

Date of Report: 11/23/2020**BURNED-AREA REPORT****PART I - TYPE OF REQUEST****A. Type of Report**

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

B. Type of Action

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

The BAER assessment for the East Troublesome fire was completed by two BAER teams. The National Park Service (NPS) mobilized a team to assess the burned area within Rocky Mountain National Park, which is approximately 23,000 acres of the total burned area. The US Forest Service mobilized a BAER team to assess the remaining portion of the burned area. This report will focus on the 171,209 acres not assessed by the NPS BAER team.

PART II - BURNED-AREA DESCRIPTION**A. Fire Name: East Troublesome****B. Fire Number: WY-MRF-000408****C. State: Colorado****D. County: Grand****E. Region: R2 Rocky Mountain Region****F. Forests: Medicine Bow-Routt, Arapahoe & Roosevelt****G. Districts: Parks and Sulphur****H. Fire Incident Job Code: P2NN4T (0206)****I. Date Fire Started: 10/14/2020****J. Date Fire Contained: 72% on 11/20/2020****K. Suppression Cost: \$15,400,000 on 11/20/2020****L. Fire Suppression Damages Repaired with Suppression Funds (estimates):**

1. **Fireline repaired (miles):** Firelines are still being repaired, or will be repaired next summer
2. **Other (identify):**

M. Watershed Numbers:*Table 1: Acres Burned by Watershed*

HUC #	Watershed Name	Total Acres	Acres Burned	% of Watershed Burned
140100010102	Upper Willow Creek	37,835	35,654	94%
140100010603	East Fork Troublesome Creek	35,917	30,212	84%
140100010103	Middle Willow Creek	20,436	20,436	100%
140100010501	Drowsy Water Creek-Colorado River	29,179	16,979	58%

HUC #	Watershed Name	Total Acres	Acres Burned	% of Watershed Burned
140100010104	Lower Willow Creek	18,044	15,488	86%
140100010303	Onahu Creek-Colorado River	24,369	13,236	54%
140100010306	Stillwater Creek	11,229	10,160	90%
140100010101	Headwaters Willow Creek	14,274	8,660	61%
140100010601	Corral Creek-Colorado River	22,452	8,144	36%
140100010602	Middle Fork Creek	12,536	5,802	46%
140100010308	Lake Granby	44,898	3,334	7%
140100010309	Smith Creek-Colorado River	14,553	1,220	8%
140100010504	Ute Bill Creek-Colorado River	16,620	851	5%
140100010301	Baker Gulch	13,150	689	5%
140100010305	North Inlet	29,334	143	<1%
101800010403	East Branch Willow Creek-Willow Creek	19,863	109	<1%
140100010604	Rabbit Ears Creek-Troublesome Creek	36,169	46	<1%
101800010402	Headwaters Illinois River	25,027	30	<1%

N. Total Acres in BAER Analysis Perimeter:

Table 2: Total Acres Burned by Ownership

OWNERSHIP	ACRES
NFS	132,916
BLM	17,858
STATE	832
PRIVATE	19,603
TOTAL	171,209

O. Vegetation Types: Lodgepole pine, Mixed Conifer, Aspen, Pinyon Juniper, Sage, shrubs, grasses.

P. Dominant Soils: Soils within the burn area reflect a wide range of lithologies. Soils formed from sedimentary deposits are dominantly a sandy to sandy loam texture. Pre-fire conditions likely exhibited thin O horizons especially in timber stands characterized predominately by lodgepole pine. Similarly, soils derived from glacial deposits tend to be of a coarser texture and not as well developed. In general, much of the area is characterized by Alfisols. This soil order typically forms under a hardwood forest cover, has a clay-enriched subsoil, and relatively high native fertility. In areas where soil formation was favored and promoted, soils have developed a finer texture and larger deposits of clay and organic matter, like in lower gradient basins and foot slopes. In general, the soils reflect the most recent glacial periods in the region and the geologic deposits subjected to those glacial forces.

Q. Geologic Types: The footprint of the East Troublesome Fire lies in the Front and Gore range to the East and the Never Summer and Rabbit Ears Range to the west. The Gore Range lies mostly south of Gore Pass, along a similar trend as the Front Range and the Park Range. The Gore Range, much like the Front Range, is a faulted anticline with Precambrian core rocks. The Never Summer Mountains along with the Rabbit Ears Range to the west, were formed by volcanic and intrusive processes 24–29 million years ago and consist mostly of igneous granitic formations along with preceding metamorphic formations. Also contained in these ranges are interspersed sedimentary deposits from the Cretaceous Western Interior Seaway reflected in thick stratum of sandstones and shales as well as fossiliferous deposits. Pleistocene glaciers of the Bull Lake and Pinedale glacial periods carved much of the present-day landscape and many

major geomorphic features like Grand Lake. The Pinedale glaciation was the last of the major ice ages to appear in the Rocky Mountains and lasted from approximately 30,000 to 10,000 years ago.

R. Miles of Stream Channels by Order or Class:

Table 3: Miles of Stream Channels by Order or Class

STREAM TYPE	MILES OF STREAM
PERENNIAL	321
INTERMITTENT	141
EPHEMERAL	490

S. Transportation System:

Trails: National Forest (miles): 193.7

Other (miles): None reported

Roads: National Forest (miles): 253.4

Other (miles): 27.8

PART III - WATERSHED CONDITION

A. Burn Severity (acres):

Table 4: Burn Severity Acres by Ownership

Soil Burn Severity	NFS	BLM	State	Private	Total	% within the BAER Analysis Perimeter
Unburned	13,974	721	2	1,583	16,280	10%
Low	43,057	7,654	381	12,578	63,670	37%
Moderate	68,650	8,725	434	4,910	82,719	48%
High	7,235	758	15	532	8,540	5%
Total	132,916	17,858	832	19,603	171,209	100%

B. Water-Repellent Soil (acres): 8,540 (high severity acres)

- C. Soil Erosion Hazard Rating:** The ratings in this interpretation indicate the hazard of soil loss from off-road and off-trail areas after disturbance activities that expose the soil surface. The ratings are based on slope, soil erosion factor K, and an index of rainfall erosivity (R).

