Iverson, R.M. 1997. The Physics of Debris Flows. Reviews of Geophysics 35(3):245-296.

Laflen, J.M., L.J. Lane, and G.R. Foster. 1991. WEPP—a next generation of erosion prediction technology. Journal of Soil Water Conservation 46(1): 34–38.

Staley, D.M., Negri, J.A., Kean, J.W., Tillery, A.C., and A.M. Youberg. 2016. Updated logistic regression equations for the calculation of post-fire debris-flow likelihood in the western United States: U.S. Geological Survey Open-File Report 2016-1106, 13p. Available at: http://pubs.usgs.gov/of/2016/1106/

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Cultural Resource Assessment

Issues

- Rocky Mountain National Park (ROMO) is an important ethnographic landscape intrinsically important and highly valued by many Native American tribes who inhabited the area for thousands of years or frequented the area for various reasons. The associated cultural and ethnographic resources of the tribes within the area are not well known and further identification and documentation is needed for the park's history and very importantly to satisfy tribal needs and concerns under 36 CFR §800.4(c)(1).
- Many areas within the Big Thompson District (BTD) burn perimeter on the east side of the park, and many areas within the Colorado River District (CRD) burn perimeter on the west side of the park do not have adequate and up-to-date archeological surveys.
- An increased level of effort (36 CFR §800.4(b)(1)) is needed to identify all historic properties within the Area of Potential Effects (APE) for all post-fire BAER treatments such as within and adjacent to existing park trail and road systems, and within and adjacent to established park authorized camping areas in order to comply with Section 106 of the National Historic Preservation Act requirements (NHPA).
- Results from previous archeological surveys conducted within the east and west burn areas (BTD and CRD) indicate the presence of at least [redacted]
- [redacted]
- Both the BAER treatments (undertakings) and all APEs will need to be adequately defined for consultation with SHPO and THPO purposes, and all historic properties will need to be identified within each APE, and the criteria of adverse effect will need to be applied to historic properties to determine the effects to historic properties from the multitude of post-fire BAER treatments.
- SHPO consultation and concurrence with park findings on previous ROMO undertakings has been problematic due in part to the lack of or inadequate archeological surveys and the lack or inadequate identification and evaluation of historic properties. An increased level of archeological documentation and consultation with the SHPO and the THPOs is be needed for the many post-fire BAER treatments or undertakings associated with the fire to ensure no delays or setbacks occur when implementing treatments.
- [redacted] may need further analysis because it has not been assessed using a higher level of effort, furthermore the criteria of adverse effect has not been applied and needs to be applied to this historic property to determine if any BAER treatments along the road will adversely affects the properties integrity (36 CFR §800.4(c)(1)).
- Post-fire BAER management activities and or treatments implemented for public safety,

preservation of agency infrastructure, or protection of natural resource values may affect historic properties and other sensitive cultural resources.

- Condition of remnant historic features [redacted].
- Post-fire risk [redacted].
- Historic properties located on moderate to steep slopes are at risk of post-fire erosion due to sheet wash flooding and/or debris flows especially when vegetation cover is limited, or when surface organics are lacking.
- Heavy rainfall or quick snow melt can cause substantial erosion at exposed sites. In some rare cases solifluction may affect the integrity of a site where supersaturated soil deposits are no longer held deeply by vegetation cover during rapid melt-off.
- Colluvial flows sometimes created by hydrophobic soils and destabilized slopes may lead to several erosion or complete blow-out of archeological sites and architectural features.
- Condition of cataloged museum objects contained with the [redacted].
- Park lands affected by the fire are intersected by many public roads and trail systems. An elevated risk of unauthorized artifact collection (looting) at historic and precontact archeological sites with exposed surfaces, and vandalism of burned historic structures and features exists along and near these road and trails. The National Register of Historic Places (NRHP) qualifying attributes of these known cultural resources are at risk.
- Hazard trees can fall and directly impact historic structures and architectural features.
- Hazard trees may cause adverse effects to significant archeological sites containing intact archeological deposits and other culturally significant features when soils are uprooted during a tree tip-out [redacted]



Figure 16. Tree tip-out affecting important [redacted].

Observations

This cultural resource assessment was completed to determine the extent of direct fire effects on historic properties and to assess if operational activities and post-fire conditions pose a risk to these cultural resource values. Observations were facilitated by first conducting a background records search and review of cultural data for areas within and adjacent to the Big Thompson Watershed burn perimeter and within and adjacent to the Colorado River District burn perimeter.

Methods

The identification of cultural resource values at risk included completing a literature review and a background records search using site files maintained by Rocky Mountain National Park (park), data in the National Park Service's Cultural Resource Inventory System (CRIS), and information from the park's cultural resource GIS databases. Ethnographic resources of value were identified using CRIS and information learned during previous tribal consultation meetings.

Field assessments were conducted using a prioritized list of cultural resources identified to be at risk based upon the geospatial analysis, fire or looting susceptibility, and specific resources most likely to be impacted by the fire and/or post-fire conditions. The list of *high priority archeological sites* to visit was developed by park's cultural resources program manager, Kelly Dick, and the BAER Team cultural resource specialists (Ash Phillips and Michael R. Peterson). According to Kelly, the park's cultural data needs to be reviewed for location accuracy and eligibility determinations and SHPO concurrence for many sites listed in the park's GIS database. Therefore some sites in the park's GIS data listed as ineligible were included on the list

of high priority archeological sites to visit since some of these sites do not have SHPO concurrence or are marked as ineligible but still need further review and a formal determination of eligibility conducted.

Two main GIS geodatabase feature classes that list these above high priority cultural resources and were used for locating and assessing cultural resources at risk in non-hazardous areas of the fire perimeter. These two databases area called: [redacted] After the data for the high priority cultural resources list were developed, these site locations were plotted on a BTD burn area map and a CRD burn area map which were georeferenced and uploaded to a Samsung phone using Avenza Maps.

Another database was used to locate cultural resources that could be at risk. This database is [redacted] Archeological sites in this database marked as eligible for listing on the NRHP or marked as unevaluated in the park's legacy database [redacted] and the two above Rapid Assessment Archeological Sites feature classes described above were considered the highest priority archeological sites to visit.

Archeological sites marked as eligible for listing on the NRHP or were marked as unevaluated in the park's legacy database [redacted] and the two above Rapid Assessment Archeological Sites feature classes described above were considered the highest priority archeological sites to visit.

A basic GIS analysis of high priority archeological sites within 30 and 100 meters of burn area trails and roads was conducted. Burned Area Reflectance Classification (BARC) data and Soil Burn Severity (SBS) map data were reviewed and highest priority archeological sites were overlaid on these data to determine the number of historic and precontact sites and historic structures located within each BARC and SBS classification. Hydrologic models developed for the burn area were also reviewed to assess risk to known archeological sites and historic structures in and adjacent to the burned area from estimated peak water flow and debris flow. Site locations were also reviewed with little to no success using a Lockheed fixed wing UAV flying at 13,000 feet.

A basic GIS analysis of high priority archeological sites within 30 and 100 meters of burn area trails and roads was conducted. Burned Area Reflectance Classification (BARC) data and Soil Burn Severity (SBS) map data were reviewed and highest priority archeological sites were overlaid on these data to determine the number of historic and precontact sites and historic structures located within each BARC and SBS classification. Hydrologic models developed for the burn area were also reviewed to assess risk to known archeological sites and historic structures in and adjacent to the burned area from estimated peak water flow and debris flow. Site locations were also reviewed with little to no success using a Lockheed fixed wing UAV flying at 13,000 feet.

Field conditions in the CRD burn area on November 7, 2020 were good, although slight winds and some hazard trees limited access to a couple locations. On November 10, 2020 in the CRD, inclement weather conditions (snow and wind events) combined with hazard trees and obscured

ground conditions within and near the prioritized cultural resources limited the number of sites that could be accurately assessed within the CRD. Snow cover was about 3 to 10 inches in some areas. On November 12, 2020 there was snow cover, sunshine and occasional slight gusty breezes. The areas assessed mainly were in burn areas containing hazard trees.

Results of Background Literature Review and GIS Analysis

[redacted]

BTD Burn Area

One [redacted] was identified as priority for assessment within the BTD burn perimeter. Other historic structures on the BTD are outside of the burn perimeter and not determined to be at risk of post-fire events.

A total of [redacted] were identified inside and within 100 meters of the BTD burn perimeter. About [redacted] Although further review of site eligibility should be conducted, a [redacted]

Table 12. **Total highest priority archeological sites by Soil Burn Severity classes in BTD.**

BTD Soil Burn Severity	Highest Priority Archeological Sites in BTD
Unburned	[redacted]
Low	
Moderate	
High	
Total	

Results from the analysis of highest priority archeological sites located along nine (9) major park trails within the BTD burn area (a total of 16.18 miles of trail), indicates that [redacted] the BTD are [redacted].

The analysis of highest priority archeological sites [redacted].

CRD Burn Area

Within the CRD burn area, [redacted] pproximately 7.5 miles of road are within the CRD burn area.

Archeological sites identified within the CRD [redacted] marked as eligible or unevaluated in the Park's GIS Legacy Sites database, thus they were assumed to be historic properties and were identified as *highest priority archeological sites* for assessment within the CRD burn area [redacted].

According to the Soil Burn Severity data for the CRD (Table 13), [redacted].

Table 13. **Total highest priority archeological sites by Soil Burn Severity classes in CRD.**

CRD Soil Burn Severity	Highest Priority Archeological Sites in CRD
Unburned	[redacted]
Low	[redacted]
Moderate	[redacted]
High	[redacted]
Totals	[redacted]

Results from the analysis of highest priority archeological sites located [redacted]

The analysis of highest priority archeological sites [redacted]

Findings

Effects to cultural resources as a result of fire, fire management actions, and post-fire conditions included three categories: 1) direct; 2) operational; and 3) indirect. Direct affects are those caused by the fire itself or its byproducts (e.g., smoke); operational impacts are caused by fire management actions made in response to wildland fires (e.g., fire line construction, water drops); and indirect affects occur as a result of fire-induced changes to the context in which cultural resources are found (e.g., peak flows, debris flows and erosion due to loss of vegetation cover, toppling of hazard trees, looting). The primary impacts to archeological resources include operational and fire-induced change.

BTD burn area Archeological Assessments

Only [redacted] were assessed for fire damage and threats by post-fire conditions and emergency stabilization treatments. [redacted] were also assessed because they were in the area the BAER team visited for other assessments or were listed in the rapid site assessment data set provided by the park's cultural resource manager.

Within the BTD burn perimeter, BAER Team archeologist Michael Peterson assessed [redacted] the GIS location point on the Avenza map may have been too coarse to make a positive relocation.

[redacted]



Figure 17. [redacted] and



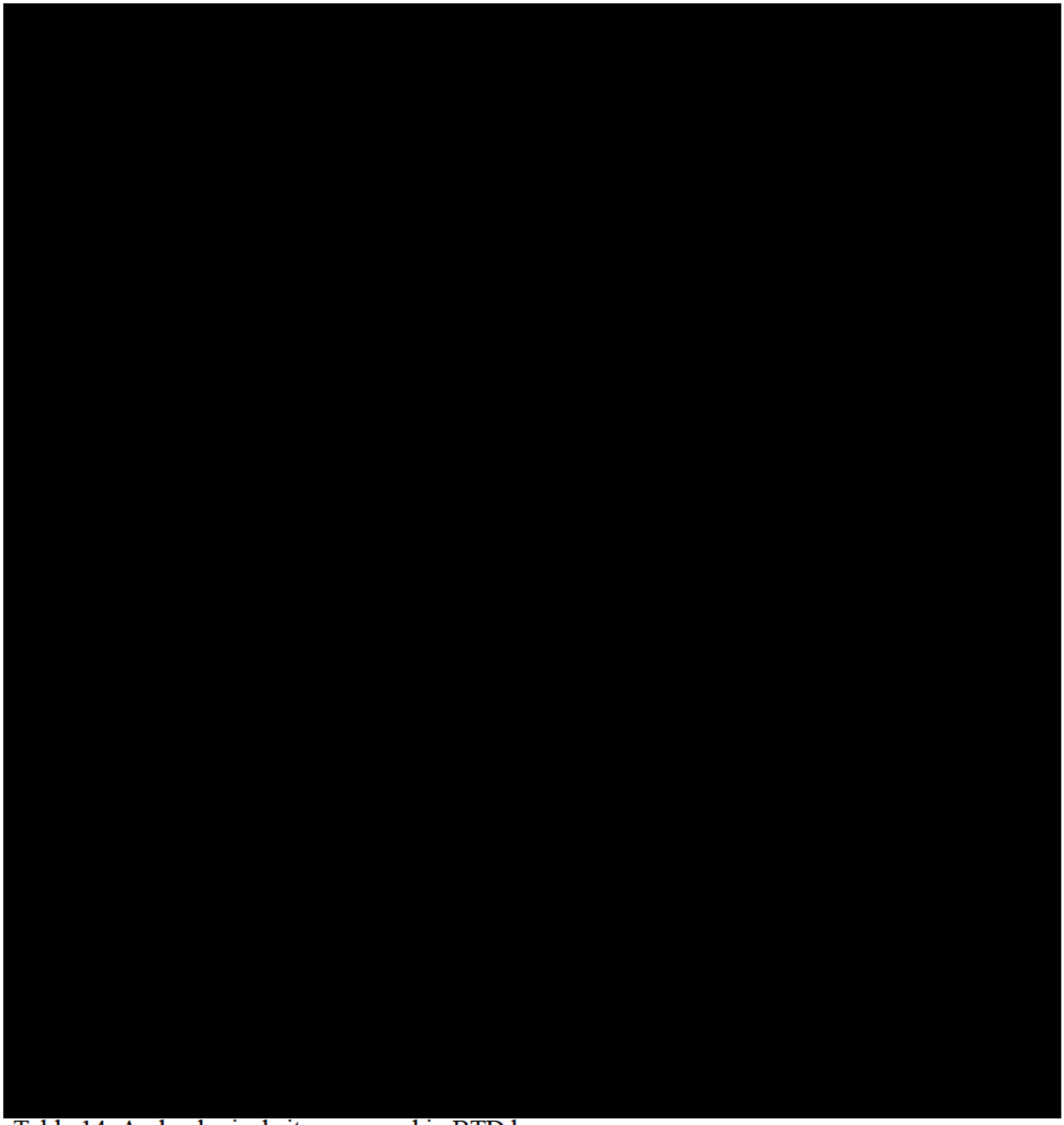


Table 14. Archeological sites assessed in BTD burn area.

CRD burn area Archeological Assessments

Results from a review of park GIS cultural data and literature, indicates

[redacted] Many of the sites assessed were reviewed from a short distance away due to hazard conditions and ground visibility within and near the site location.

On November 7, Peterson [redacted] the sites approximate location on the landscape was viewed and photographed from a short distance away due to adverse field conditions that included hazard trees, winds 10-20 mph, and moderate snow cover. On November 10th and 12th, a more accurately georeferenced map of the CRD area was uploaded to Avenza and used for field assessments.

[redacted] Eligibility determinations for this site should be reviewed again especially since this site may meet some of the National Register criteria.

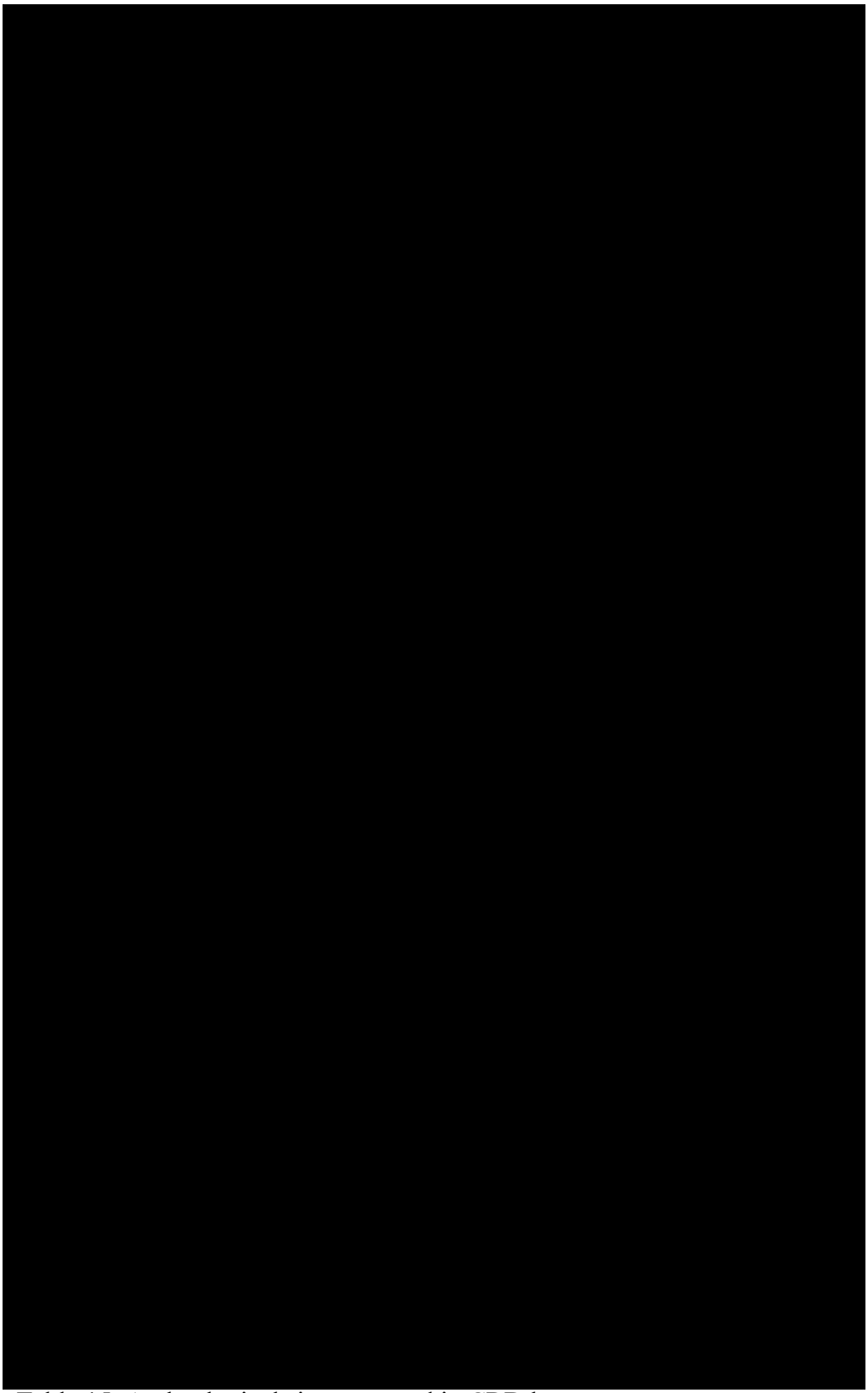


Table 15. Archeological sites assessed in CRD burn area.

[redacted]

Impacts to [redacted] on both the BTD and the CRD are primarily from direct-fire effects and are at risk from indirect threats from fire-weakened trees and looting. Hydrology modeling does not indicate historic structures within or adjacent to the burn area are at risk of damage from debris flow or erosion issues.

[redacted]

[redacted]

On the Big Thompson District [redacted] azardous conditions from hazard trees and high winds prevented BAER team access to the site. [redacted]

[redacted] are outside the burn perimeter but were initially on the priority resource list for possible hydrologic impacts. A site visit and modeling relieved all post-fire effect concerns for the area.

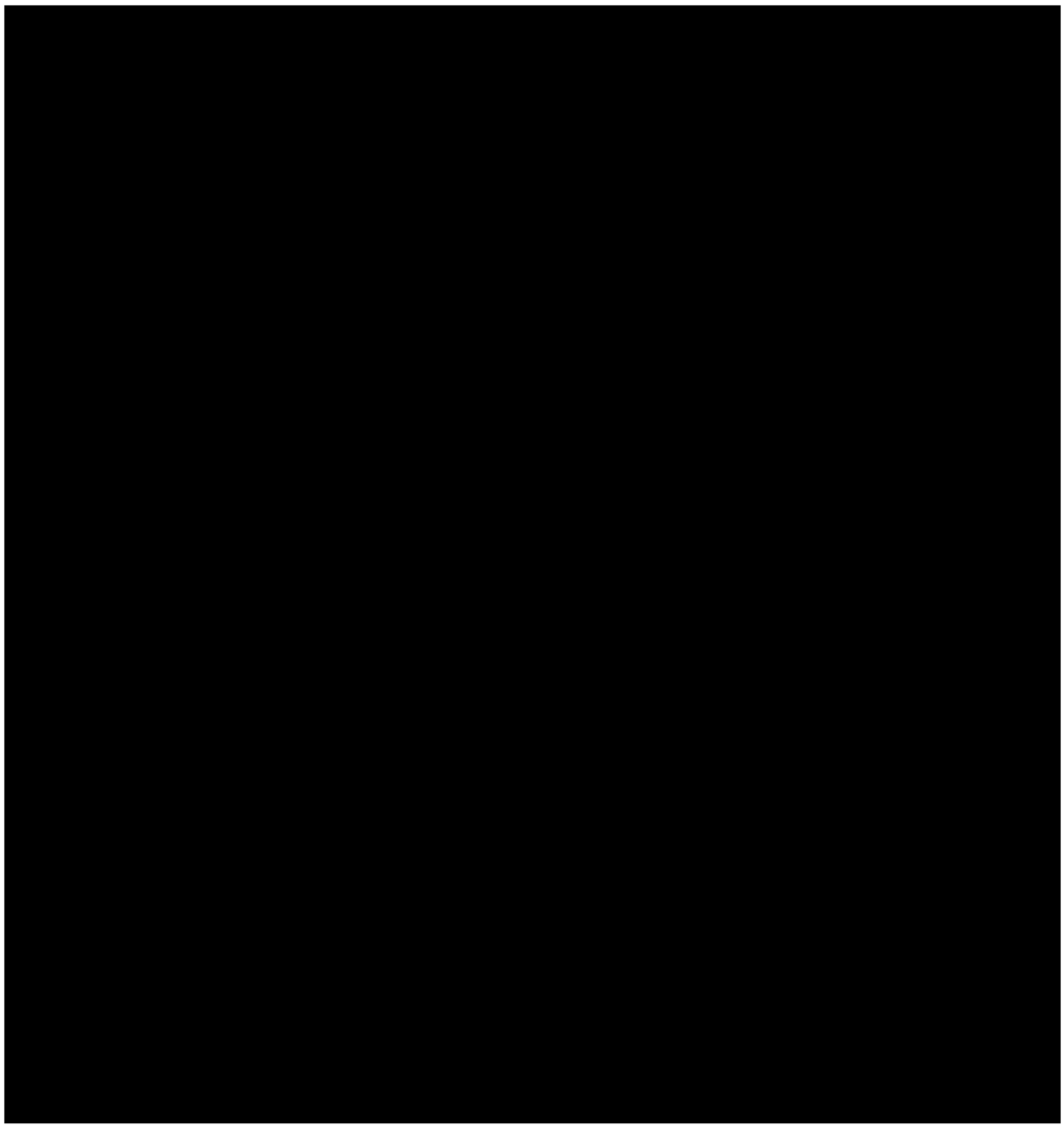


Figure X: [redacted].

CRD burn area [redacted]

[redacted]

[redacted]

[redacted] it suffers significantly under the effects of fire. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Figure X: [redacted].



Figure X: [redacted]

[redacted]

	[redacted]					
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]					
	[redacted]					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[redacted]

[redacted]

Recommendations

[redacted]

Due to outdated and inadequate levels of previous archeological survey within the CRD and BTD burn areas, and the presence of about 47 miles trails and multiple wilderness campsites within and adjacent to significant precontact and historic archeological sites, it is recommended that qualified archeologists accompany trail clearing and repair crews and be on site during wilderness campsite rehabilitation activities in both the CRD and BTD burn areas.

The archeologists will monitor all ground disturbing activities such as tree clearing, installation of small-scale trail features like water bars and trail retaining structures and rehabilitation or removal activities at wilderness campsites. The archeologists will work with the clearing and maintenance crews to evaluate and remove dead standing trees from archeological sites and to place tree branches and logs on sites to cover any newly exposed artifacts and features.

Archeologists will determine if any impacts associated with implementing BAER treatments within the BTD burn area or the CRD burn area have the potential to adversely affect historic properties and, if so, prescribe actions to minimize, negate, or mitigate identified adverse effects to properties to meet Section 106 of the NHPA.

The archeologists will document all the above activities and will transfer field data to the support archeologist (office) each week and the support archeologist will process all field data (site forms, photos, GIS data, artifacts, and database entry into CRIS) and prepare a report for the Colorado Office of Archaeology and Historic Preservation (OAHP)/State Historic Preservation Officer (SHPO) and associated Tribal partners.

[redacted]

[redacted] heavy-duty tarps held in place with sandbags to discourage looting, contain ash blow, and prevent environmental contaminants from migrating off-site. All features and objects should be left in-situ and no building features should be used to hold down tarps [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Specifications

ES-01 Burned Structure Fence

ES-10 Cultural Resource Compliance

BAR-5 Cultural Resource Compliance

Non-Specification Management Recommendations

- Park cultural resource staff and trained park staff should monitor all eligible archeological sites to detect and prevent any ARPA violations.

