USDA-FOREST SERVICE FS-2500-8 (6/06)
Date of Report: 9/17/2013

BURNED-AREA REPORT
(Reference FSH 2509.13)

PART I - TYPE OF REQUEST

A. Type of Report
[X] 1. Funding request for estimated emergency stabilization funds
[ ] 2. Accomplishment Report
[ ] 3. No Treatment Recommendation

B. Type of Action
[X] 1. Initial Request (Best estimate of funds needed to complete eligible stabilization measures)
[] 2. Interim Report
[ ] Updating the initial funding request based on more accurate site data or design analysis
[ ] Status of accomplishments to date
[ ] 3. Final Report (Following completion of work)

PART II - BURNED-AREA DESCRIPTION

A. Fire Name: **Lolo Creek Complex**
B. Fire Number: MT-SWS-000068
C. State: Montana
D. County: Missoula
E. Region: Northern (01)
F. Forest: Lolo (16)
G. District: Missoula (07)
H. Fire Incident Job Code: PNHV9J(1502)
I. Date Fire Started: 08/18/2013
J. Date Fire Contained: 9/5/2013

K. Suppression Cost: $12.5 million as of 9/9/13

L. Fire Suppression Damages Repaired with Suppression Funds
Completed as of 9/16
1. Fireline rehabilitated (miles): Handline – ; Machine –22.5
2. Fireline seeded (miles):
3. Other (identify): rehab
Planned for 2013 Rehabilitation:
1. Fireline rehabilitated (miles): Handline 10.49– ; Machine 31.9 miles–
2. Fireline seeded (miles):
3. Other (identify):

M. Watershed Numbers: 170102051406; 170102051407, 170102051408, 170102051409

N. Total Acres Burned: 10,902 total acres
NFS Acres (1,957); Plum Creek, other Private &State of Montana (8945)

O. VegetationTypes:
Ponderosa pine 40%, grassland 20%, larch 10%, lodgepole pine 10%, subalpine fire 20%

P, Q. Dominant Soils and Geologic Type:

Soils within the Lolo Creek Complex perimeter are weakly developed, shallow to moderately deep with cobbly to extremely cobbly, silty loam textures. Primary taxonomic classifications include: Andic and Typic Ustocrepts, Mollic Eutroboralfs, Dystric and Andic Eutrocrepts, Andic Cryochrepts, and Typic and Calcixerollic Xerochrepts. Most Land Type Association units (LTAs) tend to be excessively drained with rock outcrop, and silty surface textures. Surface rock ranges in cover from 5 to 70 percent and are primarily cobble size, subsoils have 35 to 90 percent rock fragment content. LTAs and attributes used in the analysis are from the Lolo National Forest Land Systems Inventory (1988).

General characteristics from the Land Type Association (LTA) unit analysis for the Lolo Creek Complex

LT	Landform	Slope Range (%)	Parent Material	Soil Family	Soil Surface Texture
13	Alluvial Terraces	0-45	Argillites, Siltites & Quartzites	Andic Ustocrepts Typic Ustocrepts	Cobbly silt loam
30	Moderate Relief Mountain Slopes	30-55	Argillites, Siltites & Limestone	Typic Ustocrepts Dytstric Eutrocrepts Mollic Eutroboralfs	Gravelly silt loam
32	Broadly Convex Ridges	10-35	Argillites, Siltites & Quartzites	Andic Cryochrepts,	Gravelly Loam
60	Stream Breaklands	55+	Argillites, Siltites, Quartzites & Limestone.	Typic & Calcixerollic Xerochrepts, Andic & Dytstric Eutrochrepts, Typic Ustochrepts	Cobbly silt Loam
64	Steep Mountain Slopes	55+	Argillites, Siltites & Limestone	Typic and Calciexerollic Xerochrepts, Typic Ustochrepts, Mollic Eutroboralfs	Gravelly silt loam

R. Miles of Stream Channels by Order or Class: Stream miles by order within the Fire Perimeter

Stream Order	Length (Miles)
1	55.83
2	18.48
3	15.45
4	2.79
5	1.69
Total	94.24

S. Transportation System

Trails: 6.8 miles Roads: Lolo National Forest: 14.0 miles; Plum Creek: 88.3 miles; Private: 12.8 miles
State of Montana: 1.6 miles, Total: 123.5 miles