Table 5: Soil Erosion Hazard Ratings within the BAER analysis area

Erosion Hazard Rating	Acres
Not Rated	5,457
Slight	59,021
Moderate	88,028
Severe	19,079

- D. Erosion Potential:** Derived from WEPP-PEP model runs. 227 lbs./acre/year (Average of 13 watersheds from 1400 to 7300 acres in size with a 2984-acre average size)

- E. Sediment Potential:** Derived from WEPP-PEP model runs. 304 lbs./acre/year (Average of 13 watersheds from 1400 to 7300 acres in size with a 2984-acre average size)

- F. Estimated Vegetative Recovery Period (years):** 3-5 years for shrubs, forest understory, 20 years for forest overstory.

- G. Estimated Hydrologic Response (brief description):** The fire has reduced or eliminated canopy and ground cover, as well as altered soil structure with varying degrees of hydrophobicity across extensive areas

within the fire perimeter. These changes will lead to reduced infiltration capacity, as well as elevated runoff compared to pre-fire conditions.

Watershed response within the burned area will likely include an initial flush of ash, rill and gully erosion in headwater drainages and on steep slopes, elevated snowmelt peak flows elevated over 50% relative to pre-fire, sediment-laden flash floods following high-intensity rain events, and potentially debris flows. Water quality will be diminished during seasonal peak runoff, as well as after high-intensity summer rains, due to elevated ash, fine sediment, and nutrient loading. This elevated post-fire response will gradually diminish as vegetation and groundcover levels recover each growing season, although some impacts are likely to persist for a decade or longer.

The most probable damaging storm events are high intensity-short duration thunderstorms that commonly occur during the July/August monsoon season. Pre- and post-fire rainfall-runoff and snowmelt-runoff peak flow estimates were modeled across the burn area (Tables 6 and 7; Figures 1 and 2). While the estimated quantity of peak flow is difficult to predict, the modeling provides some scale for the magnitude of runoff and the relative percent increase from pre-fire to post-fire peak flows for different watersheds affected by the fire. This information is used during a rapid post-fire assessment to indicate where downstream critical values may be threatened by sediment-laden flash-flooding from damaging thunderstorms.

Separate from flood hazards, the USGS completed a post-fire debris-flow hazard assessment for the East Troublesome fire. The assessment provided estimates of debris-flow likelihood and volume for several design storms with a range of peak 15-minute intensities. The design storm selected was a 15-minute event of 0.4 inches, which is a common, high intensity, short duration thunderstorm with a recurrence interval that ranges between 1 and 5 years throughout the burn area. For this storm, the threshold intensity was estimated at 38 mm/hr (1.50 inches/hour). Many stream segments on NFS lands have higher levels of debris flow hazard (probability >80%). The streams tributary to East Troublesome Cr with a higher level of debris flow hazard include Haystack Cr, Ethel Cr, Corral Cr, Hay Park Cr, Paradise Cr, McBride, Middle Fork, and Timber Creek. The streams in the Willow Creek watershed include Denver Cr, Kauffman Cr, Elk Cr, Pass Cr, Trout Cr, Buffalo Cr, Gold Run, Trail Cr, Cabin Cr, Adams Cr, and several unnamed tributaries of Willow Creek. Lastly, the streams directly tributary to the Colorado River include Stillwater Cr, South Supply Cr, Drowsy Water Cr, Kinney Cr, and Corral Cr. The material generated from a debris flow is approximated to carry a 10,000 - 100,000 m³ volume.