- The park should continue consultation with tribes on the East Troublesome Fire and should seek funding to support travel for tribes to visit the burned area. The park should provide associated tribes with a copy of the BAER plan and final cultural resources report. Tribal recommendations and concerns should be integrated as appropriate.
- [redacted]
- [redacted] g), and a fire hose wagon. Destroyed objects should be documented and de-accessioned.

References

Atkins, Ferrel. 1983. National Register of Historic Places Inventory Nomination Form. Trail Ridge Road.

Brunswig, Robert H. 2001. Report on Year 2000 Archaeological Surveys in Rocky Mountain National Park by the University of Northern Colorado. Department of Anthropology, University of Northern Colorado. Greeley, Colorado.

Brunswig, Robert H, et al. 2010. Wildland Fire Cultural Resources Management Plan for Rocky Mountain National *Park*. Center for Engaged Research and Civic Action. University of Northern Colorado. Greely, Colorado.

Heisinger, Bryan. 2020. Combined Class III Survey of Wilderness Campsites in Rocky Mountain National *Park*. National Park Service, Rocky Mountain National Park, Department of the Interior.

Larmore, Sean, Jonathan Hedlund, Abigail Sanocki, Jenny Engleman, Marcus Espinosa. 2019. Proposed Research Design: Archaeological Survey in Rocky Mountain National Park Larimer, Grand and Boulder Counties, Colorado. Prepared for Rocky Mountain National Park by ERO Resources Corporation, Denver, Colorado.

McBeth, Sally. 2007. Native American Oral History and Cultural Interpretation in Rocky Mountain *National Park*. Prepared for Rocky Mountain National Park by the University of Northern Colorado. Greely, Colorado.

Standish, Sierra. 2005. National Register of Historic Places Multiple Property Documentation Form. Trails Amendment.

Consultations

- Cheri Yost, Park Planner, Rocky Mountain National Park
- Kelly Dick, Cultural Resources Program Manager/Archeologist, Rocky Mountain National Park
- Daniel Jackson, Section 106 Coordinator, Rocky Mountain National Park
- Kelly Cahill, NPS Curator

Preparers

- Ash Phillips, NPS Historical Architect
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Wildlife Assessment

Issues

- Canada Lynx habitat
- Mexican Spotted Owl nesting habitat
- Downstream threatened and endangered species
- Golden eagle and osprey nest impacts
- Boreal Toad and Wood Frog breeding sites
- Migratory Bird Treaty Act species
- Colorado River Cutthroat Trout populations (observations of fish kill on east and west sides) and their habitat
- Sport Fisheries (observations of fish kill on east and west sides) and their habitat
- Water Quality, Mercury Release and Bioaccumulation
- River Otter and their habitat
- Elk population and effect on winter and summer range
- Moose population and effect on winter and summer range

Observations

Canada Lynx

The Canada Lynx is a federally threatened species. There are currently no ongoing projects that track lynx presence or movements in or surrounding ROMO.

A Burned Area Reflectance Classification (BARC) map was used to assess the impacts of the fire on vegetation within Lynx Analysis Units (LAUs). High severity stand replacing fire converts forests to unsuitable lynx habitat for 15-40 years following the fire event (USFS 2008). The BARC was used to estimate the acreage that is no longer suitable as lynx habitat for the Upper Colorado and Estes LAUs due to the East Troublesome Fire.

Mexican Spotted Owl

The Mexican Spotted Owl (MSO) is a federally threatened species. To assess impacts to MSO nesting habitat, a BARC map and post-fire World View 3 Imagery were used to compare changes to post-fire vegetation to nesting criteria for MSO and determine loss of nesting habitat.

Downstream Threatened and Endangered Species

Certain threatened and endangered species of the South Platte basin can be impacted by water related activities. These include the endangered Whooping Crane and Pallid Sturgeon and the threatened Least Tern, Piping Plover and West Prairie Fringed Orchid.

To assess potential impacts to downstream species, we examined the AGWA/KINEROS2 modeling framework comparing storm runoff response and erosion for both an unburned and a burned condition to get a sense of the anticipated change. In addition, the USGS provided

estimates of debris-flow likelihood, volume, and combined hazard for several design storms with a range of peak 15-minute intensities. The Debris Flow model utilizes data regarding topography (using 10m DEMs), soil burn severity, soil properties (STATSGO), and rainfall. Data from these sources was combined with information on species occurrence to assess impacts.

Golden Eagle and Osprey

Golden Eagles are protected under the Bald and Golden Eagle Protection Act. Osprey were federally listed and as a result of long-term monitoring, many nesting areas are known.

To assess impacts to nests, the area of the fire was compared to the known nests. This work was done in collaboration with the US Forest Service and Colorado Parks and Wildlife in order to understand the broader species impacts along the southwestern border of the park.

Boreal Toad and Wood Frog

The Boreal Toad is a state endangered species and the Wood Frog is a state species of concern. Known breeding sites occur in RMNP based on previous research and long-term monitoring. In addition, the Boreal Toad has been reintroduced in several areas of the park.

To assess impacts to breeding sites, the location and intensity of the fire based on soil burn severity maps and post-fire high resolution World View 3 imagery was compared to the known breeding and reintroduction sites.

Migratory Bird Treaty Act Protected Species

Birds protected under the Migratory Bird Treaty Act (MBTA) nest throughout ROMO including the areas of fire activities. To assess impacts, nesting seasons were considered and records for pre-fire surveys were consulted.

Colorado River Cutthroat Trout

The Colorado River Cutthroat Trout is a state species of concern. Locations of Colorado River cutthroat trout populations were compared with burn areas. Occupied waters were examined for burn severity using post-fire high resolution World View 3 imagery. AGWA/KINEROS2 analysis results for these streams were also used to estimate the relative increase in rate of peak flow under storm events and risk of erosion and debris flows. The USGS provided estimates of debris-flow likelihood, volume, and combined hazard for several design storms with a range of peak 15-minute intensities. The Debris Flow model utilizes data regarding topography (using 10m DEMs), soil burn severity, soil properties (STATSGO), and rainfall. Results of models were then evaluated for potential habitat impacts.

Sport Fisheries

Non-native sport fishes include Brook Trout and Brown Trout. Fishing is a popular activity with >300,000 angler days reported in the park. Observations of fish kill in non-native trout waters are as described above. Field observations for dead fish occurred in areas that could be accessed

safely and were compiled from a variety of sources (READs, adjacent landowners, firefighters, BAER team). Additional assessments using electrofishing are planned on November 20, 2020 in the lower portion of the Big Thompson River downstream of the Fern Lake Trailhead. A subset of 30 fish will be collected and analyzed by the Fish and Wildlife Service Bozeman Fish Health Center to investigate potential stressors and reasons for the fish kill.

Water Quality, Mercury Release and Bioaccumulation

USGS collected water quality information at four sites. Sites included the USGS long-term monitoring site at the Kaley Cottage Bridge and samples at three additional locations that were also sampled after the Fern Lake Fire. These three additional sites are approximately a short distance west of Kaley Bridge Site, east of Cub Lake trailhead and at Fern Lake trailhead. Each of these sites was sampled for temperature, dissolved oxygen, pH, specific conductance and major ions, total organic carbon, dissolved organic carbon, total suspended solids, total dissolved solids, turbidity, nutrients and metals (which were measured through laboratory analysis of water samples).

River Otter

River Otter are a state threatened species. To assess impacts to river otter from the fire known areas of river otter use were compared with changes to habitat resulting from the East Troublesome Fire.

Rocky Mountain Elk

Elk are an iconic species native to Rocky Mountain National Park. To assess impacts to habitat, aerial imagery, elk location data and fire perimeter information was used to assess the impacts of the fire in known areas of elk winter and summer ranges. Direct observations were also made of elk mortality near the Green Mountain Housing area.

Shiras Moose

Moose are an introduced species to the park and may impact wetland health. To assess impacts to habitat, aerial imagery, moose location data and fire perimeter information was used to assess the impacts of the fire in known areas of the moose winter and summer ranges.

Findings

Canada Lynx

Seventeen confirmed sightings of at least four different lynx occurred between 1999-2001 when lynx were introduced into the San Juan Mountains of Colorado and were actively monitored. No known lynx dens occur in the park and no credible sightings have occurred in the last five years.

Rocky Mountain National Park contains extensive suitable habitat for lynx and is managed to maintain and protect these interconnected habitat areas and connection corridors. Canada lynx and their habitat are managed based on pre-identified areas that represent the approximate home

ranges of a female lynx. These areas are called Lynx Analysis Units or LAUs. There are four LAUs shared by ROMO and the Arapaho Roosevelt National Forest and Pawnee National Grasslands (ARP). Two LAUs, the Upper Colorado LAU and the Estes LAU were impacted by the East Troublesome Fire. The habitat management threshold for LAUs is to maintain >70% of habitat in a suitable condition for Canada Lynx (USFS 2008).

Initially, a habitat impact map was created by using the BARC map. Based on this mapping, two acres of the Upper Colorado and 16 acres of the Estes LAU burned at high severity indicating stand-replacing fire. However, large areas of inconsistency were evident on the BARC image which were reflective of cloud cover and from a recent snow event over the fire area on October 24th. The result was that large burned areas were misidentified as unburned areas. The acreage impacted by the fire in each LAU as listed above, is inconsistent with actual field observations and post-fire imagery that indicate much larger impacts to habitat. In order to account for the inconsistencies in the BARC map, post-fire high resolution World View 3 Imagery will be used to estimate acres converted to unsuitable habitat. Analysis with the imagery has not been completed but we anticipate hundreds and more likely thousands of acres in each LAU were converted to unsuitable habitat.

Mexican Spotted Owl

Mexican Spotted Owls are unlikely to occur in the park. There are no known sightings from any of the surrounding counties and the nearest confirmed nest is near Deckers, CO which is south of Interstate 70. Fire impacts and suppression activities occurred outside of nesting season when owls are mobile and are not tied to their nest site. It is unlikely that fire activities directly impacted MSO. Breeding season for MSO in ROMO is from April 1 to August 31.

[redacted] High-severity burns have negative, long-term effects on MSO nesting habitat (Franklin et al. 2000). Analysis of the BARC map compared [redacted] owever, large areas of inconsistency were evident on the BARC image which were reflective of cloud cover and from a recent snow event over the fire area on October 24th. The result was that large burned areas were misidentified as unburned areas. In order to account for the inconsistencies in the BARC map, high resolution post fire World View 3 Imagery was compared to nesting habitat to better represent actual changes in habitat condition. Based on this comparison it appears that little to no habitat was impacted by stand replacing fire.

Due to safety concerns, no nesting sites were accessed on the ground to verify imagery.

Downstream Threatened and Endangered Species

Watershed modeling indicates there will be little change to South Platte species downstream of the Thompson Zone of the East Troublesome Fire. Much of the area in the Thompson Zone burned at low soil burn severity which will reduce erosion and potential for debris flows. There will be some predicted increase in flows due to removal of overstory vegetation. When modeled for a 5-year, 1-hour storm event, Beaver Brook flows increased by 31% and the Big Thompson

River has a 13% increase. In Beaver Brook, erosion is not expected to increase due to the limited amount of burn area and highly vegetated alluvial valley. Erosion in the Big Thompson is the result of increase flows rather than hillslope erosion. There could be 5.6 to 23.6 magnitude change in erosion depending on the storm intensity return period. The only area with a higher level of debris flow hazard is above the Spruce Creek Drainage. Any decrease in water quality due to increased erosion, changes in pH, mercury or other contaminants or debris flow events is expected to settle out or become diluted prior to reaching downstream threatened and endangered species habitat.

Bald Eagle, Golden Eagle and Osprey

Colorado Parks and Wildlife recommends seasonal restrictions to human encroachment within ½ mile radius of active golden eagle nests from December 15 through July 15. For osprey, the recommended seasonal restriction to human encroachment is within ¼ mile radius of active nests from April 1 through August 31. It is unlikely that fire or associated suppression activities impacted golden eagles or osprey since fire activities occurred outside of the critical nesting season.

After reviewing the fire perimeter and nest locations, it appears that no nests in RMNP were directly impacted by the East Troublesome Fire.



Boreal Toad and Wood Frog

Toads typically enter hibernacula in late September or early October, prior to the East Troublesome Fire expanding into the park. The ground insulation from penetrating heat likely protected hibernating toads unless the fire burned at high severity for extended periods of time or fire followed tree roots and stumps below ground level. Specific hibernacula for breeding sites are not known but believed to be near breeding sites.

The [redacted] is within the perimeter of the burn; however, it appears that the breeding site did not experience high severity, stand replacing fire. It is unlikely that toads at this breeding site were impacted.

The [redacted] is within the perimeter of the burn and nearly all nearby areas burned as stand replacing fire. It appears that fire burned to the water's edge on the south and east sides of the breeding pond. However, soil burn severity mapping shows the breeding site at low severity which indicates few impacts were observed >1 inch below the soil surface. Impacts to toads at this site are unlikely unless fire followed tree roots and stumps below ground level. Reduced cover from vegetation during breeding season in the spring of 2021, prior to new

growth, may increase mortality from predation.

[redacted]. Like boreal toads, wood frogs were probably hibernating when the fire occurred. Wood frog sites were situated within the Kawuneeche Valley. This area burned intensely but quickly as a wind-driven fire through riparian areas. The soil burn severity was low and it is unlikely that hibernating frogs were impacted. The loss of vegetative cover may increase predation in the spring of 2021 prior to regrowth.

Migratory Bird Treaty Act Protected Species

No comprehensive survey for nests occurred in fire areas prior to the fire and associated suppression activities. Nesting season for MBTA protected species ends by September 30. Fire and suppression activities occurred outside of nesting season and therefore, it is unlikely that there were any impacts to migratory birds.

Colorado River Cutthroat Trout

The Colorado River Cutthroat Trout is a State Species of Concern. This sub-species of trout is comprised of three different lineages. Both the blue lineage and green lineage are found on both sides of the park. Several populations and lineages were impacted by the East Troublesome Fire on both the Grand and Thompson Zones.

On the west side of the park (Grand Zone) the East Troublesome Fire perimeter included Colorado Cutthroat Trout populations in a small section of Ptarmigan Creek from War Dance Falls to Bench Lake (blue lineage, low severity), an additional small section of the creek in a spot fire (blue lineage, low severity) and the edge of Bench Lake (blue lineage, low and moderate severity). All areas are within the North Inlet drainage. AGWA modeling indicates that during a 1-hour, five-year storm event of 1.03" precipitation, there will be <100% increase in peak flows for these populations and a 1,000-3,000 percent increase in hillslope erosion near Bench Lake and Ptarmigan Creek below the lake to War Dance Falls.



Colorado River fish kill at Onahu Creek Confluence

The BAER team and two private landowners, one at the confluence of North Inlet and Tonahutu Creek, and one at the confluence of the Colorado River and Onahu Creek, observed and sent photos of dead fish. These fish kills were not investigated or quantified. In a nearby cutthroat stream, Trail Creek, on Forest Service lands only carcasses were found post-fire in an electrofishing effort to find and salvage live fish (none found). It is unknown whether the westside Colorado River cutthroat trout populations suffered similar mortality events. Current status of these populations remains unknown. If they did survive the direct and immediate impacts of the fire, there is likely little future threat to these populations.

On the east side of the park (Thompson Zone), Colorado River cutthroat trout populations likely impacted by the fire include Fern Lake and Creek (green lineage, moderate to high severity fire on northwest and northeast sides of the lake and in Fern Creek) and Spruce Lake (green lineage, low severity on eastern side of the lake, unburned on the western side). At Fern Lake, the bridge that crosses the primary spawning area at the outlet burned and there was noticeable ash at the edge of the lake.



Fern Lake Spawning Outlet, looking Northwest (left) and Southeast (right)

AGWA modeling indicates that during a 1-hour, five-year storm event of 1.23" precipitation, there will be <100% increase in peak flows for all three of these populations and a 1,000-3,000 percent increase in hillslope erosion. There is also a location above Spruce Creek that has a 60-80% chance of a debris flow during a 15-minute, 24 mm/hr precipitation event. The location of the debris flow hazard is not expected to impact Spruce Lake directly or upstream nor cause impacts to the Colorado River cutthroat trout population.

Observations by the READ team on November 2 and 3, 2020 observed no live fish in the Fern Lake outlet or downstream until 100 meters upstream of the Cub Lake trailhead bridge in Moraine Park. Thousands of dead brook and brown trout were observed between the Cub Lake trailhead and approximately one mile west of the Fern Lake trailhead. The cause of these fish

kills is unknown but suspected as a combination of direct heat and high levels of ash deposited in these waters. The observations of known mortality within one mile of the downstream extent of the Fern Creek Colorado River cutthroat trout population, could indicate significant impacts to the Fern Creek population. No dead Colorado River cutthroat trout were directly observed. Fern Creek is more at risk for fish kill events than Fern and Spruce Lakes which have more heat buffering and dilution.

Ongoing threats to these populations include changes to both Fern and Spruce Lakes at outlet areas used for spring spawning. The fire may have changed outlet characteristics and deposited ash on spawning gravels and throughout the lakes. Ash and other debris deposited during the fire or during winter wind events that are likely to topple fire weakened trees, may further change these characteristics.

The current status of eastside Colorado River cutthroat trout populations is unknown. There are future threats to these populations as a result of the East Troublesome Fire.



Big Thompson fish kill, brown trout upstream of Cub Lake Trailhead

Sport Fishing

Sport fishing is a popular activity in the park with >300,000 angler days per year. Many popular fishing areas are in the lower elevation meadows (Kawuneeche Valley - Colorado River, Moraine Park – Big Thompson River) that were impacted by the fire and contain non-native trout species. Fish kills were reported in the Colorado River, North Inlet, Tonahutu Creek and Big Thompson River. The fish kill in the Big Thompson River was extensive with thousands of dead fish documented in a 2-mile section of the river with no live fish observed in 4 miles of streams including the Big Thompson River and Fern Creek. There was no investigation of the fish kills on the west side of the park and the full extent and distribution of all fish kills related to the fire is unknown.



Big Thompson River fish kill, brook trout (left), brown trout (right)

Electrofishing surveys of the Big Thompson River are scheduled for after the report deadline and cannot be included here but will inform future fisheries management decisions. Similarly, samples collected and submitted to the FWS Bozeman Fish Health Center will provide additional data on fire impacts to sport fisheries.

In addition to the immediate impacts of the fire, future threats to sport fishing areas exist. On the east side impacts during a 1-hour, five-year storm event with 1.23" precipitation, will be limited to erosion and sedimentation due to increased peak flow. Peak flow is estimated at less than 100% above baseline in all but one tributary that will have an increase between 100-300%. Erosion could increase by a 5.6 to 23.6 magnitude change depending on the storm intensity return period.

By contrast, on the westside of the park, there are significant impacts anticipated during a 1-hour, five-year storm event with 1.03" precipitation in the Green Mountain and Tonahutu drainages, with lesser impacts in the North Inlet. Approximately 89% of the Green Mountain watershed burned with moderate soil burn severity. At Green Mountain Trailhead, models show a potential for a 1,972% peak flow increase, or a magnitude change of 20.7, which has the potential to deliver floating debris and sediment into the Colorado River. Large changes in erosion are possible from both peak flow and hillslope erosion events that are modeled to increase by 10,000 – 36,000% over baseline conditions.

In Tonahutu Creek, the mainstem of the creek and most tributaries will have a peak flow increase of <100% above normal while two tributaries will have an increased peak flow of 1,000 – 2,300%. Erosion within the drainage is modeled to increase by 3,000 – 36,000% dependent upon location but encompasses the entire stream reach from near the headwaters to the confluence with the North Inlet.

In the North Inlet, the mainstem and most tributaries will have a peak flow increase of <100% above normal while four tributaries will have an increased peak flow of 100 - 1,000%. Erosion increases are modeled to only impact about half of the sub drainages within the lower 2/3 of the North Inlet. Erosion is modeled to increase between 1,000 and 36,000% depending upon the stream reach.

Increased sedimentation is expected to fill in pools reducing or eliminating overwinter habitat and cover spawning gravels. These habitat changes are anticipated to reduce survival and reduce or eliminate recruitment in impacted stream reaches.

Water Quality, Mercury Release and Bioaccumulation

Initial data was collected but results are pending and unavailable.

River Otter

The [redacted] River otter surveys have been conducted on a regular basis since 1989 [redacted]. All

areas have supported otters and had sign or evidence of otters using these areas in the past. Over time, the density of otters in the park has decreased overall and the density of river otters change seasonally with more otters in the park in the spring and less in the fall. In 2018, [redacted] otter estimate [redacted]. The decreased density of river otters in the park has coincided with an increase in river otters downstream outside of the park, where they may be finding more favorable habitat and a larger prey base.

The primary diet of river otters is fish. Fish kills were reported in most of the waters in the burned area typically [redacted] Dead fish were reported both upstream and downstream of [redacted], but it is unclear whether any of these fish were killed and transported from [redacted]. Although the primary diet of river otters is fish, they can prey on many other aquatic and terrestrial food sources and are opportunistic in their diet.

River otters are also highly mobile as demonstrated by their ephemeral use of the park. There were no observations of direct mortality as a result of the fire. Assuming river otters in the park survived the direct effects of the fire, they are likely to redistribute to areas either upstream or downstream in the Colorado River outside of the burn area with intact fish populations. With few river otters in the park at the time of the fire impacts to river otter from the fire are likely low.

Rocky Mountain Elk

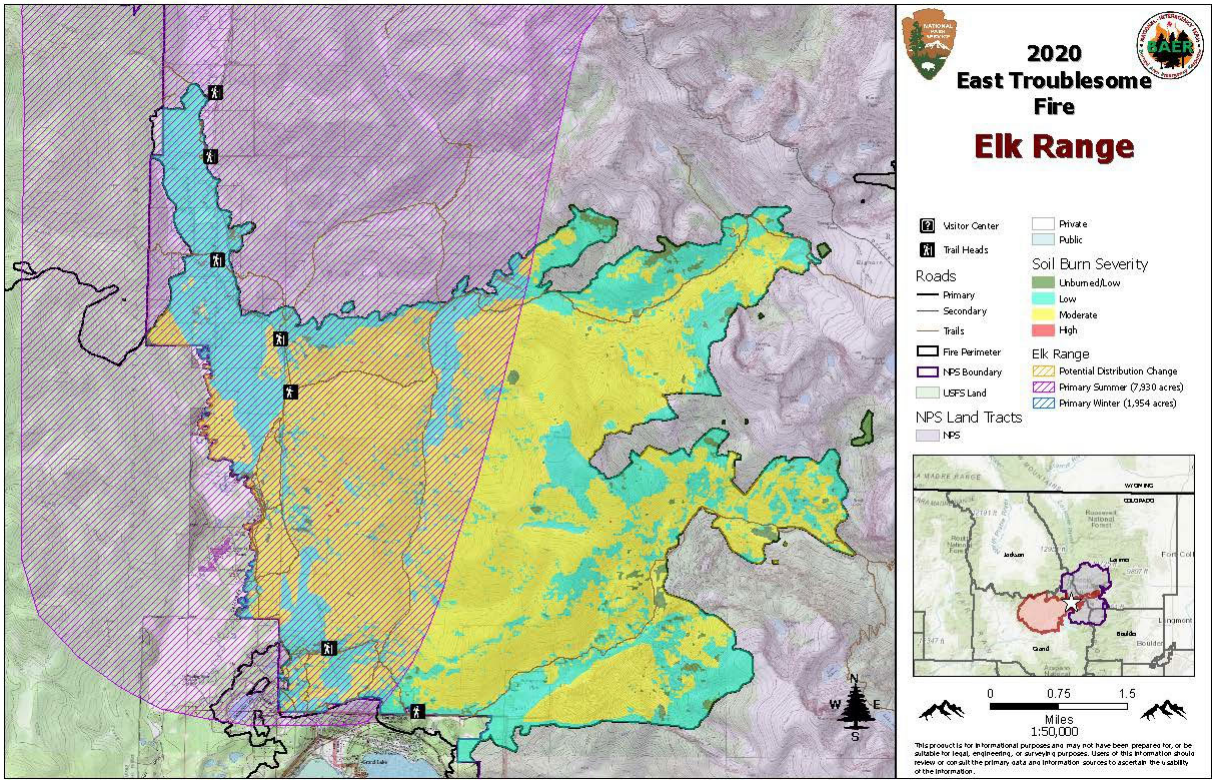
Elk were reintroduced to the Estes valley in 1913 and 1914, following their extirpation by market and subsistence hunting. Under the protection of the park and in the absence of predators, the elk population grew unchecked for decades, resulting in the highest density of free ranging elk every recorded, on the elk winter range. Over the last 12 years, the park's elk population has been the focus of long-term park management summarized in the Elk and Vegetation Management Plan (2007). The objective of the plan is to restore a healthier balance between elk and the habitat they use, while maintaining elk viewing opportunities, one of the most sought out visitor activities in the park. The winter range population size is currently under the objective of 600-800 elk utilizing the winter range, as outlined by the EVMP, and is also lower than the 200-800 animals estimated to utilize the winter range in a system with a complete suite of predators. The median of the marginal posterior distribution of the number of elk using the park during winter 2019 - 2020 based on our population model was 98 (HDI = 40, 165) (Hobbs and Abouelezz, 2020). The cow/calf ratio for the same winter was approximately 0.425. Fecundity has increased from 0.26 calves per cow in 2013, however, not enough to produce stable or positive population growth. Prevalence of chronic wasting disease are higher than surrounding populations, with a recent estimate derived from live rectal biopsy sampling and post-mortem lymph tissue sampling of collared elk estimates the east side park elk population at 6.5% (CWD prevalence = 0.065 (credible interval 0.025-0.098; Galloway Pers. communication). Summer range population size was estimated using data from fixed wing infrared surveys conducted in 2019 and 2020. Median summer population size was estimated at 1490 animals (Hobbs and Abouelezz, 2020), however these surveys were designed for moose, and error estimates are too wide (HPD low 762 – HPD high 2660) to have confidence in this median elk estimate without additional survey data.