PART III - WATERSHED CONDITION

A. Burn Severity (acres/%): unburned/verylow (1,776/16%); 5,241 low (5,241/48%); (3,600/33%) moderate; (286/3%) (high

B. Water-Repellent Soil (acres): 3886

C. Soil Erosion Hazard Rating (acres): 6,664 (low); 3,655 (moderate); 122 (high) (estimate)

D. Erosion Potential: 3.0 (avg) to 6.4 (max) tons/acre (ERMiT model estimate)

E. Sediment Potential: 785 yds^3/mi^2 (avg ersosion potential in yds^3/mi^2 x 0.3 sediment delivery ratio)

PART IV - HYDROLOGIC DESIGN FACTORS

A. Estimated Vegetative Recovery Period, (years): 2 grass/shrubs; 20-50 confiers

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

C. Equivalent Design Recurrence Interval, (years): 10 (25 for culvert replacement)

D. Design Storm Duration, (hours): 10-yr-6 hr & 2yr-30 minute

E. Design Storm Magnitude, (inches): 1.5 inches (10 yr6hr) & 0.42 inches (2 yr-30 minute)

F. Design Flow, (cubic feet / second/ square mile: 13 cfs/mi^2

G. Estimated Reduction in Infiltration, (percent): 84

H. Adjusted Design Flow, (cfs per square mile): 183 cfs/mi2 (Note: This design flow is for the Gerald watershed and is for unbulked modeled 10year post fire water discharge. Total discharge volumes could be much larger if bulk augmented with mass wasting sediment. The USGS WRI reports in Montana have measured cfs/m^{i2} at over 400 cfs following 0.41" of rainfall in 30 minutes near Helena (USGS WRI 03-4319)

PART V - SUMMARY OF ANALYSIS

A. Critical Values/Resources and Threats

- **Private Property:** Several homes and outbuildings are located on alluvial fans at the base of sub-drainages within the Lolo Creek Complex fire area. Potential exists for post-fire soil

erosion, debris flows, and mass wasting in these sub-drainages if high-intensity rainstorms occur in the fire area prior to sufficient re-vegetation. Increased runoff and soil erosion in these sub-drainages could potentially lead to loss of property and life.

- **Heritage/Cultural Resources:** Approximately 2 miles of the historic Nez Perce trail were identified in the Lolo Creek Complex burned area. This trail has potential post fire surface drainage problems and is susceptible to higher than average flows at crossings. A previously recorded mine site is located within the fire area, at the bottom of a drainage. The instability of these sites caused by burning is potentially compounded with anticipated increased overland flow and streamflow.
- **Road System:** Road segments have potential post-fire road surface drainage problems and/or undersized culverts unable to handle post-fire stream flows.
- **Soil Productivity:** Potential exists for post-fire soil erosion if high intensity rainstorm occurs prior to sufficient re-vegetation following the fire. The loss of a major portion of the topsoil would significantly reduce soil productivity of those sites. In addition, pre-fire populations of noxious weeds are anticipated to increase as a result of the fire and potentially impact soil productivity.
- **Water Quality:** Increased sediment and nutrient yields will occur from portions of watersheds that burned at moderate or greater severity. Some populations of aquatics species may continue to be impacted.

High severity burn area on National Forest lands in the south west portions of the Lolo Creek Fire Complex.

Plum Creek area with high intensity but low to moderate severity in the north east part of the Lolo Creek Fire Complex.

B. Watershed Description and Hydrologic Response

Soils and Erosion

Soil Erosion Hazard Rating combines the natural erosion potential of soil type (low, moderate, or high) with the increased erosion potential caused by soil burn severity (unburned, low, moderate, or high), to produce a single Soil Erosion Hazard Rating value (low, moderate, high) in acres of burn area. Soil Erosion Hazard Rating values were calculated as: Low= low or unburned severity, low erosion potential; Moderate= moderate burn severity, low or moderate erosion potential; High=high burn severity, moderate erosion potential.