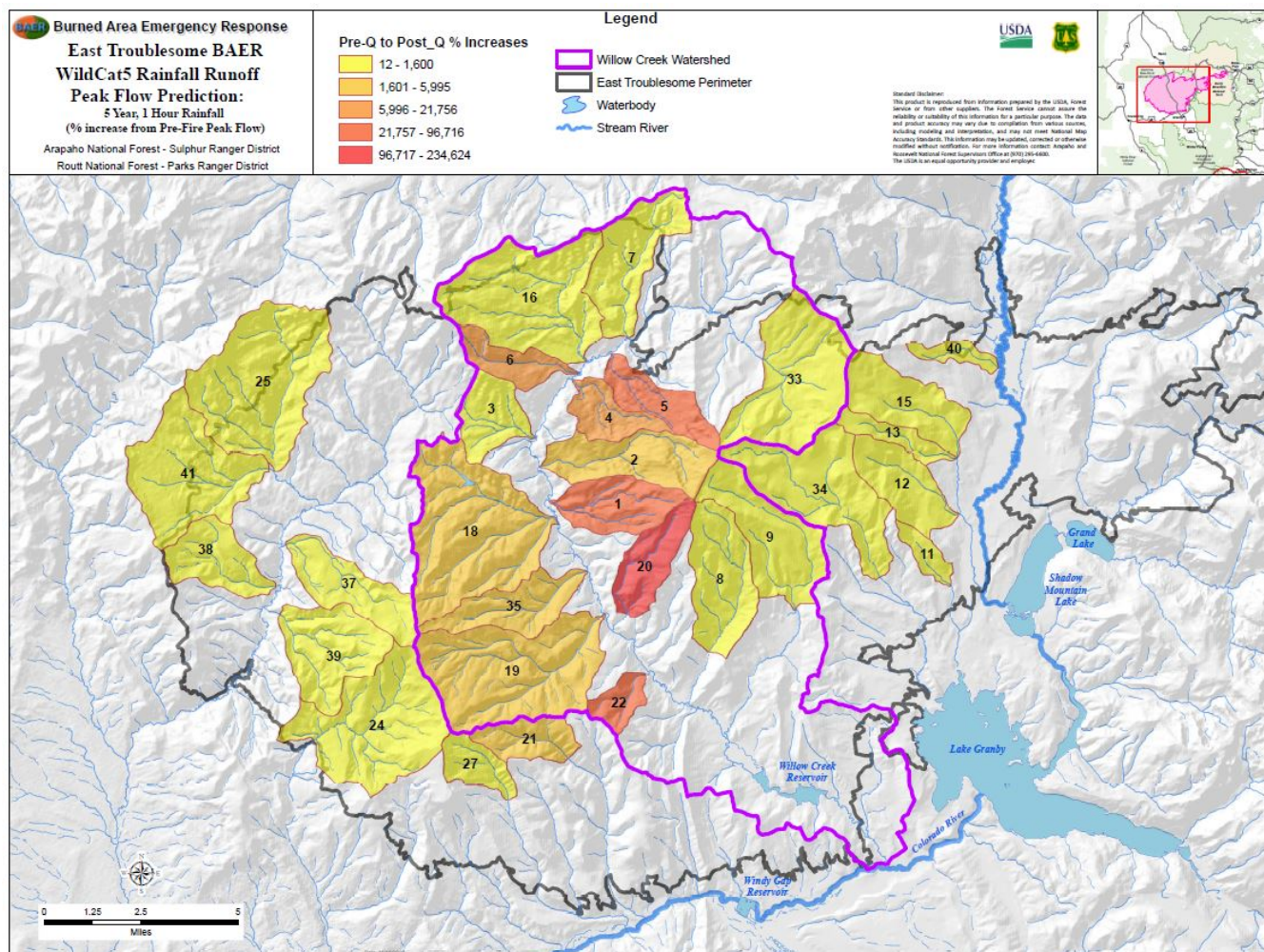


Figure 1: WildCat5 model results for 5 year, 1 hour thunderstorm in small watersheds (approx. 500 - 5000 acres) within the East Troublesome burn area. Watershed numbers (1-41) correspond to the data in Table 6. The rainfall-runoff response is displayed by percent increase from pre-fire to post-fire. Watersheds with little to no know pre-fire runoff show the greatest percent change.0

Table 6: WildCat5 model results for 5 year, 1 hour thunderstorm in small watersheds (approx. 500 - 5000 acres) within the East Troublesome burn area. Watershed numbers (1-41) correspond to the mapped watersheds in Figure X. Additionally, the rainfall-runoff post-fire peak flow is compared to the bankfull flow estimated by the USGS regression equation for peak flows.

ID	Name	Area (ac)	Pre-Fire Bankfull Flow (2 Yr RI) (ft3/s)	% Mod SBS	% High SBS	5 Yr-1 Hr Thunderstorm Runoff			% Increase from Pre-Fire Bankfull Flow (2 Yr RI) (ft3/s)
						Pre-Fire Q (cfs)	Post-Fire Q (cfs)	% Increase from Pre-Fire Q	
1	Denver Cr	2323	36	61	2	0.2	134	58362	278
2	Kauffman Cr	3130	54	69	4	3.8	200	5150	269
3	Trail Cr 1	1869	27	44	1	5.6	94	1600	252
4	Bronco Cr	1440	21	56	0	0.6	82	13682	297
5	Elk Cr	1829	35	72	0	0.1	135	96716	292
6	Mulstay Cr	1436	31	63	0	0.4	97	21756	211
7	Trout Cr	3312	52	43	6	12.6	168	1238	222
8	Gold Run	3429	52	48	0	20.5	184	799	255
9	Trail Creek 2	3696	63	54	3	20.1	235	1071	272
11	Soda Cr	651	9	22	0	7.8	36	361	279
12	S. Supply Cr	2346	44	85	1	27.8	316	1038	622
13	Mid Supply Cr	961	27	63	0	13.7	133	873	388
15	N. Supply Cr	2830	65	17	0	27.3	101	269	55
16	Pass Cr	6161	99	53	10	18.8	313	1568	217
18	Buffalo Cr	7324	81	45	2	4.5	177	3840	117
19	Cabin Cr	6734	101	33	4	2.3	143	5995	42
20	Hall Cr	1950	35	69	0	0.1	235	234624	569
21	Drowsy Water Cr	1533	33	79	10	3.4	155	4465	366
22	Adams Cr	886	18	77	5	0.1	84	84254	377
24	Corral Cr	5915	87	38	3	20.7	216	946	149
25	Haystack Cr	6709	98	15	15	31	202	545	106
27	Kinney Cr	1230	32	53	10	7	105	1411	231
33	Willow Cr HWs	5407	121	44	0	61	341	461	182
34	Stillwater Cr	4860	93	58	0	48	366	662	294
35	Sawmill Gulch	2412	37	22	2	1	51	4381	39
37	Ethel Cr	2678	37	51	4	10	153	1486	314
38	Hay Park Cr	2220	28	83	3	16	243	1409	780
39	Wheatley Cr	3407	45	75	6	22	307	1272	588
40	Trib of CO River	644	15	0	0	11	12	12	-19
41	MF Troublesome Cr	4980	60	14	7	18	114	539	90