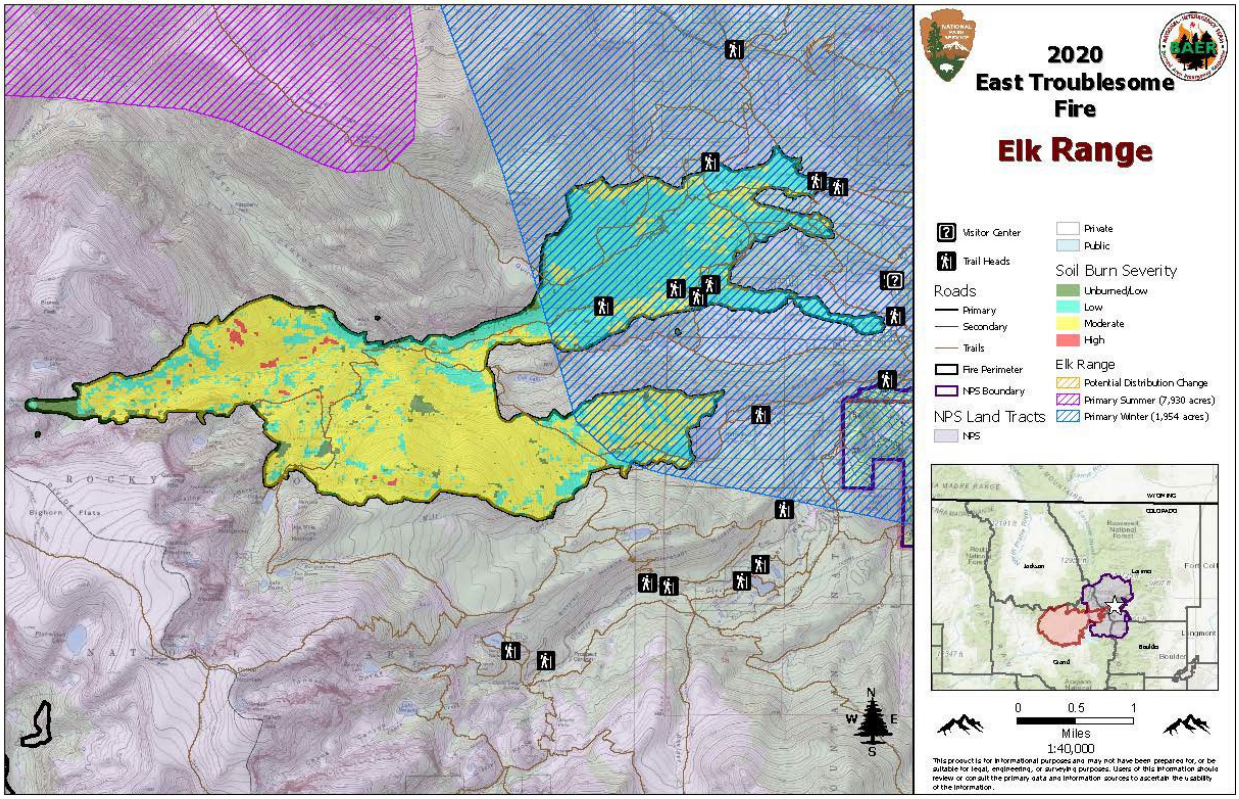
Elk winter and summer ranges have been delineated using elk location data, helicopter survey data and ground survey data and are described in the EVMP (2007). Elk winter range is on the

east side of the divide and includes burned areas in Moraine Park, Upper Beaver Meadows, the North Lateral Moraine and South Lateral Moraine, and the Fern Lake drainage. Elk summer range is largely in the tundra and the west side of the park and includes burned areas in the Kawuneeche Valley and timbered slopes that border the valley to the east and west.

Short term habitat impacts in the Grand Zone include loss of thermal cover and the loss of willow forage. A portion of the elk that summer in the Kawuneeche Valley are part of the East Troublesome herd and move to winter range in areas burned by the East Troublesome Fire outside of the park. As such, this herd may suffer short term reductions in carrying capacity. Longer term impacts will likely increase carrying capacity, as grasses and forbs regenerate and the forest floor increases in productivity, creating newly available habitat in what was previously lodgepole beetle kill.

Short term habitat impacts in the Thompson Zone include loss of thermal cover and loss of forage in Moraine Park and Upper Beaver Meadows. Suitable habitat is still available to elk in Horseshoe Park, portions of Moraine Park and Upper Beave Meadows. Elk that utilize areas in the Thompson Zone are largely from the St. Vrain herd and also have their winter range impacted by the Cameron Peak and CalWood fires in the near term. However, beyond 18 months, carrying capacity should increase as grasses and forbs recover and thrive (Bergman, Pers. Communication).





Direct impacts were observed in the form of mortality. A small group of elk, number unknown, was caught in the fire in the Kawuneeche Valley, south of the Green Mountain housing area. A carcass count was not able to be completed. Low levels of direct elk mortality from the fire was also reported outside of the park by Colorado Parks and Wildlife staff.

Shiras Moose

A Shiras moose population was established in Colorado, by Colorado Parks and Wildlife via a series of introductions that began in the late 1970s. Moose were first observed in Rocky Mountain National Park in 1980 (Stevens 1988) and have since expanded their range to suitable habitat on both sides of the continental divide. Moose use wetland habitat extensively, with over 91% of their summer diet comprised of willow species (Dungan et al. 2005). With willow declining in the park and moose populations increasing, the park initiated a study of moose movements, habitat selection, abundance and demographics in 2017 for the purpose of informing carrying capacity and future management actions.

Moose density was estimated in July of 2019 and again in July of 2020 utilized fixed wing infrared survey. Preliminary analysis estimates moose population density at 0.216 (2019) and 0.207 (2020) within the study area (Hobbs and Abouelezz, 2020), which includes both the Grand and Thompson Zones of the fire. Moose winter and summer range have not yet been delineated in the park, as this is the focus of ongoing work, and so summarizing a percentage of the moose summer and winter ranges that burned is not possible at this time. Moose exhibit mixed migratory behavior, where they move within a relatively small home range and up and down

elevational gradients within that home range in response to forage availability, temperature and the availability of thermal cover. Some areas in the home range are used largely during the winter, some largely during the summer, and some areas may be used in both seasons and during times of transition. There is more variation in habitat selection across individuals than is seen in other local ungulate species.

Preliminary analysis of GPS collar locations (Abouelezz, unpublished data), show that moose in the Grand Zone heavily utilize willow and sedge dominated habitat in the Kawuneeche Valley during the summer and move up in elevation to high elevation wet meadows and subalpine forests during the winter. The willow carr along Onahu Creek, in the vicinity of Green Mountain housing, burned entirely, as did much of the willow along the Colorado River around the Betty Dick inholder property. Both of these areas held high concentrations of moose and may have served as calving and nursery locations for cows and their calves. Moose rely heavily on forested slopes adjacent to wetlands for thermal cover during diurnal periods. The large scale of the burned area on the west side may cause animals to select habitat differently in the short term, as they seek out thermal cover and available forage. However, moose thrive in early successional forest, and should benefit from the increased productivity that will occur as native seed in the forest floor respond to increases in sunlight through an open canopy. This may increase moose carrying capacity over time.

Moose in the vicinity of the Thompson Zone utilized burned areas around Fern Lake, Cub Lake and associated drainages. Animals also utilize upland shrub habitat in the spring in burned areas in Upper Beaver Meadows and Moraine Park. The quantity of habitat burned on the eastern portion of the fire is limited, and moose with home ranges in this area have ample suitable habitat available to them in the Fall River drainage, Glacier Creek drainage, and Endovalley. Animals may avoid the burned area in the short term and then capitalize on new growth within 18-24 months.

A review of 30 collared moose in and around the fire area shows that most animals were able to make short distance movements and escape the path of the fire. Some GPS collars stopped transmitting during periods of heavy smoke, but all but one have come back online. The currently status of one adult cow (A1) in unknown and is a suspected mortality. She last transmitted a location on the northeast side of Mount Patterson on 10/22/2020, in the path of the fire as it moved upslope and spotted over the divide.

Specifications

Non-Specification Management Recommendations

Canada Lynx

After the fire, create a revised habitat impact map with the USFS to determine expanded unsuitable habitat from the wildfire impacts. Then, add the East Troublesome Fire unsuitable acreage to the previous unsuitable acreages from other activities prior to the fire. If there is less than 70% suitable habitat in LAUs for Canada Lynx, consult with USFWS and plan or adjust future projects to minimize habitat loss.

Mexican Spotted Owl Nesting Habitat

Remote sensing indicates [redacted]. Habitat maps should be updated to include post-fire changes in nesting habitat.

Downstream Threatened and Endangered Species

No recommended actions.

Golden Eagle and Osprey Nest Impacts

Continue to partner with the USFS and CPW to monitor nests and share data.

Boreal Toad and Wood Frog Breeding Sites

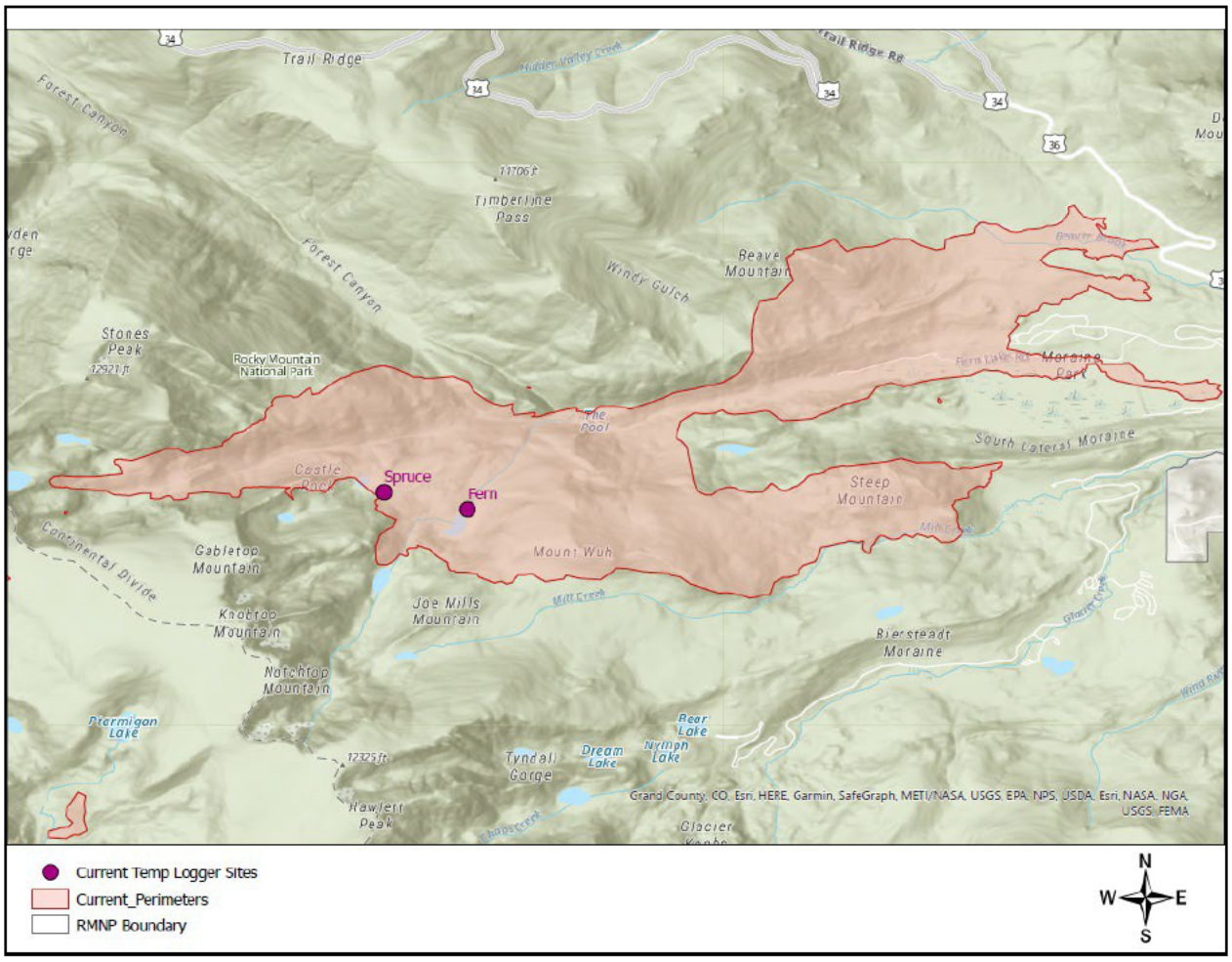
Conduct a full suite of breeding site visits for boreal toads at [redacted] for up to three years post-fire. If boreal toad populations were lost due to fire, consider reintroduction to re-establish these breeding sites.

Wood frog sites were not monitored pre-fire. Visit a subset of sites post-fire to confirm continued presence of wood frogs using visual encounter surveys. If no evidence of wood frogs is found, consider implementing a larger scale formal research study to determine post-fire abundance and distribution of wood frogs [redacted].

Migratory Bird Treaty Act Species

During BAER activities, survey for active nests and if found protect nests from destruction until young fledge and nests are no longer used. This includes dead trees and snags that may be used by cavity nesting species.

Colorado River Cutthroat Trout Populations

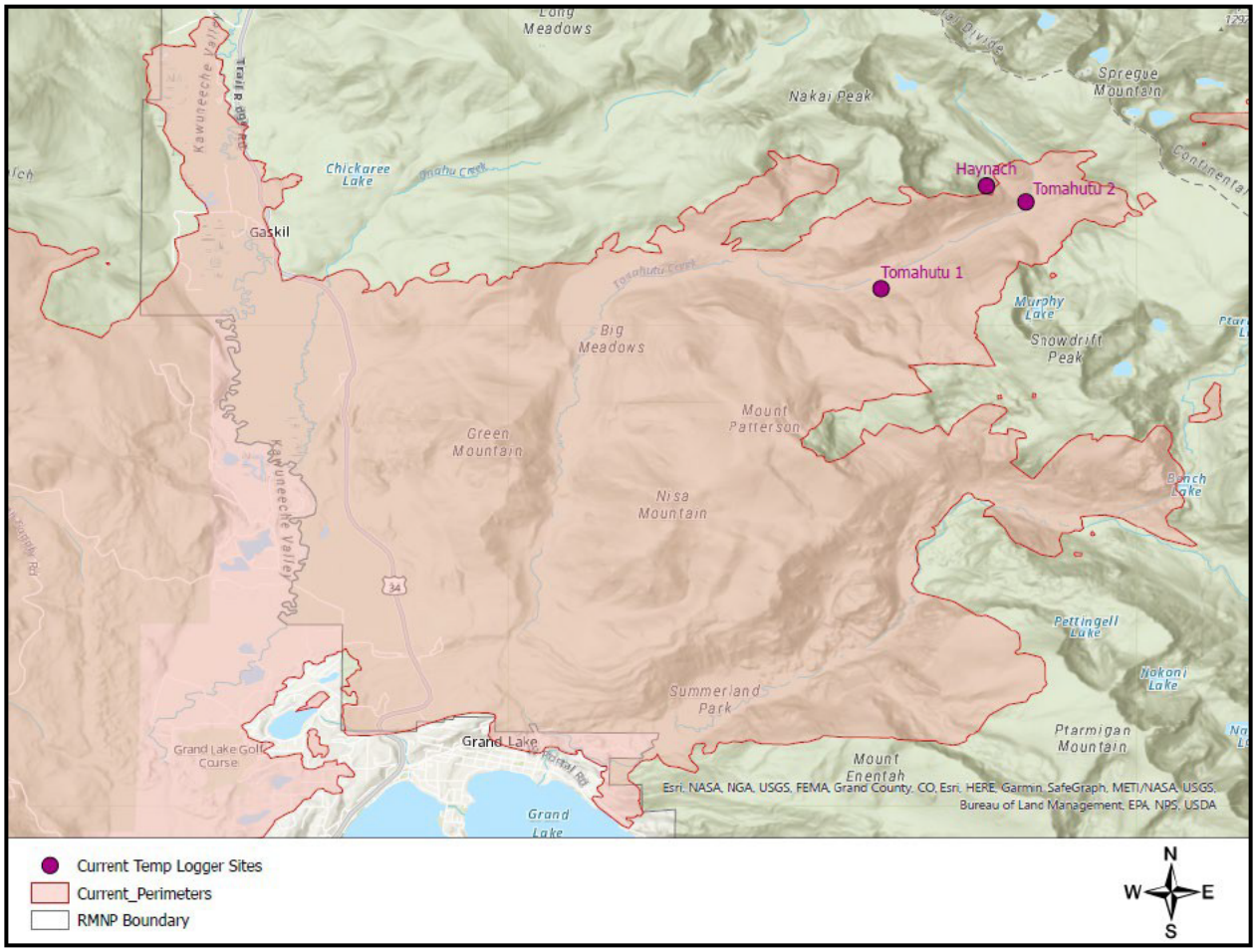


1. Continue to monitor and replace the two thermographs in Colorado River cutthroat trout habitat in the East Troublesome Fire. Long-term thermographs (USFWS – Chris Kennedy) are located at the outlets of Spruce and Fern Lakes.

2. Analyze data from five thermographs (2 shown above and 3 shown below in sport fishing populations) active during the East Troublesome fire using Roberts et al (2013) M30AT metric[1]. Temperature data in combination with previously taken stream measurements, post-fire fish survival and burn severity maps can inform under what circumstances fish populations are

[1] The M30AT is the mean of the average daily water temperature for the warmest 30 consecutive days in a year. M30AT is a measure of how well a stream can support cutthroat trout growth and recruitment. An annual M30AT below 8°C indicates that there will not be recruitment, between 8 and 9 °C there will be limited recruitment, and between 9.1 and 18 °C is optimal for growth and recruitment, 18.1-19.9 °C can reduce growth and temperatures in excess of 20 °C can stop growth of cutthroat trout.

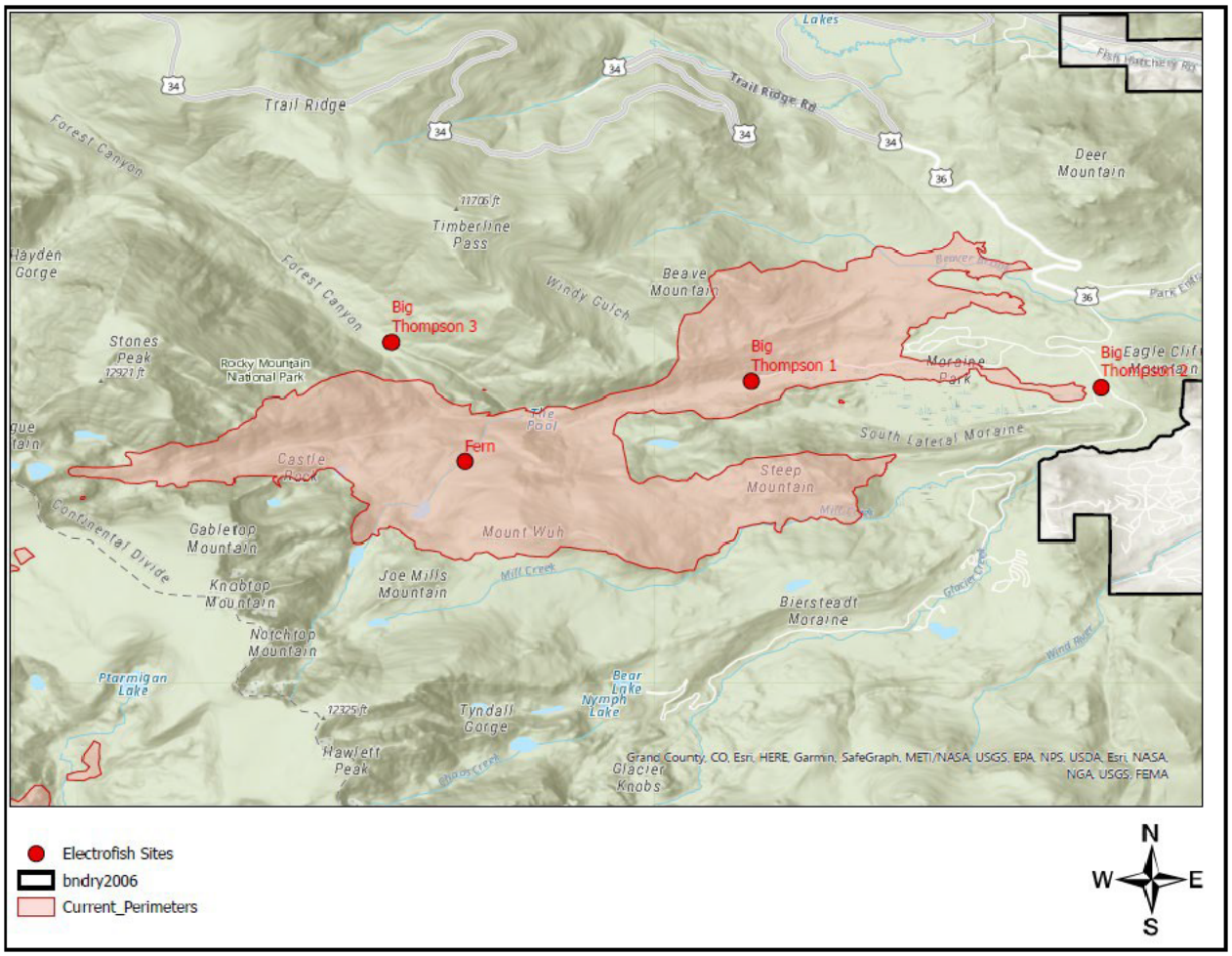
threatened by fire conditions and may need to be rescued and protected in advance of wildfires.

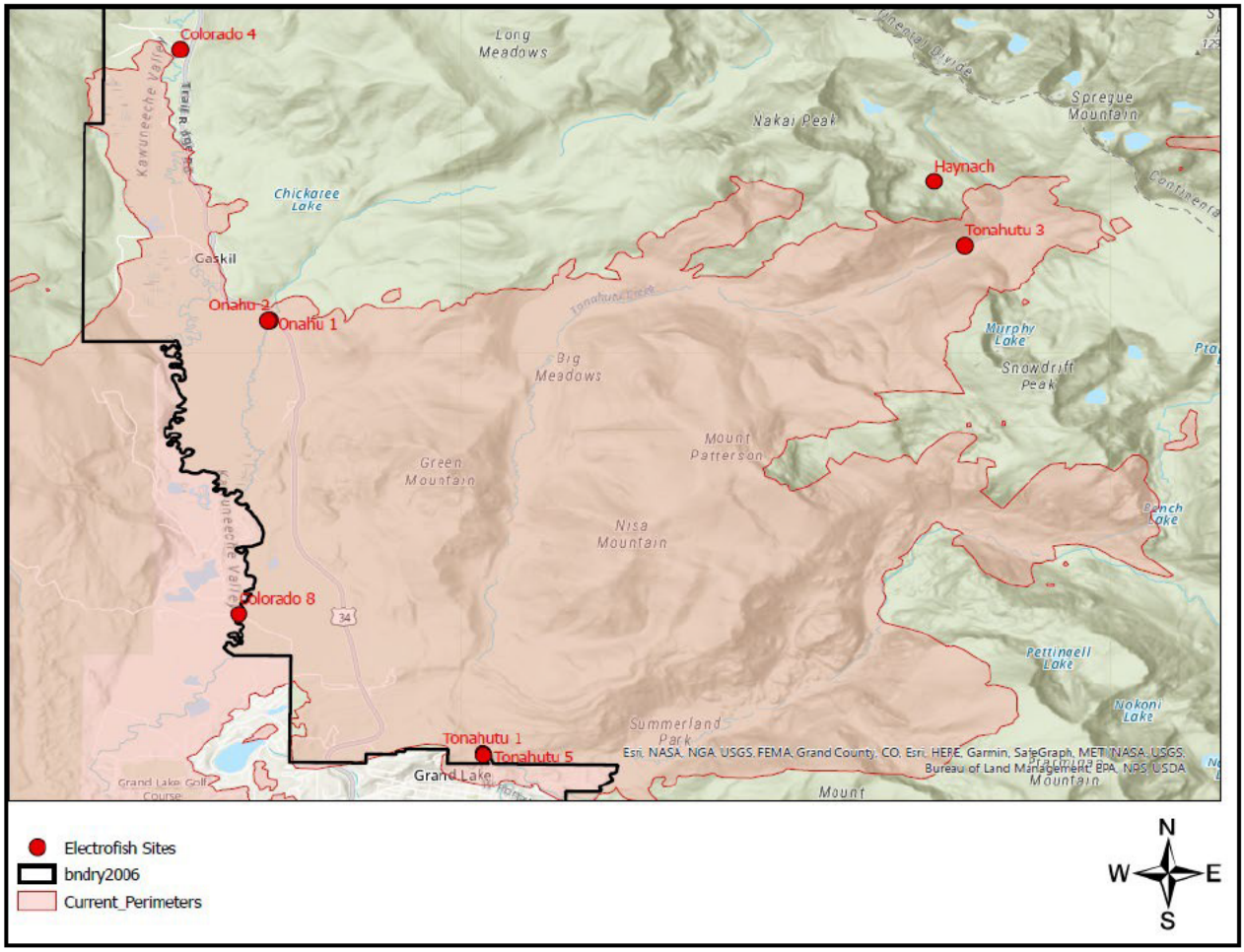


Existing temperature loggers at Tonahutu Creek and Haynach Lakes

3. Conduct post-fire population monitoring in previously monitored sites in Fern, Spruce and Bench Lakes and Fern and Ptarmigan Creeks using capture-recapture in lakes and multi-pass electrofishing depletion in streams. Verify fish presence and if fish are encountered, compare population numbers and size classes with pre-fire numbers and track changes during initial post-fire years to look for changes due to impacts to habitat or other factors. Consider fishing closures if fish populations are low to allow for recovery of the populations. If fish are not encountered, consider reintroducing native cutthroat trout lineages appropriate to each drainage. Prior to reintroductions, post-fire stream chemistry should be collected, analyzed and compared to data of known fish health thresholds. Specific parameters of concern are pH and mercury, which can change following fire events. Communicate any changes in population status to the Colorado River Cutthroat Trout Conservation Team.