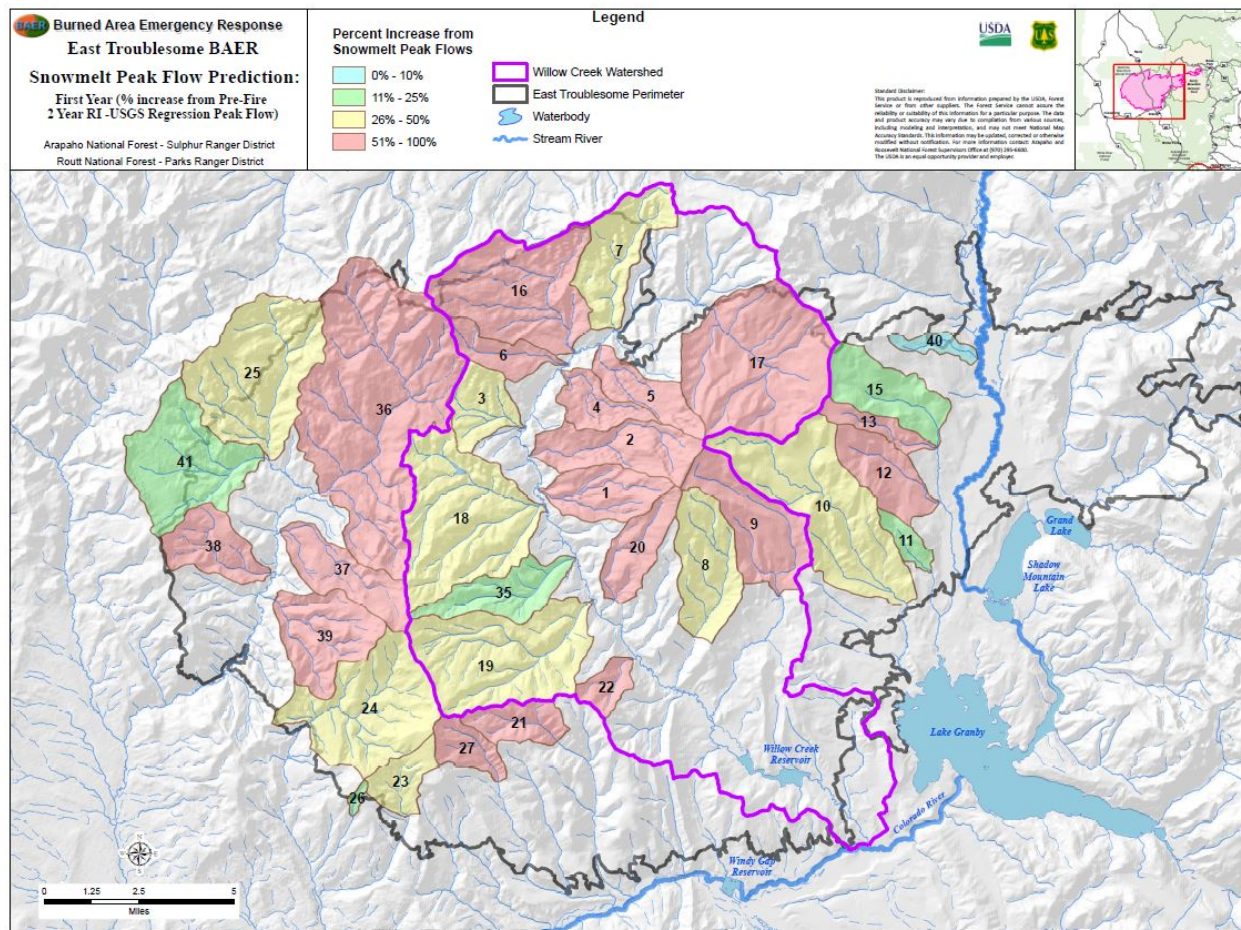


Figure 2: USGS Regression model results for snowmelt peak flows in small and large watersheds within the East Troublesome burn area. Watershed numbers (1-41) correspond to the data in Table 7. The snowmelt-runoff response is displayed by percent increase from pre-fire to post-fire.

Table 7:USGS Regression model results for snowmelt peak flows (2 Year Recurrence Interval) in small and large watersheds within the East Troublesome burn area. Watershed numbers (1-41) correspond to the mapped watersheds in Figure Y. The snowmelt-runoff response is displayed by percent increase from pre-fire 2 Year Recurrence Interval, or approximate bankfull flow.

Modeled Watersheds			Soil Burn Severity (Acres)		% Mod & High SBS	2 Year Recurrence Interval		
						USGS Snowmelt Peak Flow (with BAER modifier)		
ID	Name	Total Area (acres)	Mod	High		Pre-Fire (ft3/s)	Post-Fire (ft3/s)	% Increase from Pre-Fire Bankfull Flow (2 Yr RI) (ft3/s)
1	Denver Cr	2323	1415	57	63	36	58	63
2	Kauffman Cr	3130	2154	130	73	54	94	73
3	Trail Cr 1	1869	827	13	45	27	39	45
4	Bronco Cr	1440	801	0	56	21	32	56
5	Elk Cr	1830	1310	1	72	35	59	72
6	Mulstay Cr	1434	903	1	63	31	51	63
7	Trout Cr	3309	1438	206	50	52	78	50
8	Gold Run	3430	1643	2	48	52	77	48
9	Trail Cr 2	3699	1989	93	56	63	99	56
10	Stillwater Cr	7424	3530	18	48	102	151	48
11	Soda Cr	653	144	0	22	9	12	22
12	South Supply Cr	2349	1999	16	86	44	81	86
13	Middle Supply Cr	960	607	0	63	27	45	63
15	N. Supply Cr	2829	470	1	17	65	76	17
16	Pass Cr	6163	3276	597	63	99	161	63
17	Upper Willow	8320	4770	21	58	154	243	58
18	Buffalo Cr	7296	3317	132	47	81	120	47
19	Cabin Cr	6720	2231	283	37	101	139	37
20	Hall Cr	1952	1336	2	69	35	59	69
21	Drowsy Water Cr	1530	1211	160	90	33	63	90
22	Adams Cr	883	684	40	82	18	32	82
23	Smith Cr	1363	353	19	27	28	36	27
24	Corral Creek	5914	2265	191	42	87	123	42
25	Haystack Cr	6720	1022	986	30	98	128	30
26	First Creek	154	29	0	19	4	5	19
27	Kinney Cr	1229	652	125	63	32	52	63
35	Sawmill Gulch	2413	523	56	24	37	45	24
36	East Troublesome Cr	14272	8534	3019	81	157	284	81
37	Ethel Cr	2682	1364	99	55	37	57	55
38	Hay Park Cr	2221	1842	64	86	28	51	86
39	Wheatley Cr	3405	2553	192	81	45	81	81
40	Unnamed Trib CO River	646	3	0	0	15	15	0.4
41	Middle Fork Cr	4979	704	344	21	60	73	21

PART V - SUMMARY OF ANALYSIS

Introduction/Background: The East Troublesome Fire was reported on the afternoon of October 14. The origination point was in Grand County, Colo., on a portion of the Arapaho National Forest administered by the Medicine Bow-Routt National Forests and the cause is still under investigation. Within three days, high winds and low humidity allowed the fire to spread to over 10,000 acres. The direction of fire spread threatened State Highway 125 and forced the closure of the road and mandatory evacuation of approximately 90 homes by October 17.

Between Oct. 20-23, the fire exploded from 18,550 acres to 187,964 acres. The fire crossed Highway 125 on the afternoon of Oct. 21 and spread eastward into the Rocky Mountain National Park on Oct. 22, crossing the Continental Divide and reaching the western edge of Estes Park on Oct. 23.

The fire was fueled by wide-spread drought, numerous dead and down beetle-killed trees, red flag weather conditions created by high winds and dry conditions, and poor humidity recovery overnight. The combination of these factors led to unprecedented, wind-driven, active fire behavior with rapid spread during the overnight hours. During this period the area north of US Highway 40 from near Granby and extending eastward to Grand Lake and Estes Park had over 7,000 structures threatened, and a population of over 35,000 placed under a mandatory evacuation.

A winter storm from Saturday, Oct. 24 through the morning of Oct. 26 brought very cold temperatures, precipitation in the form of snow and lighter winds, resulting in a dramatic drop in fire behavior with smoldering and reduced fire spread. Over this 3-day period, fire growth fell to a total of around 4,500 acres for a total of 192,457 acres. From that point forward, fire activity remained minimal with little change in area and a final total acreage of 193,812. Impacted areas included the Arapaho & Roosevelt National Forests, Medicine Bow-Routt National Forests, Bureau of Land Management, Rocky Mountain National Park, and private lands. A preliminary estimate of 366 residences and 214 outbuildings and commercial structures were destroyed or damaged.

Numerous post-fire threats to off-forest critical values exist within and downslope/downstream of the East Troublesome burnscar. These include, but are not limited to, threats to municipal water supplies, utility infrastructure, highways, private property, and homes. Establishment of an interagency post-fire recovery team is currently underway.

The BAER assessment for the fire was completed by two BAER teams. The National Park Service (NPS) mobilized a team to assess the burned area within Rocky Mountain National Park, which is approximately 23,000 acres of the total burned area. The US Forest Service mobilized a BAER team to assess the remaining portion of the burned area. This remainder of this report will focus on the threats to Forest Service critical values within the 171,209 acres not assessed by the NPS BAER team

During the initial BAER assessment completed in November 2020, early season snowfall prevented the BAER team from conducting a field survey in most of the burned area. The USFS team placed an emphasis on assessing threats to human life and safety on NFS lands. When possible, other critical values were assessed, however a significant assessment workload remains and will be resumed when in late spring 2021.

A. Describe Critical Values/Resources and Threats (narrative):

Table 8: Critical Value Matrix

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

1. Human Life and Safety (HLS):

- a. Human life and safety of Forest visitors and employees traveling on NFS roads, trails, and over-snow routes in the burnscar is threatened due to the potential for injury or loss of life from hazard tree strikes, falling rocks, flash floods, debris flows, and other burned area hazards. The probability of damage or loss is **likely** as the NFS transportation system contains many motorized and non-motorized routes adjacent to and through the burned area. The hazard tree threat is particularly concerning as many of the roads and most, if not all trails have not been assessed or treated by the fire suppression resources. Much of the burned area had standing, beetle killed trees before the fire that are now further weakened. The magnitude of consequence is **major** since an overhead hazard strike, entrapment in a flood or debris flow, or motorized vehicle collision with downed trees could result in serious injury or loss of life. The risk level is **very high**. Administrative closures and treatments are recommended. See treatments P1a, P1b, P2, M1.
- b. Human life and safety of Forest visitors and employees traveling cross-country on foot, snowmobile, or horseback through the burned area (not on system roads or trails) is threatened due to the potential for injury or loss of life from hazard tree strikes, falling rocks, flash floods, debris flows, and other burned area hazards. The probability of damage or loss is **possible** as cross-country travel through the burned area is to be expected, however not with the frequency of travel that occurs on the transportation system. The magnitude of consequence is **major** since an overhead hazard strike, entrapment in a flood or debris flow could result in serious injury or loss of life. The risk level is **high**. Administrative closures and treatments are recommended. See treatment P1a, P1b, and P2.
- c. Review of additional threats to human life and safety is recommended when field conditions allow for BAER team access. These include Forest Service roads that access private lands on the Stillwater Pass and Buffalo Creek roads that could be at risk of culvert or bridge failure that would affect access, forest visitors camping in dispersed sites on the highway 125 corridor, and forest visitors at the numerous campgrounds and trailheads that are subject to hazard trees and flooding.

2. Property (P): The NFS trails within the burnscar are threatened due to increased post-fire runoff that may result in accelerated erosion of trail prisms downstream or downslope of areas of moderate and high SBS. Many of the trails affected by the fire are located on steep slopes or in the drainage bottoms and have the potential to intercept overland flow from upslope burned areas. The probability of damage or loss is **likely** because many of the threatened trails have steep grades and inadequate drainage features to withstand the expected increases in post-fire runoff. The magnitude of consequence is **major** because erosion of the threatened trail segments would result in substantial property damage and loss of the NFS investment in the trail system. The risk level is **very high**. Treatments are recommended. See treatment RT13, RT16.

- b. Campground infrastructure in the west loop of the Denver Creek CG is threatened by the potential for flash flooding and debris flows. The west loop of the CG is located adjacent to Willow Creek. The probability of damage or loss is **likely** because a significant portion of the watershed above the CG has moderate and high SBS which is expected to result in increased watershed response and flooding during summer thunderstorm events. The magnitude of consequence is **moderate** because the west loop contains approximately 20 sites that could be damaged during a flood event. The risk level is **high**. Treatments are recommended. See treatment P10.
- a. Review of additional threats to the NFS roads, campgrounds, and trailheads is recommended when field conditions allow for BAER team access.