4. Evaluate the condition at inlet/outlet spawning areas in Fern, Spruce and Bench lakes. Monitor fine sediment deposition on spawning gravels and changes in pool depth in Fern and Ptarmigan Creeks. Sediment inputs can occur from exterior sources (e.g. slope debris flows) or from interior sources (e.g. bank erosion due to loss of streamside vegetation or increased stream velocity and flows). Increased sediments are of concern because they can deposit on spawning gravels rendering large areas of stream unsuitable for spawning. Depth and area of pools can decrease through sediment deposition reducing their use or capacity to serve as overwinter habitat.





Existing electrofishing trend sites in the Colorado River, Onahu Creek, Haynach Lakes and Tonahutu Creek

Sport Fisheries

1. Continue to monitor and replace the three thermographs in and near the East Troublesome Fire sport fisheries areas. Long-term thermographs (USFWS – Chris Kennedy) are in the Haynach Lakes Drainage and two thermographs in Tonahutu Creek.

2. Conduct population monitoring at eleven electrofishing sites in and near the East Troublesome Fire. In the Thompson Zone there are 3 sites in the Big Thompson River. In the Grand Zone there are two sites on the Colorado River, two sites on Onahu Creek, one site at Haynach Lakes and three sites along the Tonahutu Creek. Six of these 11 sites are near areas of reported fish kills following major fire activity. Verify fish presence and if fish are encountered, compare population numbers and size classes with pre-fire numbers and track changes during initial post-fire years to look for changes due to impacts to habitat or other factors. Consider fishing closures if fish populations are low to allow for recovery of the populations. If fish are not encountered,

consider reintroducing native cutthroat trout lineages appropriate to each drainage. Prior to reintroductions, post-fire stream chemistry should be collected, analyzed and compared to data of known fish health thresholds. Specific parameters of concern are pH and mercury, which can change following fire events. Additionally, monitor habitat quality (spawning gravels, pools and temperature) prior to reintroductions.

Water Quality, Mercury Release and Bioaccumulation

Consider water quality parameters prior to reintroductions. If there is evidence of elevated mercury, consider testing fish to evaluate whether mercury levels are appropriate for human consumption. Adjust fishing regulations as necessary based on findings.

River Otter and their Habitat

Continue long-term river otter monitoring. Compare post-fire densities and distribution with pre-fire data.

Rocky Mountain Elk

1. In 2016 and 2017 the park worked with Colorado Parks and Wildlife to GPS collar 55 animals in the East Troublesome elk herd. 14 of those animals were collared in the Kawuneeche Valley. At this time, only a handful of collars are still functioning, with none remaining in the valley at the time of the fire. Work with CPW to determine if this small number of animals can provide information on changes in movement patterns or space use pre and post fire.
2. Explore the possibility of partnering with CPW to GPS collar additional elk on the west side of the park. The East Troublesome herd, a portion of whom summer in the Kawuneeche Valley, also winter in areas burned outside of the park. Their entire annual range has been impacted by fire. Location based monitoring would provide information on range shifts following a large fire event.
3. Explore the possibility of GPS collaring a small sample of elk in a variety of elk subgroups that utilize the elk winter range to determine if elk ranges shift as a result of the Thompson Zone. This information would be used to inform areas sampled during elk winter ground surveys, the data from which is utilized to model overwinter elk population size in the park. Aerial helicopter survey could also be used in lieu of GPS collars to acquire this information. The park has intended to fly helicopter surveys every 3-5 years to ensure that ground count surveys are still accurate. The last helicopter surveys were conducted over the winter of 2014/2015.

Shiras Moose

1. Continue to collect data from the 30 GPS collared moose in and around the burn area over the next 2-3 years. This will provide a robust dataset or pre-fire and post-fire locations which can be used to compare habitat selection and space use prior to and after the fire event.
2. Closely follow up on moose mortality signals so that the carcass can be visited within 24-

48 hours of mortality. This would allow for detailed necropsy and sampling to occur to determine the cause of death and if nutritional deficiencies may be contributing.

3. Utilize VHF tracking of collared cow moose to continue collecting calving information post fire. This may allow comparison to moose productivity pre-fire.
4. The park is currently in the beginning stages of developing a carrying capacity model for a portion of the park, which includes both the Thompson Zone and Grand Zone of the East Troublesome fire. The large area fires will alter habitat quality and quantity information that will be utilized to inform carrying capacity estimates for moose inside the park. Work with Tom Hobbs at Colorado State University and ungulate scientists at Colorado Parks and Wildlife to determine the potential carrying capacity impacts of the fire on moose and incorporate this new information into the modeling.

References

Ben-David, M. 2018. Population survey for river otters in Rocky Mountain National Park: A progress report for 2018. 12 pgs.

Dungan J.D. and R.G. Wright. 2005. Summer diet composition of moose in Rocky Mountain National Park, Colorado. Alces 41:139–146

Flanagan, D.C., and M.A. Nearing (eds.). 1995. USDA-Water Erosion Prediction Project (WEPP) Hillslope Profile and Watershed Model Documentation. NSERL Report No. 10, National Soil Erosion Research Laboratory, USDA-Agricultural Research Service, West Lafayette, Indiana.

Franklin, A.B., and R.J. Gutiérrez. 2002. Spotted owls, forest fragmentation, and forest heterogeneity. Studies in Avian Biology 25:203-220.

Hobbs NT, Abouelezz HA. 2020. Annual Report 2019 -2020: Modeling in Support of Adaptive Management of the Rocky Mountain National Park Elk Population. Unpublished report to Rocky Mountain National Park. 14 pgs.

Hobbs NT, Abouelezz HA. 2020. Progress Report: Models and Data for Predicting the Abundance of Moose and Elk on Summer Range in Rocky Mountain National Park. Unpublished report to Rocky Mountain National Park. 6 pgs.

NPS. 2008. Record of Decision: Final Elk and Vegetation Management Plan at Rocky Mountain National Park. Intermountain Region.

Roberts JJ, Fausch KD, Peterson DP, Hooten MB (2013) Fragmentation and thermal risks from climate change interact to affect persistence of native trout in the Colorado River basin. Global Change Biology, 19, 1383–1398.

Stevens, D.R. 1988. Moose in Rocky Mountain National Park. National Park Service Report. 14 pgs.

USFS. 2008. Southern Rockies Lynx Amendment Record of Decision: USDA Forest Service. Lakewood, Colorado. 78 pgs.

Preparers

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Recreation Asset Assessment

Issues

- Facilities in the burned area include Moraine Park Campground and a variety of wilderness facilities on both sides of the park, including trails, trail structures such as puncheon and check logs, trail bridges, designated wilderness campsites, privies, hitchracks, an administrative ranger camp, and numerous wayfinding signs.
- Much of the Continental Divide Trail (CDT) occurring within the park lies within the burn perimeter and may require temporary reroutes.
- Hazard trees pose a risk to human life in the vicinity of some of these facilities.
- A motorized use corridor in the Colorado River District has wooden fencing to confine snowmobile use to the corridor and provide for natural resource protection.
- The fire damaged traffic signs and signs are needed to inform public of fire-induced hazards. These are public safety and resource protection signs.

Observations

Moraine Park Campground was directly observed and photographed after the fire.

The assessment of potential fire damage to wilderness trail and campsite infrastructure in the burned area was conducted using a combination of techniques. Safety of staff due to continued high wind events made for small windows to complete lower drainage assessments in the field. BAER Team members assessed the North Inlet Trail from the trailhead to Cascade Falls on Nov. 11, 2020 and the Green Mountain Trail to Big Meadows and then southward down the Tonahutu Trail to the trailhead on Nov. 12, 2020. Weather conditions prohibited fieldwork on Nov. 14-15. Park staff assessed the Big Meadows to Haynack Lk trail junction on Nov. 16, and BAER team with park staff surveyed the Fern Lk trailhead to Odessa Lk on Nov. 17. Although snow cover existed over most of these trails, fire impacts were observed. Separately, satellite imagery both before and after fire activity was reviewed to determine the condition of some locations. Due to snow cover at the time of BAER plan creation the BARC data was not reliable for use in assessments. Geo -tagged photographs from firefighters in the field were also used for some locations.

The following tables list the infrastructure within the burn perimeter that are included in this assessment.

Moraine Park Campground Infrastructure

The campground includes one ranger station/housing building, a pumphouse/maintenance building, 1 sanitary disposal station, and a woodshed for firewood sales. Five campsite loops exist, with the following facilities:

Location	Campsites	Bathrooms	Other
Loop A	134	4	5 water stations, 2 solar showers

Loop B	55	2	2 water stations
Loop C	22	2	2 water stations, 1 amphitheatre
Loop D	29	1	1 water station
Loop E	11	1	1 water station

Wilderness Trail Infrastructure

Approximately 31 miles of trail are within the burn perimeter on the Colorado River District (west side) and 16 miles within the burn perimeter of the Big Thompson District (east side). These trails have a significant amount of wooden infrastructure, including retainer bars and water bars, turnpike edging, single footlog bridges, stringer decked boardwalk bridges, multi-use bridges, hitchrails, wooden signs, and rail fences. These trails have extensive erosion control/drainage structures of either wood or rock. Of the lower elevation trails assessed by the BAER team, the trails were in very good pre-fire condition, particularly the trail tread due to the extensive erosion control infrastructure.

Trail use by the public is considerable. Fern Lake and Cub Lake trails average 15,000-20,000 visitors/month during the summer months; on the West side, Green Mtn and North Inlet trails average 6,000-10,000 visitors/month. The park overall averages 4.5 million visitors annually.

Within the burn perimeter, some 9.1 miles on the short loop of the Continental Divide Trail lies within the burn perimeter, and 21.11 miles of the longer loop are within the burn perimeter.

The table below indicates those trails within the burn perimeter and wooden infrastructure associated with each trail.

Trail Name	**Asset**	**Number**	**Lineal feet**
Green Mountain	Decked boardwalk	4	74
	Footbridge	1	24
	Turnpike	2	333
	Hitchrail	1	
	Retaining bars & water bars	many	
North Inlet	Footbridge	7	99

	Turnpike	1	90
	Hitchrail	3	
	Retaining bars & water bars	many	
Livery	Turnpike	1	167
	Retaining bars & water bars	Many	
South Tonahutu	Turnpike	3	1841
	Footbridge	1	18
	Hitchrail	1	
Tonahutu Creek	Turnpike	2	910
	Bog bridging	1	6
	Footbridge	6	97
	Multi-use bridge	1	
	Wood wall	1	31
	Retaining bars & water bars	Many	
Haynach Lk	Retaining bars	many	
Valley and River	Turnpike	2	439
	Buck and rail fence	2	170
	Wood wall	1	
	Retaining bars & water bars	Many	

Sewer Line	Buck and rail fence	1	5100
Fern Trailhead to Pool	Turnpike	1	25
	Decked boardwalk	1	32
	Footbridge	3	20
	Retaining bars & water bars	Many	
Pool to Cub Lake	Turnpike	2	400
	Footbridge	2	31
	Decked boardwalk	1	32
	Hitchrail	1	
	Retaining wall	1	
	Retaining bars & water bars	Many	
Pool to Odessa	Turnpike	1	77
	Footbridge	5	127
	Hitchrail	3	
	Bog bridge	1	54
	Single rail fence	1	140
	Retaining walls & water bars	Many	
Spruce Lake	Turnpike	1	15
	Footbridge	1	14
	Bog bridge	1	151

FR-23 and FR-28	Turnpike	1	10
	Footbridge	2	30
	Decked boardwalk	1	202
	Footlog	1	17
	Hitchrail	2	`
	Retaining wall	1	
	Retaining bars & water bars	Many	
Beaver Meadow	Turnpike	1	78
	Footbridge	1	14
	Hitchrail	5	
	Buck and rail fence	1	25
	Retaining bars & water bars	Many	

Wilderness Campsites

There are 37 designated Wilderness campsites within the fire perimeter, at 24 different locations.

Table #: Wilderness Assets within Fire Perimeter	
Qnty.	***Asset type:***
37	Designated Wilderness Campsites
1	Ranger Camp
93	Log tent pads
36	Access trails with log retaining structures
7	Single stringer log footbridges

3	Wood bog bridges
1	Urine Diverting Toilet unit w/ wood structure
4	Pit privy units w/ wood structures
23	Metal campsites signs
41	Wood Campsite signs
6	Plastic wildlife closure signs (Boreal toad)

Snowmobile Motorized Use Corridor

A special motorized use corridor runs between CR48 and CR491 in the Columbine Lake area. This is the only designated motorized use corridor within the Park and allows access to a County maintained system of trails. The total length of this corridor is 2 miles and is defined by wood fencing on either side for a part of the distance. The fence and corridor were created for public safety reasons, allows for speed limit enforcement by law enforcement and aids in protecting natural resources by confining motorized use to this corridor.

Public Safety & Resource Protection Signs

Field visits by BAER team members and Park staff occurred between November 6th and November 17th, 2020. A variety of signs within the park that provide for public safety and/or resource protection were viewed and photographed. Regulatory signs along roadways (speed limit, stop signs, etc), within automobile campgrounds and public/park facilities, at trailheads and other visitor use locations are all common signs within the park.

Findings

Moraine Park Campground

Direct fire damage was limited to three sites. Damage at Site 151 consists of burned tent pad logs and one hazard tree. Hazard trees also were created at Sites 154 and 163, and at the water tank.



Site 151 – wood stabilizers around tent pad are burned and need to be replaced, along with a hazard tree.

Near site 150 a social trail developed by the fire crews working the fire and is considered fire suppression damage.

Park staff noted that sites 120-135 become a wetland each spring following normal spring runoff, and sites 180-202, 22, 64, 74, 81, 82, 90, 143, and 144 are affected/flooded by rainstorms. The BAER Team assessed these sites on Nov. 15, 2020 and determined that fire-related effects will not exacerbate these conditions due to low burn severity upslope. Sites 120-135 will continue to become wetted during spring runoff until water passage is enabled beneath the road just downslope of the sites. In all cases, due to low burn severity, no increases in flooding or erosion beyond pre-burn conditions are expected.

Trails

As noted above, approximately 31 miles of trail on the Colorado River District and 16 miles on the Big Thompson District are within the burn perimeter. Based on the observations of the BAER Team and photos/reports from park staff, it is safe to assume that most wood structure on the trails within the burn perimeter has some degree of fire damage Some structures suffered near total or total loss, such as turnpike edging, decked boardwalks, and footlogs, depending on how the fire moved through the area. In some cases, the wood structure is charred, with much of the wood integrity still intact, and thus the structure remains functional. Due to snow conditions

it was impossible to see all wooden structure on any given stretch of trail.

Point information was collected by BAER team members at many burned infrastructure locations along the North Inlet, Green Mtn, South Tonahutu, and Fern Lake Trailhead to Odessa Lake. This information, in Collector, will be left with the park.

At least seven larger, multi-use bridges were burned and will need to be replaced; five on the Green Mtn Trail, one on Upper Tonahutu, and one (perhaps two) at Mill Creek Basin. Due to the size of materials needed to replace these larger bridges, a Type 1 helicopter will be needed to safety and efficiently deliver replacement logs/materials to these sites.

Erosion on trails will be increased due to slope runoff, and although the park has a superior level of erosion control structures in place, burned erosion control structures and drains will require replacement/maintenance in much of the burn perimeter.

From the BAER perspective of both ensuring visitor safety and protecting the assets of these trails as highly popular, highly used recreational resources, the following emergency stabilization work needs to be completed:

- Rebuild the multi-use bridges, to enable safe crossing of larger streams
- Rebuild footlogs, decked boardwalks, and bog bridges to ensure safe footing and to protect stream/wetland resources from trampling/social trailing
- Replace the wooden edges of burned turnpike logs to keep the tread structure intact
- Replace burned water bars and drain bars to retain effective erosion control devices to protect the soil tread
- Replace hitchrails to effectively contain stock to minimize trampling effects from stock
- Remove the extensive amount of fire-killed trees and debris off the trails to ensure both safe visitor passage and prevent social trailing off the trails.



Green Mtn trail – burned decked bridge – common damage along several trails.

In those cases where wood structure is charred but still retains integrity, those structures can remain in place.

It is worth noting the Green Mountain Trail, a popular trail on the CRD, suffered considerable damage to wood structure and is at risk from elevated runoff due to burn severity. Park staff have indicated this trail likely will be a high priority to work on before the trail is opened to the public.

Wilderness Campsite Assets

A total of 37campsites lie within the fire perimeter. Overnight visitor use within the burned areas is permitted through the use of designated wilderness campsites. Annual permitted use for the fire-affected assets can exceed 4,000 permits during a summer season. An average of 12,000 overnight users will be displaced from overnight use opportunities annually due to fire damages. Campsite hazard trees are removed on an annual basis, due to increased hazards from mortality

of trees from both mountain pine and spruce beetle infestations throughout the last decade. Forest health in these locations was poor to moderately poor prior to the fire event. Post fire forest health in campsites consists of almost complete mortality and poses a high risk to employees during removal operations.

All campsites contain several built structures and facilities in order to support continued high use annually. Many wood and built assets in campsites have been consumed by fire, while those that remain are charred or partially compromised. One NPS ranger camp was damaged by fire and leaves behind pieces of a built structure. Many privy structures or units were fully burned and left exposed 4-foot deep holes open that contain human waste, representing potentially hazardous conditions for foot travel in some areas.

Based on known cultural resource information, 11 campsites within the fire perimeter are located on top of, or in very close proximity to either pre-contact, historic or culturally significant sites to the park. In addition to campsite assets, one administrative Ranger camp and numerous wilderness privy units, signs, and footbridges were lost or damaged in the fire.

A combination of burned and pre-existing overhead hazards and/or exposed cultural resources within these campsite poses an unnecessary risk to both visitor safety, natural and cultural resource protection. The loss of forest canopy and vegetation cover and the effect of human traffic will increase damage if visitor use and safety are not mitigated.

It is important to note that one campsite – Summerland Group site – lies within an elevated risk to debris flow, based on debris flow modeling associated with the BAER assessment. This site should be closed until that elevated debris flow risk lessens within a few years.

The following table represents findings related to Wilderness campsite assets found in onsite surveys conducted by the BAER Team. Snow on the ground prevented a full evaluation at many of the sites; what is presented below is what was observable given the conditions:

Location Surveyed by BAER Team	**Survey Results/Notes**
Summerland Group	Campsite trail footlog burned; hazard trees present. Elevated risk of debris flows
Summerland individual site	Burned tent pad logs, sign; hazard trees present
Twinberry campsites (2)	Burned tent pad longs, trail check logs; hazard trees present
Cascade Falls	Hitchrail was unburned; hazard trees may be present (smoldering was still ongoing near the hitchrail)
Green Mtn camp	Burned tent pad logs; hazard trees present; nearby hitchrail burned
South Meadows	Burned tent pad logs; hazard trees present

Big Meadows Group	Burned tent pad logs; hazard trees present. Privy not found
Arch Rocks	No damage. Fire perimeter close, but no obvious hazards
Old Forest Inn -2 campsites	No damage to campsites, although potential hazard trees near west site. Trail campsite sign burned; east campsite access trail logs burned. Privy toilet structure unburned.
Fern Lake group	Multiple hitchrails in area burned; campsite burned over but tent pad logs possibly intact. Urine divert privy burned over. Some hazard trees present.
Fern Lake individual sites (3)	Two sites nearest lake are burned over – tent pad logs likely burned; both have hazard trees. Most distant campsite ("#4") - not burned, but potential hazard trees nearby – needs survey
Odessa Lk – 2 individual sites	Both sites unburned, no hazard trees. Composter appears unburned but could not see bottom; assumed unburned.



Green Mtn campsite, typical of most campsites – burned tent pad logs, hazard trees present

Snowmobile Motorized Use Corridor

A total of 0.6 miles of fencing on both sides of the corridor was lost due to the East Troublesome Fire. The remaining mile is either partially burned or damaged by falling trees. A variety of sign damage exists throughout the corridor, from unaffected to complete damage. Motorized use and speed limit enforcement will not be possible until down trees and fence materials can be removed. Hazard trees are present overhead along the sides of this corridor.



Burned buck and rail fence, snowmobile trail

Public Safety & Resource Protection Signs and Ranger Patrols

Park and BAER personnel observed regulatory signs that were missing and or damaged. Hazardous conditions were observed by Park and BAER personnel on field visits of road and trails. These hazards need to be brought to visitors and users' attention using signs.



Burned bicyclist regulatory sign.

Given the number of hazards in the burned area and the need to protect park resources from visitor presence within the burn, a higher level of NPS presence is needed. Providing for additional wilderness patrol rangers, increased interactions with the public at trailheads and on social media, etc will increase the level of protection for park resources and the visiting public.

Recommendations

Specifications

ES-04 Trail Stabilization: This treatment is designed to address the numerous burned structures that provide for a trail system that is safe for the public while also protecting park resources by keeping visitors on the trail. Through a variety of in-park workers, other-park trail crew workers, a contracted Colorado Conservation Crew, and the use of a Type 1 helicopter, work is proposed to stabilize the burned trails within the park. **It should be noted that the park is providing over $573,000 of in-kind support toward this trail stabilization effort, primarily by using park trail employees to complete a significant amount of trail stabilization and infrastructure repair or replacement.**

ES-05 Wilderness Campsite Safety: This treatment funds the rehabilitation or obliteration of most of the 37 designated campsites found within the burn perimeter, primarily by closing many sites that have significant hazards while keeping up to 10 campsites open following necessary rehabilitation work.

ES-06 Ranger Safety Patrol: The East Troublesome Fire burned in areas of high visitor use in the park. Potential impacts to natural and cultural resources from social trails, looting, etc are high throughout the burned landscape. These threats will persist and increase if NPS presence is not increased post-fire. An increased agency presence is needed to address all these concerns, and could include law enforcement rangers, wilderness/Backcountry rangers, and/or a park guide/information specialist

ES-12 Burned Snowmobile Trail Fence: This treatment is to repair or replace a snowmobile trail buck and rail fence that confined snowmobile use to a specific, permitted motorized use corridor. Ensuring a fence is in place will protect natural resources outside the corridor by keeping snowmobiles on the trail.

ES-13 Public Safety and Resource Protection Signs: This treatment provides for fire hazard warning signs that are intended to inform the public of the residual risks left behind by the East Troublesome fire.

BAR-3 Trails Stabilization and Rehabilitation: This treatment provides funding for the increased trail maintenance needs that will occur in years 2 and 3 following the fire. Increased windthrow, erosion, and tread damage is likely to occur, and will simply require additional effort beyond normal years. Burned minor infrastructure will be repaired or replaced.

Preparers

- Tyrus Klasovsky, Trail Crew Supervisor, Rocky Mountain National Park
- Doug Parker, Trails Program Supervisor, Rocky Mountain National Park
- Tara Vessella, Wilderness Field Coordinator, Rocky Mountain National Park
- Hallie Groff, Fee and Campground Manager, Rocky Mountain National Park
- Jack Oelfke, Chief, Resource Management, North Cascades NPS Complex
- Eric Rhodenbaugh, Supv Forester, Wind River Agency, Fort Washakie, WY

Boundary Monument Assessment

Issues

- Boundary monuments are located within the fire perimeter. Stone, wood, and aluminum monuments may be vulnerable to erosion or damage from change in soil or vegetation cover post fire.
- Boundary monuments are classified as real government property. The DOI and the Inspector General define PLSS monuments as a resources to be protected by policy
- A Grand County Ordinance requires setbacks from NPS boundary lines. Without a posted boundary line on Park lands adjacent to private lands, community rebuild is halted.
- Encroachments along shared NPS/private property boundary lines directly affect protection of natural resources to include waterways, vegetation and wildlife (hunting)
- Hazard trees pose a risk to land monuments due to the destabilizing effects of wind and hydrologic events following fire.
- Bearing trees accompany land monuments and aid as reference points in determining accurate land ownership lines; marked/scribed trees have been lost and may require modern replacement installations.
- Lack of trees poses a challenge in accurately posting boundary lines signage.
- Loss of land monuments would inhibit posting legal property boundary lines.