- 3. Natural Resources (NR):** Water on NFS lands within and downstream of the burn scar that is used for municipal and agriculture supply is threatened due to potential water quality impacts from increased sediment and nutrient loading following runoff producing events. The probability of damage or loss is **likely** because hillslope erosion and deposition of sediment, ash, and nutrients in downslope water bodies is expected to occur following high intensity short duration storm events. The magnitude of consequence is **moderate** because the impacts will be of short duration following summer thunderstorms, but these effects to water quality are expected to persist for the next 3 to 5 years until canopy cover, ground cover, and soil water repellency return to pre-fire conditions. The risk rating is **high**. While the natural processes and associated impacts will likely impact water storage, conveyance and treatment infrastructure and processes owned and managed by water managers and providers, the BAER team did not determine a BAER risk ratings for these non-USFS values as they are outside of BAER authority and USFS responsibility. Treatments are not recommended for water quality on NFS lands as there are not cost-effective measures that would reduce the threat to an acceptable level. Other treatments to address road concerns could benefit water quality but have not been field verified and therefore not proposed at this time.
- c. Soil productivity in areas of high SBS is threatened by post-fire erosion and loss of soil horizons. The probability of damage or loss is **possible** because there is a short-term potential for large increases in hillslope erosion. The magnitude of consequence is **moderate** because the considerable loss of soil productivity is within the expected variability for soil productivity in fire adapted landscapes. The risk rating is **intermediate**. Treatments are not recommended.
 - d. Hydrologic function in areas of moderate and high SBS is threatened due to the presence of hydrophobic soils, loss of ground cover, and reduced infiltration. The probability of damage or loss is **likely** given the amount of moderate and high SBS that is present within the burn scar (approximately 53% of the BAER analysis area). The magnitude of consequence is **moderate** because the expected increases in runoff and erosion will cause channel adjustments. The risk rating is **high**. However, there are not cost-effective treatments that would reduce the threat to acceptable, therefore treatments to reduce the risk are not recommended.
 - e. Suitable occupied Lynx habitat is threatened by the loss of vegetative cover across all burn severities and the loss of soil productivity in high SBS areas that could inhibit recovery of the habitat. The probability of damage or loss **very likely** were vegetative cover has been consumed by the fire and **likely** were the loss of soil productivity is expected to result in vegetation community conversion. The magnitude of consequence for both threats is **minor** because any loss of vegetative cover is expected to be temporary and extensive suitable lynx habitat remains on the landscape. The risk rating for both threats is **low**. Treatments are not recommended.
 - f. Native plant communities are most likely threatened by potential introduction of noxious weeds into areas that were disturbed by unmitigated fire suppression activities and by loss of native vegetation that was consumed during the fire. Follow up risk assessment and treatment recommendation should be completed when staff are available.
- 4. Cultural and Heritage Resources:** Numerous cultural resource sites which are either listed on or potentially eligible for the NRHP are located within the BAER analysis area. These sites are potentially threatened by looting, erosion, sedimentation and flooding which could result in loss of artifacts. A field review assessment by the BAER archaeologist is needed in order to determine the risk rating to these sites and any potential treatments. This will occur when the burned area is snow-free and accessible in late spring 2021.

B. Emergency Treatment Objectives: Raise awareness of post-fire hazards throughout the burned area, minimize post-fire damage to NFS trails and NFS campground infrastructure, restrict access to NFS roads with untreated threats that pose unacceptable risks to human life and safety.

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

Land: N/A

Channel: N/A

Roads/Trails: 80%

Protection/Safety: 95%

D. Probability of Treatment Success

Table 9: Probability of Treatment Success

	1 year after treatment	3 years after treatment	5 years after treatment
Land	N/A	N/A	N/A
Channel	N/A	N/A	N/A
Roads/Trails	80%	90%	90%
Protection/Safety	90%	80%	70%

E. Cost of No-Action (Including Loss): \$2,758,600 (assumes 80% chance of loss of the market value of the NFS trail segments that have an unacceptable level of risk of damage or loss).

F. Cost of Selected Alternative (Including Loss): \$1,181,328 (assumes cost of the trail stabilization treatments plus a 20% chance of loss of the NFS trail system that will be protected if the trail stabilization treatments are implemented prior to the damaging event plus the cost of all other treatments).

G. Skills Represented on Burned-Area Survey Team:

☒ Soils ☒ Hydrology ☒ Engineering ☒ GIS ☒ Archaeology
☒ Weeds ☒ Recreation ☒ Fisheries ☒ Wildlife
☒ Other: PIO

Team Leader: Liz Schnackenberg

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Team Leader: Brendan Waterman

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Forest BAER Coordinator – Arapahoe & Roosevelt NF: Tom Matthews

Email: thomas.matthews@usda.gov

Phone(s): 303-567-3032

Team Members: Table 10: BAER Team Members by Skill

Skill	Team Member Name
<i>Team Lead(s)</i>	Liz Schnackenberg, Brendan Waterman
<i>Soils</i>	Ryan Adams, Kassie Skeen
<i>Hydrology</i>	Tyler Carleton, Matt Enger
<i>Engineering</i>	Karen Mighell, Nathaniel Coffman
<i>GIS</i>	Janice Naylor, Marti Aitken
<i>Archaeology</i>	Dan Snyder
<i>Weeds</i>	Marie Stiles
<i>Recreation</i>	Miles Miller, Andy Borek
<i>Wildlife</i>	Aurelia DeNasha
<i>Fisheries</i>	Val Thompson

Skill	Team Member Name
PIO	Reid Armstrong

H. Treatment Narrative: The following narratives summarize the response actions recommended to decrease risks to BAER Critical Values. Detailed specifications, cost estimates, and maps identifying the spatial location for the treatments are available in the East Troublesome BAER Assessment project record. The documents can be obtained by contacting the Arapahoe & Roosevelt NF(ARNF) and Medicine Bow-Routt NF (MBRNF) BAER Coordinators.

Land Treatments: None proposed in the initial funding request.

Channel Treatments: None proposed in the initial funding request.

Roads and Trail Treatments:

RT13 Trail Drainage/Tread Stabilization: The existing trail system drainage features are insufficient to handle the anticipated increase in post-fire runoff from areas burned at moderate to high severity on approximately 80.2 miles of trails (57.3 miles on the ARNF, 22.9 on the MBRNF) in the BAER analysis area. Predicted increased runoff due to water repellent soils and lack of effective ground cover will be intercepted and captured by trails, leading to severe trail tread erosion that will render the trails unusable and/or dangerous to use. Additional hazards caused by the fire such as hazard trees and rockfall will create unsafe conditions at trail access points and worksites along the trails to workers. Accelerated erosion that is channelized downslope and into streams may impair water quality.

Implementing this treatment will decrease the risk of unacceptable loss of trail prism, providing for continued recreation opportunities with reduced risk to human life and safety. Proper and adequate drainage for post-fire runoff will reduce and prevent the trail prism and tread from eroding. Preventing the loss of trail prism is much more cost effective than rebuilding trail prisms.

The managed use for these systems is both motorized and non-motorized. Priority trails to be worked on include those that are within or below moderate to high soil burn severity slopes, have sustained steep grades, and lack inadequate drainage to effectively maintain control of the post-fire runoff originating from areas of moderate and high SBS.

The system trails are valuable resources for visitors and recreationists in the area. Large storm events will deteriorate and compromise the trail's integrity, eventually destroying large sections if no actions are taken. The fire has most likely burned through root and stumps underlying the trail tread creating hazardous voids beneath the trail. When trail users travel over these voids, they can break through the thin overlying crust potentially causing a significant accident and injury.

This treatment will improve surface drainage on the trail tread to limit erosion and to ensure safe use and travel on the trail for BAER treatment crews. Clearing and improving undamaged drainage structures will ensure capacity to accommodate increased runoff (water bars, rolling dips). Trails will also be outsloped where appropriate and feasible. Work will include cutting hazard trees as appropriate for worker safety.

If the trails affected by the fire deteriorate or are destroyed by increased runoff and erosion the costs to reconstruct or relocate trails would be significant and costly as rebuild cost is estimated at \$50,000 per mile for Class 3 trails and \$25,000 per mile for Class 2 trails. The emergency response drainage construction would mitigate the risk of catastrophic failure and the potential for high replacement costs due to the minimum tool wilderness regulations. It is anticipated that 80% of the affected trails would experience significant damage if no emergency stabilization is

completed and 20% would have some level of damage if the work is completed prior to a damaging event. Given the stated market value of the trail resources, the BAER trails specialists conservatively estimated emergency stabilization costs for the threatened property at 12% of the value for the Class 3 trails and 20% of the value for the Class 2 trails. The 12% treatment valuation for the Class 3 trails is potentially an overly conservative estimate and may need further adjustment during implementation.

Approximately 58 miles of Trail Class 3 multiple use motorized trails were identified for treatment in this report. The Pre fire condition of these trails was “maintained to standard”. Due to the fact the majority of these trails were highly developed class 3 OHV trails with a 50” tread width, trail treatments to stabilize these trails will be greater than costs for a typical FS class 3 trail. Additionally, when formulating the emergency stabilization cost estimates, consideration was given to specific trail grades and side slopes. This has resulted in a higher frequency of drainage treatments and has resulted in slightly higher than normal treatment costs for these threatened trail segments.

The USFS Trail Class Matrix Trail (FSH 2353 Section 14.2 Exhibit 01) was utilized to develop emergency stabilization treatment specification needs for constructed features on the threatened trail segments.

For Class 3 trails, the relevant constructed features include the following items:

- Structures may be common and substantial; constructed of imported or native materials
- Natural or constructed fords
- Bridges as needed for resource protection and appropriate access

For Class 2 trails, the relevant constructed features include the following items:

- Structures of limited size, scale, and quantity; typically constructed of native materials
- Structures adequate to protect trail infrastructure and resources
- Natural fords
- Bridges as needed for resource protection and appropriate access

RT13 ARNF Trail Treatments	Units	Unit Cost	# of Units	Total Cost
Trail drainage/storm proofing - Class 3	mile	\$6,000	37.42	\$224,520
Trail drainage/storm proofing – Class 2	mile	\$5,200	14.29	\$74,308
Trail drainage/storm proofing – Class 2 and 3 Spot Treatments	Mile	\$2,500	5.6	\$14,000
TOTAL				\$312,828

RT 13 MBRNF National Forest Trail Treatments	Units	Unit Cost	# of Units	Total Cost
Trail drainage/storm proofing - Class 3	mile	\$6,000	20.3	\$121,800
Trail drainage/storm proofing – Class 2	mile	\$5,200	2.6	\$13,520
TOTAL				\$135,320

RT16. Implementation Coordinator: Implementation coordinator for safety signage, trail closures, and trail treatments expected to be completed under contract; includes contract preparation and administration. This also includes frequent coordination between the MBRNF, ARNF and BLM personnel to ensure consistency across jurisdictions since multiple trails and access points cross multiple jurisdictions.

RT16 ARNF Implementation Coordinator	Units	Unit Cost	# of Units	Total Cost
Implementation Coordinator	days	\$400	25	\$10,000

RT16 MBRNF Implementation Coordinator	Units	Unit Cost	# of Units	Total Cost
Implementation Coordinator	days	\$400	20	\$8,000

Protection/Safety Treatments:

P1a and P1b Burned Area Warning Signs: The purpose of the Burned Area Warning signs is to reduce risks to human life and safety, to inform forest visitors of potential dangers and/or hazards when entering burned areas on NFS lands. Entering burned areas presents a high risk to human and life and safety, with increased threats from post-fire effects such as falling trees, rolling rocks, flash floods, and debris flows. It is necessary to inform the public of burned-area hazards that are a direct result of wildfire; hazards which are substantially different compared to unburned forest setting and with which many forest visitors may be unfamiliar. Burned area warning signs will be installed to inform the public of the possible dangers associated with a burned area on major entry points into the burned area.

P1 ARNF Warning Signs	Units	Unit Cost	# of Units	Total Cost
P1a Road Warning Signs (materials and labor)	sign	\$450	18	\$8,100
P1b Trail Warning Signs (materials and labor)	sign	\$167	55	\$9,195
TOTAL				\$17,295

P1 MBRNF Warning Signs	Units	Unit Cost	# of Units	Total Cost
P1a Road Warning Signs (materials and labor)	sign	\$450	3	\$1,350
P1b Trail Warning Signs (materials and labor)	sign	\$167	5	\$835
TOTAL				\$2,185

P2 Road Closure Gates: This treatment will install temporary closure gates with required signing to prevent access to high risk areas in the years immediately following the fire. These closures will eventually be rescinded as determined by FS administration. These will be installed on NFSRs 112.1 and 12.1 on the MBRTB. Cost estimates were developed by the BAER team engineer using current local market values and installation costs.

P2 Treatment (MBRTB)	Units	Unit Cost	# of Units	Total Cost
Temporary closure gates, posts, hardware, reflective signs and installation	gate	\$2,100	2	\$4,200

P10 Campground Infrastructure Removal: This treatment will remove CG infrastructure from the approximately 20 sites low-lying sites in the west loop of Denver Creek CG to prevent damage or loss during flood events in Willow Creek. Items to be removed include picnic tables,

fire grates, and cooking platforms. Some hazard tree felling made be needed to make the worksite safe for forest staff.

P10 ARNF Campground Infrastructure Removal	Units	Unit Cost	# of Units	Total Cost
Remove campsite infrastructure from west loop of Denver Creek CG	Job	\$2,600	1	\$2,600

I. Monitoring Narrative: Warning sign treatments will be monitored by Forest personnel to ensure that the signs are not being vandalized, damaged, or stolen. Road closure gates will be monitored by Forest personnel to ensure that the gates are not being vandalized. Trail closures will be monitored by Forest personnel who will periodically review footage to ensure administrative closures are effectively restricting public access. Trail drainage treatments will be monitored following significant precipitation events during storm inspection and response activities.