Table 1: Boundary and Monuments

Monument type	Quantity	Type:
Original (Antiquated) monuments	35	Wood, stone, aluminum, rebar, tree historic markings, other various materials
Resurvey (Modern) monuments	17	GLO/BLM/RMNP brass monuments
Bearing trees/ marked trees impacted	72	Wood

Observations

The assessment of potential fire damage to land monuments in the burned area was conducted using fire perimeter data from NIFC GIS and in conjunction with the Bureau of Land Management Survey Monuments GIS Data. Both Regional NPS land surveyors and BLM survey staff assisted in identifying map locations via robust GIS databases and imagery. A small sample of monument types and terrain locations were visited in the field by the Park's wilderness operations manager to determine a hypothesis of post fire effects associated with monument locations. This was based on monument type and location within the following terrain: drainage bottoms, steep terrain, and in close proximity to waterways. BAER Team members also visited a portion of the burned boundary to assess fire effects to boundary markers and signs and collected

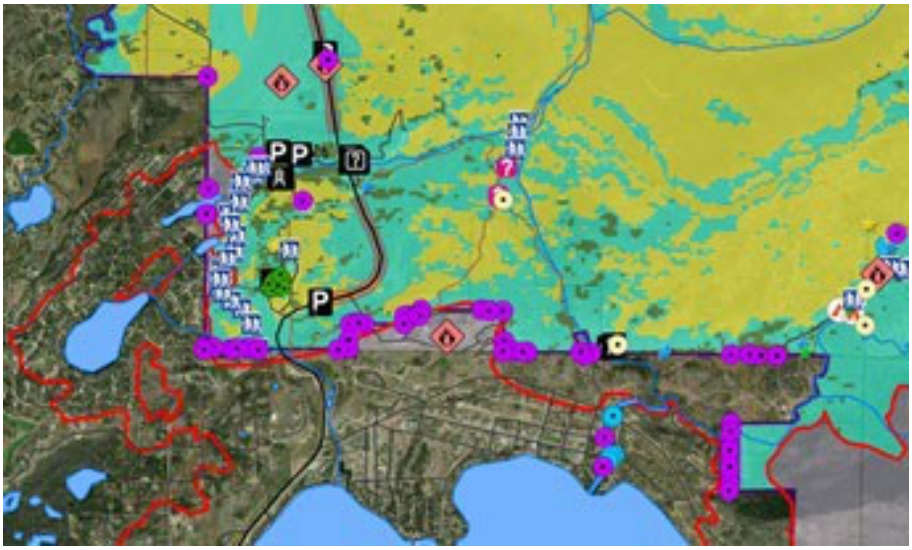
points and photos for the East Thompson BAER Web Map.

Findings

The East Troublesome Fire burned on both east and west sides of the Continental Divide in Rocky Mountain National Park. Fourteen linear miles of NPS boundary line was burned over by the fire. Rocky Mountain National Park's property boundary contains many General Lands Office and Bureau of Land Management wood, stone, and metal monuments, which mark the legal corners of the Park's property boundary. The large percentage of these monuments are located in steep terrain, drainage bottoms, and in close proximity to waterways.

Burn severity varies throughout the western boundary of Rocky Mountain National. A total of 52 monuments and 72 trees throughout this area has been affected to varying degrees. When monuments become loose or disturbed from falling trees they erode and are required to be reset for legal accuracy. Many of the monuments where installed 60-100 years ago and have had minimal monitoring since install. If monuments are destabilized and move slightly from their original locations, park boundary lines cannot be marked with signage as they directly rely on the accuracy of these monuments to post. These assets are easier to rehabilitate or stabilize, shortly after fire effects as small repairs will continue to allow for long term accuracy and reduce the need for replacement. Monument replacements are costly and require more surveyor time than rehabilitation actions.

The BAER team visited a portion of the boundary on the Colorado River District (CRD) near the town of Grand Lake. The map below shows a portion of the East Troublesome BAER Web Map. The purple discs along the park boundary indicate the CRD boundary locations visited and photographed by the BAER Team. All visible monuments were in place and signs were either undamaged by the fire or minimally singed and still readable. A few T-posts lacked signs and a few trees with signs were on the ground, but this did not appear to be associated with the fire. Photos below show a brass boundary marker and a T-post boundary sign in the burned area.



Park staff also visited a portion of the boundary on the CRD north of the town of Grand Lake


[redacted]


and west of the Onahu Trailhead where the boundary heads west across the Colorado River. One monument found in the burn area was loose in the ground (could be wiggled with two fingers). A few boundary signs were burned and no longer readable (see photo to right). Monument, loose in groundBurned boundary sign on tree.

The BAER team also visited a portion of the park's boundary with the YMCA of the Rockies on the East Side District (ESD). They were unable to find a monument corner that was likely under the snow and dense juniper vegetation. They did not find evidence that dozer line harmed the boundary, [redacted]



Rock hewn monument, [redacted]

The majority of monuments in the burned area have associated bearing trees and when lost to fire can no longer provide reference points for legal monument locations. These require rehab through the placement of rebar markers in previous tree locations. Signage protects park lands and natural resources from impacts, unlawful use and aids in allowing private landowners adjacent to NPS lands to rebuild. Land monuments are listed as real government property, while the US Government takes financial responsibility for the accurate installation of these assets in remote areas to ensure proper land ownership boundaries.

Recommendations

- Visually assess land monuments associated with the NPS property line and locate with foot survey in moderate to severe burn intensity areas, steep slopes/terrain, and in close proximity to waterways/drainage bottoms.
- Visually assess NPS signage and the cut boundary line along the NPS property line with foot survey to determine repair/replacement needs
- File assessment findings with the Bureau of Land Management to ensure legal record of monument status are current and accurate.
- If assessment finds that monuments are at risk or are found to have been displaced by fire related events, reestablish the monuments.
- Rehabilitate monuments in severe burn areas (to include removing down trees on top of/or in close proximity to, rehabilitating damaged secondary markers, installing steel t-posts to hold locations until repair, restack rock cairns)

- Real government property could be lost without rehab/stabilization of existing monuments.

Specifications

Non-Specification Management Recommendations

Survey monuments will be located, assessed, and marked. All monuments will be cleared of down trees and tree material to ensure clear visibility. When conditions present threat from erosion to monuments, these will be rehabilitated to ensure stabilization of the asset through use of rock cairns, steel t-posts or rebar installs. If it is determined that a monument is no longer accurate, a monument will be repaired on site through RTK GNSS device. When monuments are found to be damaged, it will be necessary to replace these monuments through BLM Cadastral Survey Staff. The park has a current agreement with the BLM that would facilitate these assessments and installs, should funding become available. Bearing tree or line trees damaged by fire but still firmly rooted in the ground will be marked with paint and topped to retain the base of the tree in place where monument references are measured. Lost or fallen bearing trees will be painted and replaced with rebar at the original tree base to match the previous measurements to reference the associated monument(s). If a significant number of boundary signs are observed to be lost as a direct result of the fire, boundary signage could be proposed through a BAR amendment.

Consultations

- Randy Bloom, Chief Cadastral Surveyor, Bureau of Land Management
- Kyle Scholl, Lead Land Surveyor, Bureau of Land Management
- Roger Atnes, Regional Land Surveyor, National Park Service

Preparers

- Tara Vessella, ROMO, Wilderness Field Coordinator
- Cheri Yost, ROMO, Park Planner

SPECIFICATIONS

INDIVIDUAL TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Burned Structure Enclosure	**Spec-#**	ES-01
NFPORS TREATMENT CATEGORY*	Human Life and Safety	**FISCAL YEAR(S) (list each year):**	2021
NFPORS TREATMENT TYPE *	Protective Fence Barriers	**WUI? Y / N**	Y
IMPACTED COMMUNITIES AT RISK	Rocky Mt. NP Staff and Visitors	**IMPACTED T&E SPECIES**	No

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

TREATMENT

General Description:

An assessment of structures within the East Troublesome Fire perimeter at Rocky Mountain National Park was conducted to assess the condition of the sites. [redacted]

Hazard remediation, cultural resource documentation, and cleanup may not be possible until next spring or summer, due to imminent rain, wind and substantial snow cover. Treatments are recommended to ensure visitor safety, prevent contamination from migrating off site, and protect extant historic resources.

To address the impacts and deficiencies caused by the fire activities, this specification includes the following components.

Total estimated cost of safing and stabilizing these structures is [redacted]

1. Erect temporary interlocking chain link fence panels to accomplish the following:
   a. [redacted]
2. Tarp building sites that may contain hazardous material, and/or are historic and contain features that need to be documented or collected.
   a. Tarp should be used to cover sites that cannot be remediated and cleaned up due to heavy snow cover, and/or contain historic artifacts or features that need to be documented/collected but cannot be due to heavy snow cover and protect surrounding staff, public and natural resources from wind-blown ash.
   b. Sandbags can be installed around sites that may contain environmental contaminants to prevent run-off.
3. Signage
   a. Signs warning of hazards at each site. Particularly at sites with elevated hazards.

Location/(Suitable) Sites:

Rocky Mountain National Park is in north-central Colorado between the towns of Estes Park to the east and Grand Lake to the west. The continental divide runs north-south through the park, dividing the unit into two districts: the Colorado River District (CRD) on west side of the divide, and the Big Thompson District (BTD) on the east. [redacted]

Design/Construction Specifications:

1. Fencing should be installed using interlocking panels with bases, weighed down with sandbags. Ground disturbance should be avoided. Fencing should be installed at sites where threats to life and safety are present. These threats include chimneys, basement holes, wells, exposed septic tanks, and sites near the park road. Sites with historic features that are at risk for looting should also be fenced. See attached spreadsheet for sites recommended for fencing.
2. Tarps should be at least 12-mil and ordered in a variety of sizes including 50'x50'and 20'x30'. Tarps should be held in place by either sandbags or logs. Watling can be used to encircle the sites if contaminate runoff is a concern.
[redacted] should be moved or removed prior to tarping. Foundation stones or orther rocks should not be used to weigh down tarps.
3. Sign verbiage should be clear that sites present danger to life and safety.

Purpose of Treatment Specifications (relate to damage/change caused by fire):

1. Fire damage left conditions that are dangerous to visitor and staff. Exposed sites may result in in additional resource loss through looting. Exclusionary fencing will keep people out of the area until the sites are documented, remediated, and cleaned up. Tarping will deter looting and contain contaminants until the sites can be remediated.

Treatment Reasonableness and Cost Effectiveness:

Treatment is consistent with the severity of the damage. Work will prevent visitor injury, discourage illegal looting of historic sites, and minimize threat of environmental contamination.

Treatment consistent with Agency Land Management Plan (identify which plan):

NPS Wildfire Management Reference Manual 18

MONITORING PLAN

1) **Treatment Objectives:**
   Secure site with fencing until the site is stabilized and no longer a safety hazard and historic material has been documented and/or collected from the site.

2) **Describe how implementation will be monitored.**
   Some work will be implemented by contractors and overseen by experienced park staff, other work will be completed by park staff and overseen by a regional IMT team.

3) **Describe how effectiveness will be monitored, and within what time period.**
   Effectiveness will be monitored by periodic site visits over the next year to assess the integrity of the fencing and tarping of the resources.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**



SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	x
2. Documented cost figures from similar project work obtained from local agency sources.	x
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	x
5. No cost estimate required - cost charged to Fire Suppression Account	

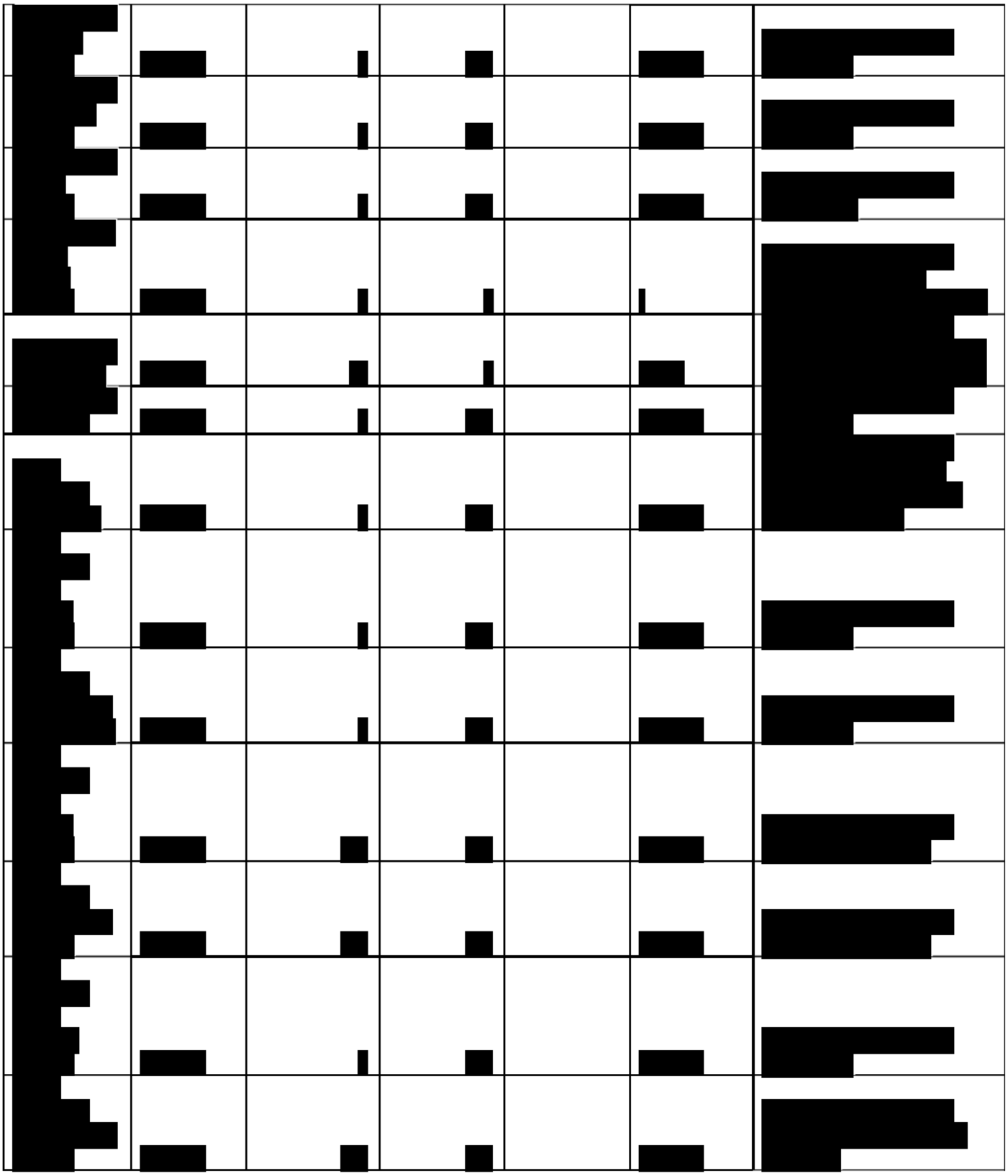
P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** =

Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

1. Spreadsheet of burned sites within the East Troublesome Fire Perimeter.







BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Exotic Plant Control	**Spec#:**	ES- 2
NFPORS TREATMENT CATEGORY*	Invasive Species	**FISCAL YEAR(S) (list each year):**	2021
NFPORS TREATMENT TYPE *	Chemical Treatment	**WUI?**	N
IMPACTED COMMUNITIES AT RISK	n/a	**IMPACTED T&E SPECIES**	

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

Approximately 21,300 acres of riparian corridor, forest, meadows, alpine tundra, and other montane and subalpine habitat were burned within the Park boundary during the East Troublesome Fire. While fire can reinvigorate native vegetation in the long term, the lack of competition from native vegetation in the first several years following the fire provides an opportunity for exotic invasive weeds to spread and establish, ultimately suppressing native vegetation from returning. Creation of holding lines and structure defense by hand crews also has the potential to bring in exotic invasive seed or create conditions where exotic invasive plants can readily establish. Non-native plants were also present in some areas prior to the fire, but now have a much greater potential for spread and invasion with the lack of competition from native vegetation. It is critical to minimize the establishment of these exotic invasive plants in the first years following the fire to allow for the native vegetation to begin to reestablish without further degradation of critical habitat.

TREATMENT

General Description:

Fire, especially in areas where heat intensity was high, temporarily eliminates much if not all the native vegetation that was once present. With this lack of native vegetation, it provides heightened opportunities for exotic invasive plants to spread and establish which further reduces the chances of native vegetation returning to these sites. It is critical that native vegetation does reestablish as it provides important habitat for many species of wildlife in the Park and provides natural site stabilization and erosion control. The fire regime could also change if exotic invasive plants are allowed to dominate (for example, cheatgrass has been documented as increasing fire frequency throughout western states). To prevent exotic invasive plants (noxious weeds) from establishing within the burn area, it is critical that surveys and early treatments occur in the first few years post fire. Exotic invasive species most likely to occur within the burn due to their presence in nearby locations include Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), bull thistle (*Cirsium vulgare*), common mullein (*Verbascum thapsus*), orange hawkweed (*Hieracium aurantiacum*), cheatgrass (*Bromus tectorum*), knapweeds (*Centaurea ssp.*), leafy spurge (*Euphorbia* esula), and houndstongue (*Cynoglossum officinale*) although many other noxious species may be present as well. The main herbicides likely to be used to treat these exotic invasive species include Milestone, Quinstar, Plateau, Overdrive, Rodeo, and Esplanade mixed with the appropriate surfactants to be most effective in controlling these species.

Location/(Suitable) Sites:

There are approximately 47 miles of trail that will need to be surveyed and treated. These includes the North Inlet Trail, Big Meadows/Tonahutu Trail, Green Mountain Trail, Onahu Trail, Valley and CO River Trail, CRD Admin Trail, Horse and Snowmobile Trails, Grand Lake Lodge Trail, Bowen Gulch Trail, Bowen Baker Trail, and Coyote Valley Trail on the Colorado River District of the park. On the East side, trails within the burn perimeter include Spruce Lake Trail, Fern Lake Trail, Cub Lake Trail, Mill Creek Trail, Moraine Park Trails, Upper Beaver Meadows Trails, Beaver Mountain Trail, and lower part of Ute Trail.

Stream banks through Moraine Park and Upper Beaver Meadows are particularly susceptible to exotic plant invasions and will require surveying along the banks. These areas cover approximately 8 miles.

Additional areas that will require exotic plant surveys and treatments include several locations where clearing and fire suppression activities have occurred around structures or where contingency fire line has been constructed. These areas cover approximately 10 miles.

Design/Construction Specifications:
Teams of natural resources staff will survey and treat exotic invasive plant infestations with herbicides using backpack sprayers. They will follow all mitigations outlined in the park's 2018 Exotic Plant Management Plan and Environmental Assessment so as not to impact waterways or any other resources of concern within the burned areas and other suppression areas. Different herbicides will be required depending on the species found on the initial surveys. Team size and herbicides will be determine based on the species found and abundance of plants in each area, but in general each team will consist of 2 to 3 people. When appropriate, smaller infestations of exotic invasive plants may be manually removed using shovels or similar hand tools. If exotic plants are flowering, flower heads will be clipped, bagged, and disposed of appropriately off site.

Certain species of exotic plants are already known to exist along various trails of the park. Stock use will provide additional pressures of exotic species seeds moving into trail corridors. Suppression activities such as handline and dozerline may have also introduced exotics species to the edges of the fire perimeter where such activities took place. Waterways will also be susceptible to the spread and transport of exotic species.

Without early detection and rapid response to these invasive species, weeds will quickly overtake the burned areas and prevent the establishment of critical wildlife habitat within the Park. Once established, the cost of controlling exotic invasive species becomes nearly prohibitive. It is much more cost effective to treat invasive plants and protect Park resources early while the new infestations of noxious weeds are still manageable.

Per the park's 2018 Exotic Plant Management Plan and Environmental Assessment, exotic invasive plants should be surveyed and treated. Furthermore, according to the Colorado Department of Agriculture, List A noxious weeds such as orange hawkweed (*Hieracium aurantiacum*) are required to be controlled, and List B noxious weeds should be managed whenever possible to stop their further spread. Other policy such as Executive Order 131112 also direct actions related to prevention and control efforts of invasive species on Federal lands.

MONITORING PLAN

1) **Treatment Objectives:**
   The purpose of these treatments is to reduce or eliminate the spread of exotic invasive species within the burn or suppression areas to ensure that native vegetation can begin to reestablish on these sites.

2) **Describe how implementation will be monitored.**
   Initial surveys will be conducted to determine where exotic plants are establishing. These surveys will be conducted by staff in pairs travelling along trails within the fire footprint, navigating to areas where bucket drops occurred, and visiting locations where clearing or other suppression activities have occurred.

Future monitoring will occur in subsequent years to observe whether treatments are successful, and adjustments will be made to improve treatment success as necessary.

3) Describe how effectiveness will be monitored, how it will be monitored, and within what time period.

Surveyed and treated sites will be revisited annually for at least three years to monitor effectiveness of treatment actions. If after three years, continued monitoring or treatment seems necessary, these actions will continue as resources and funding allow.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
[redacted]	[redacted]
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**

TOTAL CONTRACT COST	

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (MM/DD/YYYY)	PLANNED COMPLETION DATE (MM/DD/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISH MENTS	PLANNED COST
2021	05/01/2021	9/30/2021	F	mile	[redacted]	[redacted]	[redacted]
						TOTAL	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	P, E, M, T
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	P
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, E = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Elk Moose Exclosure Fence	**Spec-#**	ES-3
NFPORS TREATMENT CATEGORY*	Riparian	**FISCAL YEAR(S) (list each year):**	2021
NFPORS TREATMENT TYPE *	Animal Damage Control		

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

Five ungulate exclosure fences were damaged by the East Troublesome Fire. The BM50 exclosure in Upper Beaver Meadows was the most damaged. The fence was constructed with wooden support posts which sustained fire exposure, leaving the fence in an unstable and actively degrading state. Exclosure fences are constructed in the park to protect valuable wetland ecosystems from extensive browse pressure from ungulate species such as elk and moose. These wetland ecosystems are a critical park resource which have taken decades of protection to reach a mature state. They will be destroyed by ungulate browse if the fence is not stabilized. In its current state, the existing fence also poses a threat to human safety. Fence condition will continue to degrade over time, becoming more unstable and unsafe. This exclosure fence should be stabilized with fire-resistant metal t-posts according to modern design to avoid damage in future fire events.

TREATMENT

General Description:

The BM50 exclosure in Upper Beaver Meadows was originally constructed in 1962 as a part of a research study. It has provided decades worth of data that contributed to the development of the park's Elk and Vegetation Management Plan (EVMP), which informs decision making regarding management of the park's riparian wetland ecosystems. Currently, the original fence serves as part of the exterior of a larger exclosure installed for implementation of the EVMP. Exclosure fences protect valuable recosystems from extensive browse pressure from ungulate species such as elk and moose. Without the protection provided by intact exclosure fences, critical species such as willow, birch, alder, and aspen become overbrowsed and overall ecosystem integrity degrades over time. This negatively impacts biodiversity and in turn, the visitor experience. Fire damage has left the remaining vegetation within the fence vulnerable to ungulate browse pressure.

This exclosure sustained damage to its wooden support posts, which has caused them to become unstable. Several other fences inside the fire footprint were originally constructed with steel support posts and did not sustain structural damage from exposure to fire. To ensure long-term protection of critical wetland species and to avoid incurring severe damage in future fire events, BM50 should be stabilized with fire-resistant metal t-posts according to modern design. This work will be completed by park staff. Additionally, the park will stabilize the other four damaged exclosure fences using in-kind staff time.

Location/(Suitable) Sites:

The BM50 exclosure is located in Beaver Meadows on the east side of ROMO, about four miles from Estes Park. See attached maps for details.

Design/Construction Specifications:

ROMO park staff will perform stabilization work on the BM50 exclosure fence. The existing fence should be stabilized with fire-resistant metal t-posts according to modern design. Specifications are as follows:

- Install 35 steel t-posts along fence line adjacent to (within 6 inches of) each damaged wooden posts using a pneumatic post pounder.
- Attach t-posts to fence fabric with wire fence clips to stabilize fence.

Survey for archeological resources will need to occur prior to construction at BM50 to identify, document, and collect data on known and unknown archeological sites.

MONITORING PLAN

4) Treatment Objectives:

The purpose of this treatment is to eliminate human safety hazards from the landscape by stabilizing this fire damaged exclosure fence with fire resistant materials. Stabilizing this exclosure will also ensure the continued protection of critical native wetland vegetation from extensive browse pressure by ungulates such as elk and moose.

5) Describe how implementation will be monitored.

Repairs will be implemented by ROMO seasonal Resource Stewardship staff. Implementation will be overseen by a permanent GS 07 Biotech to ensure that t-posts are being installed correctly and that the fence is adequately stabilized.

6) Describe how effectiveness will be monitored, how it will be monitored, and within what time period.