M1 Trail Closure Effectiveness Monitoring Cameras: This treatment would install game cameras at key trailheads that access the trail closure locations to determine if the closure is working and whether additional treatment or patrol is necessary.

M1 ARNF Trail Closure Monitoring Treatment	Units	Unit Cost	# of Units	Total Cost
Monitoring of trail closure effectiveness	site	\$1,850	5	\$9,250
TOTAL				\$9,250

PART VI – EMERGENCY STABILIZATION TREATMENTS AND SOURCE OF FUNDS ARNF

Line Items	Units	Unit Cost	NFS Lands		Other \$	Other Lands				All Total \$
			# of Units	BAER \$		# of units	Fed \$	# of Units	Non Fed \$	
A. Land Treatments										
				\$0	\$0		\$0		\$0	\$0
<i>Insert new items above this line!</i>				\$0	\$0		\$0		\$0	\$0
<i>Subtotal Land Treatments</i>				\$0	\$0		\$0		\$0	\$0
B. Channel Treatments										
				\$0	\$0		\$0		\$0	\$0
<i>Insert new items above this line!</i>				\$0	\$0		\$0		\$0	\$0
<i>Subtotal Channel Treatments</i>				\$0	\$0		\$0		\$0	\$0
C. Road and Trails										
RT13 Class 3 Trails	Miles	6,000	37	\$224,520	\$0		\$0		\$0	\$224,520
RT13 Class 2 Trails	Miles	5,200	14	\$74,308	\$0		\$0		\$0	\$74,308
RT13 Class 2 and 3 Trails -	Miles	2,500	6	\$14,000	\$0		\$0		\$0	\$14,000
RT16 Implementation Coord	Days	400	20	\$8,000	\$0		\$0		\$0	\$8,000
<i>Insert new items above this line!</i>				\$0	\$0		\$0		\$0	\$0
<i>Subtotal Road and Trails</i>				\$320,828	\$0		\$0		\$0	\$320,828
D. Protection/Safety										
P1a Road Warning Signs	Signs	450	18	\$8,100	\$0		\$0		\$0	\$8,100
P1b Trail Warning Signs	Signs	167	55	\$9,195	\$0		\$0		\$0	\$9,195
P10 CG Infrastructure Remo	Job	2,600	1	\$2,600	\$0		\$0		\$0	\$2,600
<i>Insert new items above this line!</i>				\$0	\$0		\$0		\$0	\$0
<i>Subtotal Protection/Safety</i>				\$19,895	\$0		\$0		\$0	\$19,895
E. BAER Evaluation										
Initial Assessment Total Cos	Report	\$53,000		---	\$0		\$0		\$0	\$0
				\$0	\$0		\$0		\$0	\$0
<i>Insert new items above this line!</i>				---	\$0		\$0		\$0	\$0
<i>Subtotal Evaluation</i>				\$0	\$0		\$0		\$0	\$0
F. Monitoring										
M1 Trail Closure Cameras	Each	\$1,850	5	\$9,250	\$0		\$0		\$0	\$9,250
<i>Insert new items above this line!</i>				\$0	\$0		\$0		\$0	\$0
<i>Subtotal Monitoring</i>				\$9,250	\$0		\$0		\$0	\$9,250
G. Totals				\$349,973	\$0		\$0		\$0	\$349,973
Previously approved										
Total for this request				\$349,973						

PART VII - APPROVALS

1. _____
 Arapahoe & Roosevelt NFs Forest Supervisor Date

PART IX. – EMERGENCY STABILIZATION TREATMENTS AND SOURCE OF FUNDS MBRNF

Line Items	Units	Unit Cost	NFS Lands		Other \$	Other Lands				All Total \$
			# of Units	BAER \$		# of units	Fed \$	# of Units	Non Fed \$	
A. Land Treatments										
				\$0	\$0		\$0		\$0	\$0
<i>Insert new items above this line!</i>				\$0	\$0		\$0		\$0	\$0
<i>Subtotal Land Treatments</i>				\$0	\$0		\$0		\$0	\$0
B. Channel Treatments										
				\$0	\$0		\$0		\$0	\$0
<i>Insert new items above this line!</i>				\$0	\$0		\$0		\$0	\$0
<i>Subtotal Channel Treatments</i>				\$0	\$0		\$0		\$0	\$0
C. Road and Trails										
RT13 Class 3 Trails	Miles	6,000	20	\$121,800	\$0		\$0		\$0	\$121,800
RT13 Class 2 Trails	Miles	5,200	3	\$13,520	\$0		\$0		\$0	\$13,520
RT6 Implementation coordin	Day	400	15	\$6,000						
<i>Insert new items above this line!</i>				\$0	\$0		\$0		\$0	\$0
<i>Subtotal Road and Trails</i>				\$141,320	\$0		\$0		\$0	\$135,320
D. Protection/Safety										
P1a Road Hazard Signs	Sign	450	3	\$1,350	\$0		\$0		\$0	\$1,350
P1b Trail Hazard Signs	Sign	167	5	\$835	\$0		\$0		\$0	\$835
P2 Road Gates	Gate	2,100	2	\$4,200	\$0		\$0		\$0	\$4,200
<i>Insert new items above this line!</i>				\$0	\$0		\$0		\$0	\$0
<i>Subtotal Protection/Safety</i>				\$6,385	\$0		\$0		\$0	\$6,385
E. BAER Evaluation										
Initial Assessment Total Cost	Report	\$53,000		---	\$0		\$0		\$0	\$0
				\$0	\$0		\$0		\$0	\$0
<i>Insert new items above this line!</i>				---	\$0		\$0		\$0	\$0
<i>Subtotal Evaluation</i>				\$0	\$0		\$0		\$0	\$0
F. Monitoring										
				\$0	\$0		\$0		\$0	\$0
				\$0	\$0		\$0		\$0	\$0
<i>Insert new items above this line!</i>				\$0	\$0		\$0		\$0	\$0
<i>Subtotal Monitoring</i>				\$0	\$0		\$0		\$0	\$0
G. Totals				\$147,705	\$0		\$0		\$0	\$141,705
Previously approved										
Total for this request				\$147,705						

PART X - APPROVALS

1. _____
 Medicine Bow-Routt NFs Forest Supervisor Date