Treatments will be considered effective if completed to specifications as determined by NPS Resource Stewardship Staff. Post-stabilization, fences will be monitored 1-2 times annually by park staff to ensure fence integrity remains intact.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
Pneumatic post pounder (note: this would be the park's first t-post replacement outside of wilderness, which would allow mechanized equipment. This purchase would increase the efficiency of the project)	[redacted]

TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	[redacted]
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL TRAVEL COST	**$0**
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL CONTRACT COST	**$0**

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
FY 21	11/30/2020	08/01/2021	F	1	[redacted]	[redacted]	[redacted]
						[redacted]	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	P,M
3. Estimate supported by cost guides from independent sources or other federal agencies	E
4. Estimates based upon government wage rates and material cost.	
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Trail Stabilization	**Spec-#**	ES-4
NFPORS TREATMENT CATEGORY*	Asset Repair and Replacement	**FISCAL YEAR(S) (list each year):**	FY21
NFPORS TREATMENT TYPE *	Trail Stabilization Structures		

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

Fire-caused damage to park trails will require stabilization work to make them safe for public use, to protect the trail asset from erosion along the trails, and to prevent resource damage where bridges and footlogs/boardwalks have burned (at least 7 multi-use bridges have burned and require replacement, and as many as 35 footlogs/footbridges may have burned). Considerable fire-caused windthrow across the 47 miles of park trail within the burn perimeter will need to be cleared to allow trail crew access, erosion control structures replaced (drain bars, log checks), and tread stabilization installed (outer tread edge stabilization, turnpike edging replaced). The loss of wooden trail structures has caused the trail surface to be destabilized and at risk of loss due to rain events that would wash away the tread surface held in place by log retaining structures and water bars. Given the very high recreational use of these trails, in a park that serves millions of people from the adjacent Front Range metro areas near the park, these trails require stabilization and repair work to enable visitors to safety use the trails, minimize resource impacts, and protect the trails asset.

TREATMENT

General Description: The 47 miles of burned over trail will be stabilized prior to opening to the public. Windfall will be cleared, multi-use bridges, footlogs, bog bridges, decked boardwalks, and hitchrails will be replaced, erosion control structures will be replaced as needed. Priorities will be set based on known visitor use patterns and trail conditions.

Location/(Suitable) Sites: All 47 miles of trail that lie with in the burn perimeter, on both districts of the park. The multi-use bridges known to have been burned include 5 on the Green Mtn Trail; 1 on Upper Tonahutu; 1 or 2 in Mill Creek Basin; and 1 on the Fern Outlet.

Design/Construction Specifications: Multi-use bridges will be replaced, and will require the use of Type 1 K-Max helicopter to safety and efficiently deliver large/heavy materials in a high-elevation environment. Other burned wooden materials will be flown into various locations throughout the burn perimeter, such as foot logs and lumber decking. In some cases, where efficient, park pack stock will haul materials into the work areas. The standard materials for most of these structures is pressure treated logs/lumber, although in some cases, where useable log material is available, local native material will be used. Drain bars and retaining bars will be replaced where necessary; although some are charred, if they remain functional, they can remain in place in this first year post-fire. The burned log edging for turnpikes need to be replaced to maintain the tread structure in place. Hitchrails will be replaced to effectively confine stock. A mix of park staff, Colorado Conservation Crew (CCC), and external park trail crews will provide a work force that can address different aspects of the work ahead, based on efficiencies and technical aspects of the work.

In-kind park trail crew costs (over $570K) supports this ES specification.

MONITORING PLAN

1. **Treatment Objectives:** Reopen park trails that have been damaged by the fire, returning them to a safe condition for visitor use.
2. **Describe how implementation will be monitored.** The Trails Supervisor will monitor work, either individually or thru his crew supervisors, to ensure trails work meets park standards.
3. **Describe how effectiveness will be monitored, how it will be monitored, and within what time period.** Park trail crew supervisors will oversee all work in the wilderness/backcountry. External trail crews will be briefed on ROMO standards to ensure their work meets park standards; the CCC will work under the supervision of a park trails supervisor; and ROMO trail crews will work under their normal park supervision and oversight. Oversight occurs on a regular basis as work is occurring.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that	[redacted]
[redacted]	[redacted]
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL MATERIALS AND SUPPLY COST	
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**

C[redacted]	[redacted]
[redacted]	[redacted]

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2021	12/1/2020	09/30/2020	F	Miles	[redacted]	[redacted]	[redacted]
[redacted]							
						[redacted]	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Wilderness Campsite Safety	**Spec-#**	ES-5
NFPORS TREATMENT CATEGORY*	Human Life and Safety	**FISCAL YEAR(S) (list each year):**	FY21
NFPORS TREATMENT TYPE *	Closures		

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

37 wilderness campsites lie within the burn perimeter; 30 wilderness campsites were burned in the fire. All sites have hazard trees that pose significant risk to visitors, and most have burned wooden structures. Eleven campsites within the burn perimeter have known archeological sites within or near the campsite. This treatment will mitigate hazard trees and close 27 camps, mitigate hazard trees and rehabilitate 10 sites for visitor use. Closing and mitigating tree hazards at 37 of the campsites will provide for visitor safety, protect archeological resources, and enable the park to do proactive wilderness camp planning for the future.

TREATMENT

General Description: Of the 37 campsites located within the burn perimeter, up to 27 will be indefinitely closed to visitor use, and 10 will be rehabilitated to allow for continued visitor use. The park needs flexibility to first view all the sites before making a final determination as to how many may be possible to effectively rehabilitate, but all 37 sites will require some level of work, regardless whether they are closed, obliterated or rehabilitated.

Location/(Suitable) Sites: All 37 campsites within the burn perimeter, of which the large majority have partial or total damage/loss of campsite structure.

Design/Construction Specifications: At those sites that will be closed, work will include scarifying the tent pads, removing and dispersing tent pad logs, removing campsite signs, and dropping some standing dead trees across the tent pads to further discourage visitor use of the tent pads. At those sites that will be rehabilitated to allow continued visitor use, work will include removal of all hazard trees and replacement of any damaged wooden infrastructure, such as tent pad logs, signs, and check logs at access trails. Work will be completed by park staff within the Wilderness program.

MONITORING PLAN

1. **Treatment Objectives:** Close indefinitely up to 27 wilderness campsites and rehabilitate10 campsites within the burn perimeter**.**
2. **Describe how implementation will be monitored.** The park's Chief Ranger has oversight of the park Wilderness program; the park Wilderness Field Coordinator will oversee the campsite rehabilitation, obliteration actions and ensure the park direction for this effort is implemented.
3. **Describe how effectiveness will be monitored, how it will be monitored, and within what time period.** Each campsite will be monitored for whether it meets the objective of obliteration (tent pads scarified; wooden structure removed and scattered; signpost removed; privy holes filled and structure removed, or for rehabilitation (burned wooden structure and signs replaced; hazard trees mitigated. Campsites will be evaluated as work is completed**.**

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	COST / ITEM
[redacted]	[redacted]
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	COST / ITEM
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	COST / ITEM
[redacted]	[redacted]
TOTAL MATERIALS AND SUPPLY COST	
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	COST / ITEM
[redacted]	[redacted]
TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	COST / ITEM
TOTAL CONTRACT COST	[redacted]

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
						[redacted]	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

INDIVIDUAL TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Ranger Safety Patrol	**Spec-#**	ES-6
NFPORS TREATMENT CATEGORY*	Human Life and Safety	**FISCAL YEAR(S) (list each year):**	2021
NFPORS TREATMENT TYPE *	Hazard Removal - Other	**WUI? Y / N**	N
IMPACTED COMMUNITIES AT RISK	N/A	**IMPACTED T&E SPECIES**	N/A

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

TREATMENT

General Description: The East Troublesome Fire burned in areas of high visitor use in the park. There are 47 miles of trail within in the fire and public safety hazards on trails are high from hazard trees, burned root/stump holes, etc. Potential impacts to natural and cultural resources from social trails, looting, etc are high throughout the burned landscape. These threats will persist and increase if NPS presence is not increased post-fire. Increased impacts from trespass ORVs on the Colorado River District (CRD) is a concern for resource damage and looting of historic sites. An increased agency presence is needed to address all these concerns, and could include law enforcement rangers, wilderness/Backcountry rangers, and/or a park guide/information specialist.

Location/ (Suitable) Sites: An increased presence is needed on both sides of the park, but particularly on the Big Thompson District (BTD), which sees heavy use from nearby communities of Boulder, Colorado and Fort Collins, Colorado.

Design/Construction Specifications: NPS staff will provide increased patrols in key areas of the park where the fires burned. Patrols are to provide for public safety and deterrence and interdiction to prevent resource damage. Two rangers are needed on the BTD, and two additional rangers are needed on the CRD.

Purpose of Treatment Specifications (relate to damage/change caused by fire): Increased agency presence has proven to be an effective method for managing visitors for their own safety and to protect potentially vulnerable park resources, natural and cultural. A ranger/information specialist could also produce considerable content for social media and monitor/respond to interactions and inquiries about the fire, post-fire effects, etc.

Treatment Reasonableness and Cost Effectiveness: NPS staff will interact directly with the public where access issues might occur and an online presence will reach a much greater audience. Law Enforcement rangers provide the opportunity to directly address negative interactions or illegal activity/entry into the burned area. Wilderness patrol rangers familiar with the terrain and burn-related issues are effective in addressing the concerns within Wilderness.

Treatment consistent with Agency Land Management Plan (identify which plan): Foundation Document, Rocky Mountain National Park, 2013.

MONITORING PLAN

1. **Treatment Objectives:** Increase agency presence to increase visitor safety and reduce impacts to natural and cultural resources.

2. **Describe how implementation will be monitored:** NPS supervisors will oversee all these activities.

3. Describe how effectiveness will be monitored, and within what time period: Evaluation of success/difficulties will be addressed on a routine basis and adjustments will be made accordingly.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
	COST / ITEM
[redacted]	[redacted]

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2021	4/01/2021	10/01/2021	F	District	[redacted]	[redacted]	[redacted]
							0
						TOTAL	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	

3. Estimate supported by cost guides from independent sources or other federal agencies	E
4. Estimates based upon government wage rates and material cost.	F, M, T
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Front Country Hazard Trees	**Spec-#**	ES-7
NFPORS TREATMENT CATEGORY*	Human Life and Safety	**FISCAL YEAR(S) (list each year):**	2021
NFPORS TREATMENT TYPE *	Hazard Removal - Other		

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

The East Troublesome Fire burned through recreation and administrative areas creating tree hazards. Hazard trees are a threat to human life and safety as well as to infrastructure. These trees must be removed before the areas can be opened to the public or park staff.

TREATMENT

General Description: Mitigate hazard trees at recreation and administrative facilities, as well as along road corridors. Felling will be done by a combination of park staff and contract.

Location/(Suitable) Sites:

Area	# Trees/ acres	Description
North Inlet Trailhead	7	Group of aspen trees near toilet
Grand Lake Cemetery - Imminent	8	Lodgepole pine, have been recorded with GPS
Corral by Facilities shop	3	Lodgepole pine
Dry Storage Building	3	Lodgepole pine
Green Mtn Trailhead	40	100ft buffer around trailhead
Green Mountain Housing - Imminent	10	Trees are adjacent to the two unburned houses.
Green Mountain Housing	1.8 acres	100ft buffer around area.
Onahu Creek Trailhead	3	In a clump within an island adjacent to parking area
US HWY 34	19.4 acres	Buffer 100ft along a one-mile length starting at Green Mtn Trailhead and extending south.
US HWY 34	50	Two small areas identified in collector – 30 at one site and 20 at the other.
Moraine Park Stables	4	4 large beetle-killed ponderosa pine burned at base adjacent to parking lot
Fern Lake Road & Trailhead	150	Dense aspen with burned boles and bases along road corridor; large diameter cottonwood with burned boles and bases at trailhead.

Design/Construction Specifications: Hazard trees will be felled by hand or machine. The hazard trees at Moraine Park Stables, Fern Lake Road and Trailhead, North Inlet Trailhead, Kawuneeche horse corral, Kawuneeche cold storage building, and Onahu Creek Trailhead should be mitigated by park staff before the areas are open to the public. The 100ft hazard tree buffer at Green Mountain Trailhead, Green Mountain Housing, and along US HWY 34 should be mitigated by contract, utilizing mechanical equipment. Usable material may be removed. Non-usable material and slash should be piled for later burning; if necessary, it may be removed to an approved location for burning or pile burned on-site. Hazard tree mitigation at the Grand Lake Cemetery should be managed in accordance with the Rocky Mountain National Park Grand Lake Cemetery Permit (1997).

MONITORING PLAN

1) Treatment Objectives:
This treatment is designed to eliminate the safety concern of hazard trees impacting recreation and administrative areas, and road corridors.

2) Describe how implementation will be monitored.
Park personnel will oversee the felling of hazard trees and will make adjustments as needed. At a minimum, progress will be tracked weekly.

3) Describe how effectiveness will be monitored, how it will be monitored, and within what time period.
The weekly monitoring will include documentation of progress, issues identified and potential solutions.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
[redacted]	[redacted]

MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years:	COST / ITEM
[redacted]	[redacted]
[redacted]	[redacted]
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE	PLANNED COMPLETION DATE	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2021	11/18/2020	9/30/2021	F	278 trees	[redacted]	[redacted]	[redacted]
2021	11/18/2020	9/30/2021	F	21.2 acres	[redacted]	[redacted]	[redacted]
TOTAL							[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	E, C
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	P, M, T
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, E = Equipment **M** = Materials/Supplies, T = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

See Treatment map in Appendix

BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Road Storm Patrol	**Spec #**	ES-8
NFPORS TREATMENT CATEGORY*	Human Life and Safety	**FISCAL YEAR(S) (list each year):**	2021
NFPORS TREATMENT TYPE *	Hazard Removal - Other		

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

NPS maintained roads within the fire perimeter receive year-round public use. Culvert failure, debris accumulations and instances of adverse surface erosion threaten to strand motorists in relatively remote locations and damage road infrastructure.

TREATMENT

General Description: There are 3.5 miles of transportation network with culverts at risk of inundation, debris deposition, flood damage and other post-fire related impacts from elevated flows carrying sediment and debris. There is the increased potential of culverts clogging with sediment and debris from burned and damaged woody debris. Established rainfall thresholds will require the need to assess the potential damage to the roads and culvert infrastructure. Due to the fires removal of ground cover there is a higher failure risk of culvert clogging/damage during higher rainfall events. Storm patrols are designed to identify clogged culverts and road prism damages and to take measure of removing clogged debris.

Location/(Suitable) Sites: Approximately 2.5 miles of the Hwy. 34/Trail Ridge Road between the West Entrance Station to the Green Mountain Trailhead and 1.0 miles of the Fern Lake Road between the Moraine Park Stables to Fern Lake Trailhead. The BAER team utilized the soil burn severity map, debris flow map developed by the USGS and the parks road/culvert inventory to prioritize areas with a higher degree of impact from the fire.

Design/Construction Specifications: Prior to any storm/rain events the following should be implemented:

1. Culverts will need to have excess sediment material and debris removed from the culverts inlet drainage system as well as this material needs to be placed outside of the bank-full channel and floodplain where it cannot re-enter stream channels. Preferably the material will be moved to an off-site debris staging site.
2. The culvert cleaning before the first rain events will require that all accumulated soils, gravels, rocks and debris be removed before the seasonal rains begin. Culvert inspections and cleaning needs to take place before storm patrol teams begin their rainfall culverts inspections.
3. Utilization of both the watershed response and USGS debris flow map illustrating the culvert points locations of known culverts that should be used as an inspection guideline.
4. Immediately after receiving heavy rain the NPS will send out patrols to the roads and facilities of high importance on NPS lands to identify road and other hazard conditions – obstructions such as rocks, sediment, trees and plugged culverts so the problems can be corrected before they worsen or jeopardize motor vehicle users.
5. The road patrols shall bring in heavy equipment necessary to mechanically remove any obstructions from the roads and culvert inlets where necessary.
6. All excess material and debris removed from the drainage system shall be placed outside of the bankfull channel and floodplain where it cannot re-enter stream channels. Preferably the material will be moved off-site.

MONITORING PLAN

7) Treatment Objectives:
The objective of the treatment is to identify and minimize impacts to park infrastructure, primarily roads, as well as threats to life and safety.

8) Describe how implementation will be monitored.

- Inspections of culverts identified from USGS debris flow map and watershed response maps will establish the initial needs for culvert cleanings
- The storm patrol team maps and identifies the chronic culverts using AGOL Collector or similar program
- Identified culverts that are compromised with sediment, rocks, woody debris and pose a safety to life and property will be identified.
- If the blockage is determined to NOT be capable of being removed by the storm patrol team theteam will note this for future maintenance activities.
- Clogging and cleaning should be noted using AGOL Collector or similar program to add to mapfor future storm patrols visits.
- If the clog is not capable of being dealt with by the storm patrol team a backhoe should berequested to remove the clog or debris materials.

9) Describe how effectiveness will be monitored, how it will be monitored, and within what time period.
The storm patrol will verify that the work has been completed and the infrastructure is ready for the next rain event. Storm patrollers can also recommend changes to, or additional treatments, in the first year after the fire.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**
Patrol East Side - 2 – WG 10 @ $190.80/day X 10 patrol days =	$3,816
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**

TOTAL MATERIALS AND SUPPLY COST	
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL CONTRACT COST	

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (MM/DD/YYYY)	PLANNED COMPLETION DATE (MM/DD/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2021	12/1/2020	09/30/2021	F	events	[redacted]	[redacted]	[redacted]
						[redacted]	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	P, E
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, E = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

ESRS INDIVIDUAL TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Cultural Resource Compliance	**Spec #**	ES-9
NFPORS TREATMENT CATEGORY*	Cultural and Heritage Resources	**FISCAL YEAR(S) (list each year):**	2021, 2022
NFPORS TREATMENT TYPE *	Protect Cultural/Heritage Sites	**WUI? Y / N**	N
IMPACTED COMMUNITIES AT RISK	None	**IMPACTED T&E SPECIES**	None

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

- Emergency stabilization treatments proposed in the 2020 East Troublesome BAER plan for Rocky Mountain National Park require compliance with Sec. 106 of the National Historic Preservation Act (NHPA) in order to accomplish the treatments. To comply with the Act, the area of potential effects (APE) must be defined and identification of historic properties within the APE is required; then a determination of affect must be made as to whether an historic property is affected by the proposed undertaking (36.CFR.800, and 2008 PA for NHPA Sec. 106.). Archeological survey in the APE must be completed according to the Secretary of the Interior Standards by a professional Archeologist to comply with NHPA to complete this stabilization work. Archeologists are needed to comply with the Act or if certain criteria are met the 2008 Programmatic Agreement for Section 106 Compliance between the National Park Service, the Advisory Council on Historic Preservation (ACHP) and the National Conference of State Historic Preservation Officers (NCSHPO) may be used.

TREATMENT

General Description:

A crew consisting of [redacted] to complete National Historic Preservation Act (NHPA) Section 106 compliance and project monitoring for activities associated with other ES specifications developed for treatments as a result of the East Troublesome Fire. [redacted] archeologists, and to assist with any Native American Graves Protection and Repatriation Act (NAGPRA) issues and tribal consultation.

This treatment includes the following activities and goals:

- Conduct archeological site monitoring, protection, field data collection and reporting to comply with Section 106 of the NHPA for trail stabilization, campsite safety or repair, bridge and trail stabilization, sign repair and installation activities, and assist with SHPO and THPO consultation.
- Conduct NHPA Section 106 compliance for stabilizing a wildlife exclosure fence.
- Recommend archeological site stabilization and protection measures to prevent degradation and loss of site integrity and potential looting.
- Ensure emergency stabilization treatments conform to Section 106 of the NHPA.
- Facilitate tribal consultation during activities and during potential NAGPRA inadvertent discoveries.

Location/(Suitable) Sites:

- Within approximately [redacted] and within the Big Thompson District (BTD) burn area, and within approximately [redacted] in the Colorado River District (CRD) burn area.
- Within and adjacent to the following [redacted]

- [redacted]

Design/Construction Specifications:

- Monitor and document Emergency Stabilization treatments thatcould potentially adversely affect historic properties.
- Conduct NHPA Section 106 compliance for said treatments prescribed for other resources or values at risk on NPS managed lands affected by the East Troublesome Fire.
- Conduct archeological survey where hazard trees will be treated and where culverts, bridges, puncheons, signs, and other trail infrastructure will be repaired, replaced or removed, or where other trail related activities will occur along approximately [redacted]
- An archeological survey will be conducted prior to decommissioning wilderness campsites and or hazard tree removal in these areas to identify any historic properties, to make determinations of affect, and to propose mitigation strategies to resolve or mitigate potential adverse effects.
- Archeologists will use a tablet with Arrow 100 GPS or one with an accuracy of 1 meter or less to document artifacts, features, and for documenting site conditions to provide accurate data for emergency stabilization needs and activities.
- A GPS with an accuracy of 1 meter or less will be used to document inherently and culturally important sensitive inadvertent discoveries such as burial sites, exposed human remains, and other historic or Native American unassociated funerary objects, sacred objects, or objects of cultural patrimony (as per 25 U.S. Code § 3001) as a result of increased exposure of cultural materials due to the fire and possibly treatment activities.
- Archeologists will use a tablet with Arrow 100 GPS to accurately document trails, signs, bridges, and any other park infrastructure treated, repaired, or replaced, to meet or exceed a level of effort and documentation standards as outlined in 36 CFR § 800.4(b)(1) and SOI standards outlined in NPS 28.
- Archeologists will record field data to a high level and standard to facilitate professional, accurate and comprehensible project descriptions and maps for inclusion in SHPO and THPO consultation packages.

Design/Construction Specifications cont.:

- X,Y,Z coordinate data (accurate within 1 meter), photos and other depictions of existing campsite features that are slated for removal, modification, or treated in some manner shall be documented within park infrastructure areas containing or near to historic properties areas so accurate baseline data is captured and can used for following years monitoring and additional possible treatments.
- Integrity and condition of potentially effected historic properties within or near park infrastructure treated shall be accurately documented so precise comparison of any changes in condition and intra-site geospatial relationships from year to year can be accomplished through accurate photo points and GIS data of artifacts and park infrastructure containing sub-meter coordinates.

Purpose of Treatment Specifications (relate to damage/change caused by fire):

- This activity will fulfill the requirements for cultural resource compliance activities under the National Historic Preservation Act as codified in 36.CFR.800, and as described in the NPS 2008 PA for NHPA Sec. 106.

Treatment Reasonableness and Cost Effectiveness:

- ROMO Cultural Resources Division does not have the capacity to conduct NHPA Section 106 compliance for activities associated with East Troublesome Fire BAER treatmentspecifications.
- Providing ROMO [redacted] for one year will ensure NHPA Section 106 compliance for treatments that could affect historic properties, will ensure potential adverse effects to historic properties are avoided, and may reduce potential NAGPRA issues.

- [redacted] Park Cultural Resources Program Manager for any NAGPRA issues and for tribal consultation, and will conduct planning with, lead and oversee the [redacted] and documentation for quality control and superior scientific results that will add value to the park's cultural databases and in general, knowledge of the history of the park. The Park Cultural Resources Manager/Archeologist will coordinate with [redacted].

Land Use Plan Conformance:

Treatment consistent with Agency Land Management Plan (identify which plan):

- National Historic Preservation Act as codified in 36 CFR 800.
- US DOI Final Land Protection Plan - Rocky Mountain National Park (1984)
- Rocky Mountain National Park - Trail Plan (2000)

MONITORING PLAN

10) Treatment Objectives:

Achieve compliance with the National Historic Preservation Act for activities associated with the protection, stabilization, and avoidance of adverse effects to historic properties as defined in 36 CFR § 800.5.

11) Describe how implementation will be monitored.

Tasks listed in the design section above will be tracked through GPS data collected about treatment areas which will also benefit other resources and park infrastructure documentation. Tasks will also be tracked through daily activity logs and through assessment forms to document stabilization treatments and associated activities. Photo documentation using a tablet camera connected to a sub-meter GPS will be used for documentation, and a report will be prepared throughout the post-fire effect mitigation efforts. A draft and final report summarizing field season findings shall be submitted to Regional Archeologist and Park Cultural Resources Program Manager/Archeologist no less than one month before the end of the GS-9 Archeologist's first year appointment. The report at minimum will describe all treatment activities, describe any effects to historic properties, and document any new and previously identified historic properties. The report will also provide recommendations for monitoring and documentation of year two and three stabilization treatments activities. Standardized ROMO procedures and forms will be used and followed as well as guidance of NPS 28, RM #28A, applicable National Register Bulletins, and also as defined and provided by the Colorado SHPO.

12) Describe how effectiveness will be monitored, how it will be monitored, and within what time period.

A [redacted] will provide oversight and indirect supervision for the [redacted] Either will assure that documentation, as specified above, has been completed at regular intervals, and that GIS data and other site records (e.g. ROMO CRIS database) has been updated to reflect stabilization treatments potentially effecting archeology sites. The GS-9 will lead the three GS-7s and will collaborate, coordinate and consult with the GS-11 and GS-12 and archeologists for planning survey areas, data collection, report writing, any public outreach, and for consultation with Tribes or CO-SHPO when required. ROMO Superintendent FY ASMIS/CRIS

certifications will show all updated site condition assessments of sites monitored as a result of Sec. 106 NHPA compliance and monitoring activities. Lastly, treatments will be considered effective if Section 106 NHPA compliance and documentation are completed consistent with the Secretaries Standards for preservation and will be considered successful when CO-SHPO concurs with the park's Sec. 106 NHPA findings and recommendations.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
[redacted]	[redacted]
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years =	[redacted]
[redacted]	[redacted]
TOTAL TRAVEL COST	[redacted]
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL CONTRACT COST	**$0**

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2021	02/13/2021	09/30/2021	F	Pay Periods	[redacted]	[redacted]	[redacted]
2022	10/01/2021	12/17/2021	F	Pay Periods	[redacted]	[redacted]	[redacted]
						TOTAL	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	P, E, T
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment, **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Implementation Leader	**Spec-#**	ES-10
NFPORS TREATMENT CATEGORY*	Administration	**FISCAL YEAR(S) (list each year):**	2021
NFPORS TREATMENT TYPE *	Administration		

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

Implementation Leader is needed to coordinate ES and BAR work and to submit annual reports.

TREATMENT

General Description:
This specification will fund salary, travel and miscellaneous expenses for personnel responsible for overseeing implementation of proposed BAER treatments and activities associated with the East Troublesome Fire in FY21.

Location/ (Suitable) Sites: East Troublesome Fire, Rocky Mountain National Park, Colorado

Design/Construction Specifications: Among the tasks to be performed under this specification include (as applicable):
(1) Develop and amend specifications
(2) Develop scopes of work
(3) COTR
(4) Interagency coordination
(5) Implementation monitoring
(6) Budget tracking
(7) Communication and education
(8) Accomplishment reporting
(9) Environmental compliance

Purpose of Treatment Specifications (relate to damage/change caused by fire): The East Troublesome Fire created a variety of emergency post-fire issues on NPS lands The purpose is to provide quality control and accountability over project implementation of treatments designed to respond to damage directly caused by the fire.

Treatment Reasonableness and Cost Effectiveness: Proper project oversight is critical to ensure implementation, documentation, and reporting are completed on time and within budget. This specification will likely lead to cost savings throughout the duration of this project.

Treatment Effectiveness Monitoring Proposed: The Project Administrator will monitor to ensure specified projects are successfully completed on time and within budget, including any projects incorporated by approved plan amendments. Annual and final accomplishment reports will be used to document treatment effectiveness.

Treatment consistent with Agency Land Management Plan (identify which plan): Foundation Document Rocky Mountain National Park, 2016

Location/(Suitable) Sites:

Rocky Mountain National Park

Design/Construction Specifications:
NA

MONITORING PLAN

1) **Treatment Objectives: Effectively implement BAER specifications and report accomplishments.** The Implementation Leader is necessary to ensure the work specified in the BAER plan is completed in a timely and professional manner, and adequate accountability of treatment effectiveness and funding expenditures is maintained and documented.

2) **Describe how implementation will be monitored. Through fiscal audits and annual accomplishment reports**
The Implementation Leader will monitor to ensure specified projects are successfully completed on time and within budget, including any projects incorporated by approved plan amendments. Annual and final accomplishment reports will be used to document treatment effectiveness.

3) **Describe how effectiveness will be monitored, how it will be monitored, and within what time period. Implementation activities will be according to approved specifications in BAER plan.**
Project oversight is critical to ensure implementation, documentation, and reporting are completed on time and within budget. This specification will likely lead to cost savings throughout the duration of this project.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**
[redacted]	[redacted]
TOTAL PERSONNEL SERVICE COST	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
Miscellaneous Supplies	[redacted]
TOTAL MATERIALS AND SUPPLY COST	[redacted]
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**

TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL CONTRACT COST	

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2021	01/01/2021	09/30/2021	F	1	[redacted]	1	[redacted]
						TOTAL	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	M
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	P
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Culvert Trash Rack	**Spec-#**	ES-11
NFPORS TREATMENT CATEGORY*	Human Life and Safety	**FISCAL YEAR(S) (list each year):**	2021
NFPORS TREATMENT TYPE *	Hazard Removal - Other		

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

An unnamed stream draining Green Mountain flows through a 48" culvert with flares under Highway 34 between the Onahu Ranch and Green Mountain trailhead. Much of the drainage is burned which resulted in predominately moderated soil burn severity. As a result, this watershed will experience increased runoff with the ability to mobilize debris in and adjacent to the stream channel which can plug the culvert and cause damage to or washout Highway 34.

TREATMENT

General Description: The treatment will consist of installing a prefabricated bullnose trash rack on the culvert inlet and flares. This will allow for anticipated increased streamflows to pass through the culvert while preventing debris from plugging the culvert and causing road damage.

Location/(Suitable) Sites: Highway 34 (Trail Ridge Rd) at Green Mountain Trailhead where unnamed stream draining Green Mountain crosses under the road.

Design/Construction Specifications: See attached design/installation spec sheet in Relevant Details, Maps, and Documentation Section. The following link is to a company that makes prefabricated bullnose trash racks as an example: https://www.haala.com/products/bullnose-trash-guards .

MONITORING PLAN

1) **Treatment Objectives:** The objective of this treatment is to minimize damage to Highway 34 from a culvert that has the potential to plug from increased post-fire streamflows.

2) **Describe how implementation will be monitored**. Monitoring of the treatment will be a completed installation of the bullnose trash rack. Additional monitoring will be to inspect the culvert during and following storm events to determine if debris removal is warranted.

3) **Describe how effectiveness will be monitored, how it will be monitored, and within what time period.** Effectiveness will be monitored by inspecting the trash rack following storm events and the amount of debris captured with no damage to the road. Effectiveness monitoring will occur during the primary storm event period, April through September.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**

Trash Grate Installation – 2 – WG 10 @ $47.70/hr X 12 hrs=	[redacted]
TOTAL PERSONNEL SERVICE COST	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL CONTRACT COST	

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (MM/DD/YYYY)	PLANNED COMPLETION DATE (MM/DD/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2021	01/15/2021	01/30/2021	F	1	[redacted]	[redacted]	[redacted]
						TOTAL	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

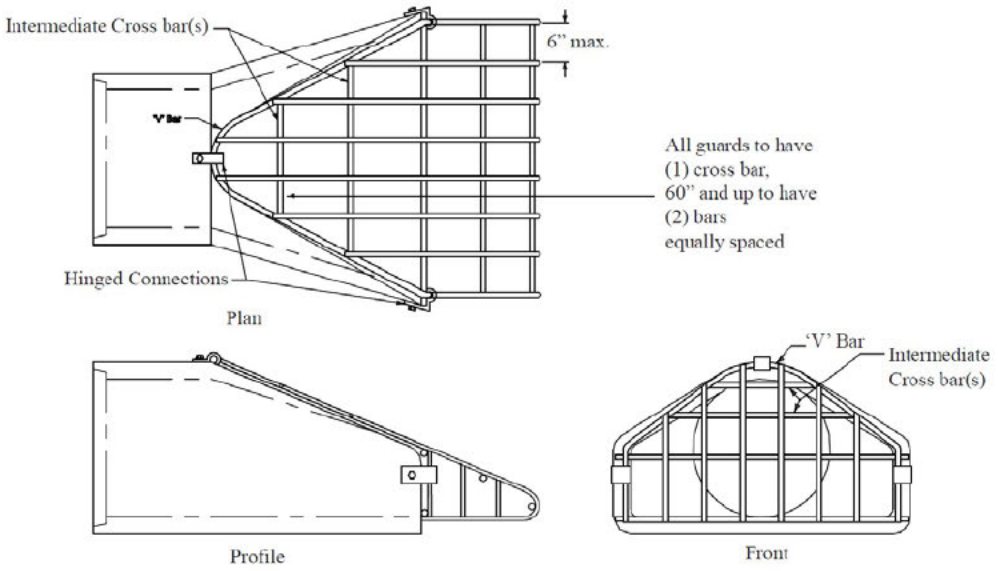
1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	
3. Estimate supported by cost guides from independent sources or other federal agencies	M

4. Estimates based upon government wage rates and material cost.	P
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, E = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

Bullnose Trash Guard For Flared Ends



Hot dip galvanized per ASTM A123

Bar Sizes			
Standard Design			
Pipe Size	Hole Dia. Required	Bolt Dia.	Bar Size
12"-18"	3/4"	5/8"	5/8"
21"-51"	7/8"	3/4"	3/4"
54"-90"	1-1/8"	1"	1"
Bolt Lg. = Pipewall Thk. + 2-1/2"			

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Ph: 507-794-5821 ext. 115
Cell: 507-920-9182

BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Burned Snowmobile Fence	**Spec-#**	ES-12
NFPORS TREATMENT CATEGORY*	Asset Repair and Replacement	**FISCAL YEAR(S) (list each year):**	FY21
NFPORS TREATMENT TYPE *	Fence Replacement		

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

.6 mile of wooden jack rail fence was either burned or damaged by the fire and wind-related event. This fence is essential to keep snowmobilers confined to a special motorized use corridor passing thru the park between County roads 48 and 491 in the Colorado River District of the park. Without this obvious barrier, in place for years, snowmobilers will leave the approved motorized corridor and cause potential harm to natural resources outside the corridor.

TREATMENT

General Description: Remove existing burned fencing and install buck and rail fencing along an approximately 0.6 mile corridor between County roads 48 and 491 within the burn perimeter; construction on both sides of corridor means 1 mile of buck and rail fencing.

Location/(Suitable) Sites: Within the burned forest sections of the special use motorized corridor between County roads 48 and 491.

Design/Construction Specifications: The existing buck and rail fencing was constructed of local native tree species in the area. Replacement of this fencing should be with similar materials; lodgepole fencing is common in the area and would be an appropriate fencing material. Removal of burned fencing materials and fallen trees in the area of the fence line will be required prior to installation of the new fence line.

MONITORING PLAN

1) **Treatment Objectives:** Purpose of this treatment is to confine snowmobilers to the groomed trail corridor, and so the primary objective of constructing the fence is to ensure new fence line is stable and complete along both sides of the corridor within the burn perimeter.
2) **Describe how implementation will be monitored.** If constructed with NPS labor, implementation will be monitored by the Facilities supervisor overseeing the crew. If constructed by a contractor, implementation will be monitored by a Facilities division Contracting Officer Representative.
3) **Describe how effectiveness will be monitored, how it will be monitored, and within what time period.** Effectiveness by onsite visits to the job site on a scheduled basis during the construction and at construction completion to ensure it meets the standards described by the NPS.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**
[redacted]	[redacted]

[redacted]	[redacted]
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL CONTRACT COST	

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2021	12/01/2020	01/15/2021	F	Mile	[redacted]		[redacted]
2022							
2023							
2024							
						[redacted]	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	

3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

ESRS INDIVIDUAL TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Public Safety & Resource Protection Signs	**Spec-#**	ES-13
NFPORS TREATMENT CATEGORY*	Human Life and Safety	**FISCAL YEAR(S) (list each year):**	2021
NFPORS TREATMENT TYPE *	Warning and Safety Signs	**WUI? Y / N**	
IMPACTED COMMUNITIES AT RISK		**IMPACTED T&E SPECIES**	N/A

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

Fire hazard warning signs are intended to inform the public of the residual risks left behind by the East Troublesome fire. Without the warning signs the risk of injury or death would be greater. The East Troublesome fire has burned regulatory signs in the fire perimeter. Regulatory signs are used by travelers to communicate regulation and information on the road to ensure safe motor operation within the Park. Without the signs the potential for accidents would increase. Regulatory signs provide for safe driving and information on roads managed by the Park.

TREATMENT

General Description:

The East Troublesome fire has burned regulatory signs in the fire perimeter. These signs provide for safe driving along Park managed roads and allow traffic to communicate their location on the road to avoid collisions. Warning signs will inform the public of the hazards associated with fire weakened trees, rockfal and debris and other potential hazards within the fire area.

Location/(Suitable) Sites: Park Service managed roads and recreation sites within the East Troublesome fire perimeter. Installation of hazard signs should be placed at locations within the fire perimeter and at the start of all trails that have some or all trail sections within the fire perimeter.

Design/Construction Specifications:

A. Fire Hazard Warning Signs

1) Install signs on roads and trail heads at all locations roads and trails intersect the fire.
2) Example language: “Warning – Danger. Wildfire burn area. Walking or driving through this area could result in injury or death. Fire weakened trees, unstable slopes, and other hazards are present” or as approved by local recreation and/or road specialist.

B. Regulatory Signs

1) Replace fire damaged signs and posts
2) Regulatory signs include Stop/Yield signs, Speed Limit Signs, No Parking Signs, One Way signs, etc.
3) Regulatory signs must meet the requirements of the Manual on Uniform Traffic Control Devices (MUTCD)

Fire Hazard Warning signs are intended to inform the public of the hazards that were left behind by the East Troublesome Fire. Regulatory signs proposed for replacement have been damaged by the fire. Damage includes burned signposts and burned/melted signs.

Costs for this treatment were developed using Park staff knowledge and local supplier cost estimates.

Treatment consistent with Agency Land Management Plan (identify which plans):
2006 NPS management Plan

MONITORING PLAN

13) **Treatment Objectives:** In all cases signage is intended to either protect the public from hazards left by the East Troublesome Fire or replace damaged regulatory signs.

14) **Describe how implementation will be monitored.** Sign installation locations will be recorded.

15) **Describe how effectiveness will be monitored, how it will be measured, and within what time period.** Work leads or supervisors will spot check field work to ensure work quality as installations are completed.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
[redacted]	[redacted]
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]

[redacted]	
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL CONTRACT COST	

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2021			F	1	[redacted]	[redacted]	[redacted]
						TOTAL	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	M
2. Documented cost figures from similar project work obtained from local agency sources.	E
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	P
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Exotic Plant Control	**Spec#:**	BAR- 1
NFPORS TREATMENT CATEGORY*	Invasive Species	**FISCAL YEAR(S) (list each year):**	2022, 2023
NFPORS TREATMENT TYPE *	Chemical Treatment	**WUI?**	N
IMPACTED COMMUNITIES AT RISK	n/a	**IMPACTED T&E SPECIES**	

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

Approximately 21,300 acres of riparian corridor, forest, meadows, alpine tundra, and other montane and subalpine habitat were burned within the Park boundary during the East Troublesome Fire. While fire can reinvigorate native vegetation in the long term, the lack of competition from native vegetation in the first several years following the fire provides an opportunity for exotic invasive weeds to spread and establish, ultimately suppressing native vegetation from returning. Creation of holding lines and structure defense by hand crews and dozerlines also has the potential to bring in exotic invasive seed or create conditions where exotic invasive plants can readily establish. Non-native plants were also present in some areas prior to the fire, but now have a much greater potential for spread and invasion with the lack of competition from native vegetation. It is critical to minimize the establishment of these exotic invasive plants in the first years following the fire to allow for the native vegetation to begin to reestablish without further degradation of critical habitat.

TREATMENT

General Description:

Fire, especially in areas where heat intensity was high, temporarily eliminates much if not all the native vegetation that was once present. With this lack of native vegetation, it provides heightened opportunities for exotic invasive plants to spread and establish which further reduces the chances of native vegetation returning to these sites. It is critical that native vegetation does reestablish as it provides critical habitat for many species of wildlife in the Park and also provides natural site stabilization and erosion control. The fire regime could also change if exotic invasive plants are allowed to dominate (for example, cheatgrass has been documented as increasing fire frequency throughout western states). In order to prevent exotic invasive plants (noxious weeds) from establishing within the burn area, it is critical that surveys and early treatments occur in the first years post fire. Exotic invasive species most likely to occur within the burn due to their presence in nearby locations include Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), bull thistle (*Cirsium vulgare*), common mullein (*Verbascum thapsus*), orange hawkweed (*Hieracium aurantiacum*), cheatgrass (*Bromus tectorum*), knapweeds (*Centaurea ssp.*), leafy spurge (*Euphorbia* esula), and houndstongue (*Cynoglossum officinale*) although many other noxious species may be present as well. The main herbicides likely to be used to treat these exotic invasive species include Milestone, Quinstar, Plateau, Overdrive, Rodeo, and Esplanade mixed with the appropriate surfactants to be most effective in controlling these species.

Location/(Suitable) Sites:

There are approximately 47 miles of trail that will need to be surveyed and treated. These include the North Inlet Trail, Big Meadows/Tonahutu Trail, Green Mountain Trail, Onahu Trail, Valley and CO River Trail, CRD Admin Trail, Horse and Snowmobile Trails, Grand Lake Lodge Trail, Bowen Gulch Trail, Bowen Baker Trail, and Coyote Valley Trail on the Colorado River District of the park. On the East side, trails within the burn perimeter include Spurce Lake Trail, Fern Lake Trail, Cub Lake Trail, Mill Creek Trail,

Moraine Park Trails, Upper Beaver Meadows Trails, Beaver Mountain Trail, and lower part of the Ute Trail.

Stream banks through Moraine Park and Upper Beaver Meadows are also particularly susceptible to exotic plant invasions and will require surveying along the banks. These areas are approximately 8 miles in length.

Additional areas that will require exotic plant surveys and treatments include several locations where clearing and fire suppression activities have occurred around structures or where contingency fire line has been constructed. These areas are approximately 10 miles in length.

Design/Construction Specifications:
Teams of natural resources staff will survey and treat exotic invasive plant infestations with herbicides using backpack sprayers. They will follow all mitigations outlined in the park's 2018 Exotic Plant Management Plan and Environmental Assessment so as not to impact waterways or any other resources of concern within the burned areas and other suppression areas. Different herbicides will be required depending on the species found on the initial surveys. Team size and herbicides will be determine based on the species found and abundance of plants in each area, but in general each team will consist of 2 to 3 people. When appropriate, smaller infestations of exotic invasive plants may be manually removed using shovels or similar hand tools. If exotic plants are flowering, flower heads will be clipped, bagged, and disposed of appropriately off site.

Certain species of exotic plants are already known to exist along various trails of the park. Stock use will provide additional pressures of exotic species seeds moving into trail corridors. Suppression activities such as hand line and dozer line may have also introduced exotics species to the edges of the fire perimeter where such activities took place. Waterways will also be susceptible to the spread and transport of exotic species.

Without early detection and rapid response to these invasive species, weeds will quickly overtake the burned areas and prevent the establishment of critical wildlife habitat within the Park. Once established, the cost of controlling exotic invasive species becomes nearly prohibitive. It is much more cost effective to treat invasive plants and protect Park resources early while the new infestations of noxious weeds are still manageable.

Per the park's 2018 Exotic Plant Management Plan and Environmental Assessment, exotic invasive plants should be surveyed and treated. Furthermore, according to the Colorado Department of Agriculture, List A noxious weeds such as orange hawkweed (*Hieracium aurantiacum*) are required to be controlled, and List B noxious weeds should be managed whenever possible to stop their further spread. Other policy such as Executive Order 131112 also direct actions related to prevention and control efforts of invasive species on Federal lands.

MONITORING PLAN

1) **Treatment Objectives:**
The purpose of these treatments are to reduce or eliminate the spread of exotic invasive species within the burn or suppression areas to ensure that native vegetation can begin to reestablish on these sites.

2) **Describe how implementation will be monitored.**
Initial surveys will be conducted to determine where exotic plants are establishing. These surveys will be conducted by staff in pairs travelling along trails within the burn scar, visiting locations where clearing or other suppression activities have occurred. Future monitoring will occur in subsequent years to observe

whether treatments are successful, and adjustments will be made to improve treatment success as necessary.

3) Describe how effectiveness will be monitored, how it will be monitored, and within what time period.

Surveyed and treated sites will be revisited annually for at least three years to monitor effectiveness of treatment actions. If after three years, continued monitoring or treatment seems necessary, these actions will continue as resources and funding allow.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
[redacted]	[redacted]
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**

TOTAL CONTRACT COST	[redacted]

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
						[redacted]	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	P, E, M, T
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	P
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Limber Pine Recovery	**Spec-#**	BAR-2
NFPORS TREATMENT CATEGORY*	Forestry	**FISCAL YEAR(S) (list each year):**	2022 2023 2024
NFPORS TREATMENT TYPE *	Planting	**WUI?**	N
IMPACTED COMMUNITIES AT RISK	n/a	**IMPACTED T&E SPECIES**	

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

Four limber pine stands totaling approximately 240 acres have been burned by the East Troublesome Fire. Limber pine is the only five needle white pine in the park and defines the park's alpine tree line. It plays a valuable role in slope stability, snowpack retention, food webs, and cultural landscapes. Limber pine in the southern Rocky Mountains is in decline due to a native mountain pine beetle but also anthropogenic causes including white pine blister rust and climate change. While fires can open habitat for limber pine stands to reestablish, Clark's nutcrackers must first cache the seeds in the burn area. High intensity fires that cause limber pine mortality can locally extirpate stands of this declining species when nearby seed sources are not available for stand regeneration.

TREATMENT

General Description: With limber pine in decline, the NPS and USFS have created a Proactive Limber Pine Conservation Strategy for the Greater Rocky Mountain National Park Area (2019). Because Rocky Mountain National Park has limber pine stands with some of the highest resistance to white pine blister rust in the southern Rocky Mountains, the preservation of stands within the park have been identified in the plan as critical to the future of limber pine both outside and inside the park.

The burned stands are unlikely to regenerate naturally after the fire because of numerous stressors have reduced seed production and post-fire regeneration requires caching by Clark's nutcrackers to regenerate. Because the seed available for this project is limited, seedlings will be propagated and outplanted. This method uses 10% of the seed that direct seeding requires.

Location/(Suitable) Sites:

Cones of limber pine will be collected from known stands within the park. The sites for planting were identified in the park's vegetation map and BARC as being limber pine stands that were subjected to moderate to high intensity fire. Sites include the Steep Mountain grove (45 acres), the Mount Patterson stand (93 acres), Castle Rock (30 acres) and Fern Lake (5 acres); of these, only the Steep Mountain and Fern Lake groves are logistically feasible for planting seedlings. The driving time to the trailhead is approximately 0.5 hours.

Design/Construction Specifications:

Live planting will take place in FY22 and FY23 with propagated seedlings. To improve success, plantings will be microsited to the north or west of objects when possible. This disturbance will require archaeological clearance. Due to the complex logistical nature of transporting, handling, packing, and storing a high volume of seedlings from a nursery, a refrigerated rental truck will be necessary to keep seedlings fresh from the time of retrieval until planting.

At Steep Mountain, approximately 12 acres of the 45 impacted acres will be planted by selecting sites and regions with the best soil quality and placement near nurse objects; it is expected that the projected

density rate of trees per acre may not be achieved, yet the target number of trees will be distributed across the landscape. At Fern Lake, the entirety of the 5 acres burned will be planted at the recommended rate of 266 trees per acre.

The park's seed bank will be replaced through seed collection. Seed collection will take place in FY22 and FY23, and FY24 early in the masting cycle. Collection will follow the protocols from the conservation plan and take 2 to 6 cones per tree depending on cone production from high in the canopy.

The remote location of the planting sites, steep terrain, and the need to plant in the best microsites results in planting costs higher than commercial tree planting.

MONITORING PLAN

1) Treatment Objectives:

The purpose of the limber pine treatments is to assist the regeneration of the impacted limber pine stand to maintain critical limber pine habitat for the future. Studies have shown that limber pine can regenerate and outcompete other conifer species, as long as there is a seed source.

2) Describe how implementation will be monitored.

The park forest ecologist will select sites for limber pine seed collection. Natural resource staff will consult with park archeologists prior to planting to avoid areas of high cultural resource value. A park archeologist may also be on site to monitor during planting and rehabilitation if the likelihood of encountering cultural or archeological sites is high.

3) Describe how effectiveness will be monitored, how it will be monitored, and within what time period.

Monitoring of the planted limber pine site will occur in FY 24 using plots designed by the park forest ecologist to determine the effectiveness of the treatment. Future monitoring paid out of other fund sources will be necessary to observe that seeding and planting efforts have led to regeneration of these important stands.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	COST / ITEM
[redacted]	[redacted]

[redacted]	
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
[redacted]	[redacted]
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	[redacted]
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL MATERIALS AND SUPPLY COST	[redacted]
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2021							
2022	06/01/2022	09/30/2022	F	Planting	[redacted]	[redacted]	[redacted]
2023	06/01/2023	09/30/2023	F	Planting			
2024	06/01/2024	09/30/2024	F	Planting			
						TOTAL	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Trail Stabilization and Rehabilitation	**Spec-#**	BAR-3
NFPORS TREATMENT CATEGORY*	Asset Repair and Replacement	**FISCAL YEAR(S) (list each year):**	FY22, 23
NFPORS TREATMENT TYPE *	Repair minor trail asses		

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

Trail rehabilitation maintenance in the FY22 and FY23 is necessary to keep park trails open, safe to the public, and to protect the tread surface and resources from further damage. Wooden infrastructure that was not addressed in FY21 Stabilization effort will be rehabilitated in FY22/23 to make trails passable by visitors; increased rates of rockfall and ravel that has fallen onto the trail will need to be removed; fire-caused windthrow will occur at above average levels and will need to be removed. BAER assessments have indicated many locations where the outer edge of the trail tread is now vulnerable to erosion, and downslope movement of material onto the trail tread will be an issue for several years. Burned drain bars and retaining logs that are minimally functional now will be replaced in these outyears to ensure long-term erosion control.

TREATMENT

General Description: The 47 miles of burned over trail will be stabilized and increased post-burn effects onto trails addressed each year to ensure a safe trail for visitors and that the extensive trail asset is protected and maintained. Increased annual windfall and erosion control/debris removal off trails is the focus on the outyear trails workload, along with tread stabilization on the outer edge of the trail that will be necessary in many locations to keep the trail in place.

Location/(Suitable) Sites: All 47 miles of trail that lie with in the burn perimeter, on both districts of the park.

Design/Construction Specifications: Windfall removal will occur early in the season to ensure safe passage and prevent social trailing. Erosion control and maintenance will be on ongoing effort. Stabilization of eroding outer edge slopes of the trail tread will be completed either with rocks or onsite native log materials, whichever is most appropriate at the site. Debris falling onto trails will be removed on an ongoing basis, as needed. Other minor wood structures that were not replaced in FY21 will be repaired or replaced as needed.

MONITORING PLAN

1. **Treatment Objectives**: Address the increased workload associated with the fire-damaged trails.
2. **Describe how implementation will be monitored.** The Trails Supervisor will monitor work, either individually or thru his crew supervisors, to ensure trails work meets park standards. One park trails work leader will be funded to oversee the Colorado Conservation Corp (CCC) crew that will primarily focus on these out-year trail maintenance needs.
3. **Describe how effectiveness will be monitored, how it will be monitored, and within what time period.** Park trail crew supervisors will oversee all work in the wilderness/backcountry; one park trails work leader will work directly with the CCC crew to monitor work performance on all ongoing work.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	COST / ITEM
[redacted]	[redacted]
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL MATERIALS AND SUPPLY COST	
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2021							
2022	04/01/2022	09/30/2022	F	Miles	[redacted]	[redacted]	[redacted]
2023	04/01/2023	09/30/2023	F	Miles			
2024							
						TOTAL	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

INDIVIDUAL TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Ranger Resource Protection Patrol	**Spec-#**	BAR-4
NFPORS TREATMENT CATEGORY*	Natural Resource	**FISCAL YEAR(S) (list each year):**	2022-2024
NFPORS TREATMENT TYPE *	Treatment Protection	**WUI? Y / N**	N
IMPACTED COMMUNITIES AT RISK	N/A	**IMPACTED T&E SPECIES**	N/A

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

TREATMENT

General Description: The East Troublesome Fire burned in areas of high visitor use in the park. There are 47 miles of formal trail, a myriad of informal social trails, 37 designated wilderness campsites, and over 200 archaeological sites within the burned area. Once emergency stabilization is finished, formal trail corridors and a small subset of campsites will be re-opened to visitors. Increased impacts from trespass ORVs on the Colorado River District (CRD) also is a concern. Enhanced agency presence is needed to keep visitors from ORV use and from accessing closed campsites, social trails, and overland routes to allow the burned area to naturally recover. The goal is to keep people on open formal trails and to minimize ORV trespass, soil and vegetation trampling, spread of exotic plants, and looting of archaeological sites during this vulnerable period of natural recovery. An increased agency presence is needed to address these concerns, and could include law enforcement rangers, wilderness/Backcountry rangers, and/or a park guide/information specialist.

Location/ (Suitable) Sites: An increased presence is needed on both sides of the park.

Design/Construction Specifications: NPS staff will provide increased patrols in key areas of the park where the fires burned. Patrols are to provide for deterrence and interdiction to prevent resource damage. Patrols also will replace visitor-moved logs and branches that had been placed on closed campsites, newly vulnerable archeological sites, and along social trails to conceal them and deter visitor access. At a minimum, one additional ranger is needed on each side of the park (total of two).

Purpose of Treatment Specifications (relate to damage/change caused by fire): Increased agency presence has proven to be an effective method for managing visitors to protect vulnerable park resources, natural and cultural. A ranger/information specialist also will produce considerable content for social media and monitor/respond to interactions and inquiries about the fire, post-fire effects, etc.

Treatment Reasonableness and Cost Effectiveness: NPS staff will interact directly with the public where access issues might occur; an online presence will reach a much greater audience. Law Enforcement rangers provide the opportunity to directly address negative interactions or illegal activity/entry into the burned area. Wilderness patrol rangers familiar with the terrain and burn-related issues are effective in addressing the concerns within Wilderness.

Treatment consistent with Agency Land Management Plan (identify which plan): Foundation Document, Rocky Mountain National Park, 2013.

MONITORING PLAN

1. **Treatment Objectives**: Increase agency presence to reduce impacts to natural and cultural resources.

2. **Describe how implementation will be monitored**: NPS supervisors will oversee all these activities.

3. **Describe how effectiveness will be monitored, and within what time period**: Evaluation of success/difficulties will be addressed on a routine basis and adjustments will be made accordingly.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	COST / ITEM
[redacted]	[redacted]
TOTAL PERSONNEL SERVICES	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
	COST / ITEM
TOTAL COST	[redacted]

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2022	04/01/2022	10/01/2022	F	1	[redacted]	[redacted]	[redacted]
2023	04/01/2023	10/01/2023	F	1	[redacted]	[redacted]	[redacted]
2024	04/01/2024	10/01/2024	F	1	[redacted]	[redacted]	[redacted]
						TOTAL	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	
3. Estimate supported by cost guides from independent sources or other federal agencies	E
4. Estimates based upon government wage rates and material cost.	F, M, T
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

ESRS INDIVIDUAL TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Cultural Resource Compliance	**Spec-#**	BAR-5
NFPORS TREATMENT CATEGORY*	Cultural and Heritage Resources	**FISCAL YEAR(S) (list each year):**	2022, 2023
NFPORS TREATMENT TYPE *	Protect Cultural/Heritage Sites	**WUI? Y / N**	N
IMPACTED COMMUNITIES AT RISK		**IMPACTED T&E SPECIES**	None

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

- BAR treatments proposed in the 2020 East Troublesome BAER plan for Rocky Mountain National Park require compliance with Sec. 106 of the National Historic Preservation Act (NHPA) in order to accomplish the treatments. To comply with the Act, the area of potential effects (APE) must be defined and identification of historic properties within the APE is required; then a determination of affect must be made as to whether an historic property is affected by the proposed undertaking (36.CFR.800, and 2008 PA for NHPA Sec. 106.). Archeological survey in the APE must be completed according to the Secretary of the Interior Standards by a professional Archeologist to comply with NHPA to complete this stabilization work. Archeologists are needed to comply with the Act or if certain criteria are met the 2008 Programmatic Agreement for Section 106 Compliance between the National Park Service, the Advisory Council on Historic Preservation (ACHP) and the National Conference of State Historic Preservation Officers (NCSHPO) may be used.

TREATMENT

General Description:

[redacted] to continue work started in 2021 for completing National Historic Preservation Act (NHPA) Section 106 compliance for activities associated with specifications developed for treatments as a result of the East Troublesome Fire. Secondly, continue managing cultural data collected in year one and two and finalizing archeological survey reporting and completing final SHPO correspondence for successful completion of Section 106 compliance will be conducted before or by the end of year three. Ensure continued support and involvement of local [redacted] by continued funding to help oversee and review work of [redacted], to assist with any Native American Graves Protection and Repatriation Act (NAGPRA) issues and tribal consultation, and to help guarantee all products are professionally completed and on time so all other treatment activities continue on schedule.

This treatment includes the following activities and goals:

- Continue to conduct archeological site monitoring, protection, field data collection and reporting to comply with Section 106 of the NHPA for trail stabilization, and assist with SHPO and THPO consultation.
- Finalize NHPA Section 106 compliance by the middle of year twoif not sooner for wetland-vegetation treatment, and planting limber pine within approximately 50 acres and monitor activity ifnecessary.
- Finalize recommendations for archeological site stabilization and protection measures to prevent degradation and loss of site integrity and potential looting.
- Ensure BAR treatments conform to Section 106 of the NHPA throughout all three years.
- Continue to facilitate tribal consultation during activities and for any NAGPRA related discoveries.

Location/(Suitable) Sites:

- Within approximately [redacted]a, and within approximately [redacted]
- Within approximately [redacted]

Design/Construction Specifications:

- Monitor and document BAR treatments that could potentially adversely affect historic properties.
- Conduct NHPA Section 106 compliance for said treatments prescribed for other resources or values at risk on NPS managed lands affected by the East Troublesome Fire.
- Conduct archeological survey where hazard trees will be treated and where trail infrastructure will be repaired, replaced or removed, or where other trail related activities will occur along [redacted]
- Monitor wilderness hazard tree removal activities in these areas. Avoid any historic properties and follow mitigation strategies to resolve potential adverse effects.
- Use tablets with Arrow 100 GPS or one with an accuracy of 1 meter or less to accurately document trails, signs, bridges, and any other park infrastructure treated, repaired, or replaced; and to document artifacts, features, and site conditions to meet or exceed a level of effort and documentation standards as outlined in 36 CFR § 800.4(b)(1) and SOI standards outlined in NPS 28.
- Be cognizant of and attentive for the potential to discover and subsequently protect culturally important sensitive inadvertent discoveries such as burial sites, exposed human remains, and other historic or Native American unassociated funerary objects, sacred objects, or objects of cultural patrimony (as per 25 U.S. Code § 3001) as a result of increased exposure of cultural materials due to the fire and possibly treatment activities.
- Record field data to a high level and standard to facilitate professional, accurate and comprehensible project descriptions and maps for inclusion in SHPO and THPO consultation packages.

Design/Construction Specifications cont.:

- Photograph and collect accurate baseline data (with GPS to achieve sub-meter X,Y,Z coordinate data), and document park infrastructure and historic properties that overlap or are near treatment areas that may be directly or indirectly affected.

Purpose of Treatment Specifications (relate to damage/change caused by fire):

- These position fulfills the requirements for cultural resource compliance activities under the National Historic Preservation Act as codified in 36.CFR.800, and as described in the NPS 2008 PA for NHPA Sec. 106.

Treatment Reasonableness and Cost Effectiveness:

- ROMO Cultural Resources Division does not have the capacity to conduct NHPA Section 106 compliance for activities associated with East Troublesome Fire BAER treatment specifications.
- Providing [redacted] will ensure NHPA Section 106 compliance for treatments that could affect historic properties, will ensure potential adverse effects to historic properties are avoided, and may reduce potential NAGPRA issues.
- [redacted] with GS-11 Park Cultural Resources Program Manager for any NAGPRA issues and for tribal consultation, and will conduct planning with, lead and oversee [redacted] and documentation for quality control and superior scientific results that will add value to the park's cultural databases and in general, knowledge of the history of the park. The Park Cultural Resources Manager/Archeologist will coordinate with [redacted]

Land Use Plan Conformance:

Treatment consistent with Agency Land Management Plan (identify which plan):

- National Historic Preservation Act as codified in 36 CFR 800.
- US DOI Final Land Protection Plan - Rocky Mountain National Park (1984)

- Rocky Mountain National Park - Trail Plan (2000)

MONITORING PLAN

16) Treatment Objectives:

Achieve compliance with the National Historic Preservation Act for activities associated with the protection, stabilization, and avoidance of adverse effects to historic properties as defined in 36 CFR § 800.5.

17) Describe how implementation will be monitored.

Tasks listed in the design section above will be tracked through GPS data collected about treatment areas which will also benefit other resources and park infrastructure documentation. Tasks will also be tracked through daily activity logs and through assessment forms to document stabilization treatments and associated activities. Photo documentation using a tablet camera connected to a sub-meter GPS will be used for documentation, and a report will be prepared throughout the post-fire effect mitigation efforts. A draft and final report summarizing each field season's findings shall be submitted to Regional Archeologist and Park Cultural Resources Program Manager/Archeologist no less than one month before the end of the GS-9 Archeologist's first, second, and third-year appointment. The report at minimum will describe all treatment activities, describe any effects to historic properties, and document any new and previously identified historic properties. The report will also provide recommendations for monitoring and documentation stabilization treatments activities for subsequent years. Standardized ROMO procedures and forms will be used and followed as well as guidance of NPS 28, RM #28A, applicable National Register Bulletins, and also as defined and provided by the Colorado SHPO.

18) Describe how effectiveness will be monitored, how it will be monitored, and within what time period.

A [redacted] will provide oversight and indirect supervision for [redacted]. Either will assure that documentation, as specified above, has been completed at regular intervals, and that GIS data and other site records (e.g. ROMO CRIS database) has been updated to reflect stabilization treatments potentially effecting archeology sites. T[redacted] and archeologists for planning survey areas, data collection, report writing, any public outreach such as a presentation of findings, and for consultation with Tribes or CO-SHPO when required. ROMO Superintendent FY ASMIS/CRIS certifications will show all updated site condition assessments of sites monitored as a result of Sec. 106 NHPA compliance and monitoring activities. Lastly, treatments will be considered effective if Section 106 NHPA compliance and documentation are completed consistent with the Secretaries Standards for preservation and will be considered successful when CO-SHPO concurs with the park's Sec. 106 NHPA findings and recommendations.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	COST / ITEM
[redacted]	[redacted]
TOTAL PERSONNEL SERVICE COST	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL MATERIALS AND SUPPLY COST	
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL CONTRACT COST	

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2022	April 10, 2022	Oct. 22, 2022	F	1	[redacted]	[redacted]	[redacted]
2023	April 9, 2023	Oct. 21, 2023	F	1			
						TOTAL	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	P, E, T
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Implementation Leader	**Spec-#**	BAR-6
NFPORS TREATMENT CATEGORY*	Administration	**FISCAL YEAR(S) (list each year):**	2022, 2023, 2024
NFPORS TREATMENT TYPE *	Administration		

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

Implementation Leader is needed to coordinate ES and BAR work, submit annual reports.

TREATMENT

General Description:
This specification will fund salary, travel and miscellaneous expenses for personnel responsible for overseeing implementation of proposed BAER treatments and activities associated with the East Troublesome Fire in FY22, FY23 and FY24, as applicable.

Location/ (Suitable) Sites: East Troublesome Fire, Rocky Mountain National Park, Colorado

Design/Construction Specifications: Among the tasks to be performed under this specification include (as applicable):
(1) Develop and amend specifications
(2) Develop scopes of work
(3) COTR
(4) Interagency coordination
(5) Implementation monitoring
(6) Budget tracking
(7) Communication and education
(8) Accomplishment reporting
(9) Environmental compliance

Purpose of Treatment Specifications (relate to damage/change caused by fire): The East Troublesome Fire created a variety of emergency post-fire issues on NPS lands The purpose is to provide quality control and accountability over project implementation of treatments designed to respond to damage directly caused by the fire.

Treatment Reasonableness and Cost Effectiveness: Proper project oversight is critical to ensure implementation, documentation, and reporting are completed on time and within budget. This specification will likely lead to cost savings throughout the duration of this project.

Treatment Effectiveness Monitoring Proposed: The Project Administrator will monitor to ensure specified projects are successfully completed on time and within budget, including any projects incorporated by approved plan amendments. Annual and final accomplishment reports will be used to document treatment effectiveness.

Treatment consistent with Agency Land Management Plan (identify which plan): Foundation Document Rocky Mountain National Park, 2016

Location/(Suitable) Sites:

Rocky Mountain National Park

Design/Construction Specifications:
NA

MONITORING PLAN

1) **Treatment Objectives: Effectively implement BAER specifications and report accomplishments.** The Implementation leader is necessary to ensure the work specified in the BAER plan is completed in a timely and professional manner, and adequate accountability of treatment effectiveness and funding expenditures is maintained and documented.

2) **Describe how implementation will be monitored. Through fiscal audits and annual accomplishment reports**
The Implementation Leader will monitor to ensure specified projects are successfully completed on time and within budget, including any projects incorporated by approved plan amendments. Annual and final accomplishment reports will be used to document treatment effectiveness.

3) **Describe how effectiveness will be monitored, how it will be monitored, and within what time period. Implementation activities will be according to approved specifications in BAER plan.** Project oversight is critical to ensure implementation, documentation, and reporting are completed on time and within budget. This specification will likely lead to cost savings throughout the duration of this project.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
TOTAL MATERIALS AND SUPPLY COST	[redacted]
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**

TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL CONTRACT COST	

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2022	10/01/2021	09/30/2022	F	PP	[redacted]	[redacted]	[redacted]
2023	10/01/2022	09/30/2023	F	PP			
2024	10/01/2023	09/30/2024	F	PP			
						TOTAL	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	M
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	P
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Monitoring Equipment	**Spec-#**	BAR-7
NFPORS TREATMENT CATEGORY*	Asset Repair and Replacement	**FISCAL YEAR(S) (list each year):**	FY 2021
NFPORS TREATMENT TYPE *	Re-establish Permanent Long-term Monitoring Plot		

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

Rocky Mountain National Park and the Rocky Mountain Inventory and Monitoring Network have been monitoring the condition of wetlands throughout the park for decades as part of a long-term restoration strategy due to human-caused disturbances including the extirpation of beaver, the creation and demolition of a golf course, and ditching and grazing by early settlers.

[redacted] of the 241 wetland monitoring sites were inside the fire perimeter. Field visits to [redacted] that were safe to access confirmed the loss of groundwater wells. Seven stream monitoring sites were in the fire perimeter but only two had installed equipment.

TREATMENT

General Description:

Staff from the Rocky Mountain Inventory and Monitoring Network, accompanied by base-funded Rocky Mountain NP staff will replace wetland monitoring equipment that was damaged or lost in the East Troublesome Fire. This equipment will allow for the park to continue to collect data on wetland condition and response to the fire.

Location/(Suitable) Sites:



Design/Construction Specifications:

Installation of equipment will follow established protocols in the Rocky Mountain Network Wetland Ecological Integrity Monitoring Protocol Standard Operating Procedures, Version 1.0

MONITORING PLAN

1) Treatment Objectives:

Install 49 groundwater wells, 5 groundwater loggers, and 4 water temperature loggers in order to continue long-term monitoring of wetland condition and restoration.

2) Describe how implementation will be monitored.

Equipment will be checked at the time of deployment.

3) Describe how effectiveness will be monitored, how it will be monitored, and within what time period.

Status and uptime of the equipment will be monitored while the sample plots are revisited according to a rotating panel of up to five years as established in the Rocky Mountain Network Wetland Ecological Integrity Monitoring Protocol Narrative, Version 1.0

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	**COST / ITEM**
All labor provided by Rocky Mountain Inventory and Monitoring Network (ROMN)	
TOTAL PERSONNEL SERVICE COST	
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years =	**COST / ITEM**

Cost/Item):	
All travel covered by ROMN	
TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL CONTRACT COST	

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE MM/DD/YYYY	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
FY 2021	8/1/2020	9/30/2021	F	Site	[redacted]	[redacted]	[redacted]
						[redacted]	[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	E
3. Estimate supported by cost guides from independent sources or other federal agencies	
4. Estimates based upon government wage rates and material cost.	
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

BAER TREATMENT SPECIFICATION

TREATMENT/ACTIVITY NAME	Wetland Vegetation Restoration	**Spec-#**	BAR-8
NFPORS TREATMENT CATEGORY*	Riparian	**FISCAL YEAR(S) (list each year):**	2022, 2023
NFPORS TREATMENT TYPE *	Planting		

*See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

ES/BAR ISSUE STATEMENT

Thirteen wildlife exclosure fences were burned in the footprint of the East Troublesome fire. A total of 118 acres of wetland and riparian vegetation inside of these exclosures were impacted by the fire. Several exclosures sustained severe damage to enclosed vegetation. Severely burned vegetation is unlikely to regenerate naturally in these areas due to canopy loss and subsequent reduced seed rain density in future years. Altered hydrologic conditions and a low water table in some of the affected valleys will further prevent woody wetland vegetation from reestablishing naturally from seed as roots will not be able to reach the water table. Many mature plants were burned down to piles of ash and charred branches, from which new stems will not be able to re-sprout. Active restoration efforts are required to reestablish wetland vegetation in these burned areas. Birch, alder, and willow should be planted inside of exclosures to repopulate the native vegetation that is unlikely to recover naturally.

TREATMENT

General Description:

Healthy wetlands provide many beneficial ecosystem services such as fire break and flood mitigation, as well as increased biodiversity and an improved visitor wildlife viewing experiences. Without active restoration efforts, woody wetland vegetation will not reestablish naturally and these valuable wetland ecosystem services will be lost.

Due to extensive canopy loss and damage to root crowns, mature willow, birch, and alder plants impacted in the fire will not regenerate naturally. Altered hydrology and lowered water table will further prevent successful unaided reestablishment. In order to reestablish a healthy population of these species similar to pre-fire conditions, willow stakes and birch & alder nursery stock saplings should be planted to replace damaged and destroyed vegetation. Planting efforts will only be targeted inside of exclosures to ensure successful establishment of restored species. Exclosure fences are in place to protect valuable riparian ecosystems from extensive browse pressure from ungulate species such as elk and moose. Without the protection provided by exclosure fences, willow, aspen, and other riparian species become over browsed and ecosystem integrity degrades over time.

Planting projects will be implemented inside of six exclosure fences by Wildlands Restoration Volunteers (WRV), a Colorado-based nonprofit specializing in native plant restoration. WRV staff comprised of a team of habitat restoration specialists will work with ROMO Resource Stewardship staff to coordinate several days of planting events conducted by trained WRV volunteers.

Location/(Suitable) Sites:

Exclosures which sustained the most severe damage to wetland vegetation, therefore requiring active restoration efforts are:

- Moraine Park: MP60, MP20.
- Beaver Meadows: BM65, BM49, BM45, BM40.

Design/Construction Specifications:

- Planting events will occur over the course of two years, one in FY22 and one in FY23.
- Birch and alder seed will be collected within the park in fall of FY22 and grown into plants in the park greenhouse by resource stewardship staff over the winter. A total of 1500 birch and 1500 alder will be grown and planted over the course of the two year project.
- Willow stakes will be harvested from healthy willow stands within the park by natural resource seasonal staff and the Wildlands Restoration Volunteer (WRV) group. Willow stakes will be harvested 1-5 days before planting events as well as same day. 4000 total willow stakes will be harvested and planted over the course of the two year project.
- Willow stakes and nursery stock plants will be planted by WRV in select exclosures in Moraine Park and Beaver Meadows. Planting will occur inside of six exclosure fences over the course of the two planting events. Planting events will total seven days across the two years.
- Willow stakes will be planted 1/sq. m. in wet areas such as stream banks and wet depressions. Alder and birch will be planted 1/sq. m. in areas with a water table of no less than 50-75cm below the surface.
- Perimeters of planted areas will be mapped by park staff using a GPS unit.

MONITORING PLAN

19) Treatment Objectives:

The purpose of this treatment is to reestablish native wetland vegetation inside of exclosure fences burned in the East Troublesome Fire. Vegetation will not reestablish on its own due to a major canopy/seed loss and impaired hydrologic conditions of impacted valleys.

20) Describe how implementation will be monitored.

Park Resource Stewardship staff will be on site throughout the willow stake harvesting and planting process. They will work with WRV to ensure that only healthy willow stakes are harvested and that proper planting techniques are implemented. Staff will direct WRV volunteers to appropriate planting locations within select exclosures.

21) Describe how effectiveness will be monitored, how it will be monitored, and within what time period.

Park Resource Stewardship staff will revisit planting sites one month after planting to assess plant health. They will also return to the planting site the following spring to determine what percentage of plants were able to establish roots and survive the winter. This process will be repeated annually for three years.

PERSONNEL SERVICES: (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item):	COST / ITEM
[redacted]	[redacted]

[redacted]	[redacted]
[redacted]	[redacted]
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	**COST / ITEM**
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	**$ -**
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	**COST / ITEM**
[redacted]	[redacted]
[redacted]	[redacted]
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	**COST / ITEM**
TOTAL TRAVEL COST	**$ -**
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	**COST / ITEM**
WRV agreement (not contract)	
[redacted]	[redacted]
TOTAL CONTRACT COST	[redacted]

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE	PLANNED COMPLETION DATE	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
2022	10/1/2021	9/30/2022	F, C	1	[redacted]	Plant 600 nursery stock plants and 900 willow stakes	[redacted]
2023	10/1/2022	9/30/2023	F, C	1	[redacted]	Plant 800 nursery stock plants and 1200 willow stakes	[redacted]
TOTAL							[redacted]

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	
3. Estimate supported by cost guides from independent sources or other federal agencies	C
4. Estimates based upon government wage rates and material cost.	P, M, T
5. No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, **E** = Equipment **M** = Materials/Supplies, **T** = Travel, **C** = Contract, **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

APPENDIX A—ENVIRONMENTAL COMPLIANCE

Pertinent Management Plans

- 1974 ROMO General Management (Master) Plan
- 1982 ROMO Trail Plan
- 1985 ROMO Land Protection Plan
- 1992 ROMO Statement for Management
- 1993 ROMO Commercial Horse Use Plan/Environmental Assessment
- 2001 Backcountry Wilderness Management Plan
- 2005 ROMO Bark Beetle Management Plan/Environmental Assessment
- 2008 Southern Rockies Lynx Amendment
- 2009 Long Draw Reservoir Special Use Authorization Environmental Impact Statement
- 2012 ROMO Fire Management Plan/Environmental Assessment
- 2013 ROMO Foundation Document
- 2018 Exotic Plant Management Plan and Environmental Assessment
- 2019 Proactive Limber Pine Conservation Strategy for the Greater Rocky Mountain National Park Area
- 2019 Recovery Outline for the Greenback Cutthroat Trout, prepared by the Greenback Cutthroat Trout Recovery Team.
- 2019 Rocky Mountain National Park Boundary Marking Standard Operating Procedures

Compliance Summary

This BAER plan is consistent with our Programmatic Categorical Exclusions for Forestry Operations and Routine Trails and Wilderness Activities and the Exotic Plant Management Plan and Environmental Assessment. However, the park will conduct environmental review for the activities and consult as needed on the proposed actions. The park will create a project in PEPC to document this proposal, its review, and approval.