Soil Scientists from the Forest Service and the Natural Resources Conservation Service (NRCS) applied the established Forest Service protocol (Parson and others, 2010 Field guide for Mapping Post-Fire Soil Burn Intensity) to validate the BARC imagery. Methodology involved purposive transect sampling in each of the representative intensity categories (Unburned, Low, Moderate, and High) to determine soil burn severity. Aerial reconnaissance was used for BARC polygon refinement. Burn severity acreages derived from the field validated BARC map were used as the basis for post wildfire predictions

Severity of burn on the soil was influenced by a combination of high density, mixed conifer fuels and steep, mountainous terrain. A majority of high severity burn occurred in high density stands in drainages, and/or on south-facing slopes. While there were significant areas of high severity fire in individual watersheds in the fire area, total percentage of high severity areas was limited to <1% of the total fire area. Overall most high intensity areas burned at a moderate severity, while moderate intensity areas burned at low to moderate severity.

Soil burn severity results based on field recon, BARC map, and ERMiT modeling–Lolo Creek Complex

BARC Burn Severity Classification	Soil Burn Severity % of total	Burn severity indicator(s)	Water Repellency Degree	1st Year Maximum Erosion Potential (tons/acre)
Unburned	16%	Viable roots and above ground crowns remaining, no change in soil structure, abundant ground cover	N/A to Weak (depth N/A), discontinuous	<1
Low (Forested)	48%	Viable roots, no change in soil structure, shallow ash depth, moderate ground cover	Weak to moderate with shallow to moderate depth, discontinuous	1.9
Moderate (Forested)	33%	Most roots still viable, ash clearly present, little change in soil structure	Moderate to Strong with Moderate to Deep depth, discontinuous to continuous	3.5
High (Forested)	3%	No viable roots, white/red ash present, lacking soil structure	Moderate to strong with moderate to deep depth, continuous	7.7

Water repellency was generally fairly strong at the soil surface throughout the fire area. Water repellent soil conditions occurred naturally in unburned areas within the fire. .Only water repellent soils in moderate/high burn severity areas were attributed to fire effects. Post fire water repellant conditions tend to naturally weaken within several weeks with short duration, low intensity rains but duration of water repellent conditions can be quite variable (Huffman et al 2001) and remain for several years. In the Lolo Creek Fire Complex, regardless of water repellency, the loss of the duff layer in the burned area will produce increased post fire runoff.

Field observations indicate that the low burn severity sites have a good potential for rapid natural revegetation. Limited sprouting of shrubs and grasses were noted throughout the fire. Moderate soil burn severity sites have a variable amount of viable shrub root crowns and roots of grasses and forbs which will probably retard re-vegetation in these areas, but the remaining root mat may potentially limit erosion.

Soil erosion ratings based on Land Type Associations (LTA) units with associated acres within the fire perimeter

Land Type	Geologic Group	Surface Erodibility*	Sediment Delivery Efficiency*	Percent of Burn Area
13	U	Low	Low	1%
30	M	Moderate	Low	26%
32	M	Moderate	Low	5%
60	Q	Low	High	43%
64	M	Low	Moderate	25%

The surface erosion potential for representative landform hill-slopes within the Lolo Creek Complex was estimated using the ERMiT (Erosion Risk Management Tool) model (Robichaud et al 2006). ERMiT combines weather variability with spatial and temporal variability of soil properties to model the range of post-fire erosion rates that are likely to occur. The ERMiT model limitations are primarily related to the difficulty of applying the model across a landscape. ERMiT modeling is usually applied to a relatively small area that is typical and extrapolated across a wider view. Recent validation of the model in Montana and Idaho indicate that results are improving with refinement of the model.

The data entered into the ERMiT model includes climate, soil texture, rock content of the soil profile, vegetation type (forest, range, or chaparral), hillslope gradient and horizontal length, and soil burn severity. The climatic data for the Lolo Creek Complex was modified using the PRISM function to adjust climate data. Assumptions for modeling parameter inputs are:

Primary Climate Location: Stevensville, MT
Prism Adjustments: to 46.79°N, 114.34°W; 4346' elevation
Vegetation: Forest
Soil Texture: Silt Loam
Rock Content: 40%
Gradient of top 10% of hillslope (i.e. ridgetops): 10%
Gradient of middle 80% of hillslope: 10%, 30%, and 60%
Gradient of hillslope toe: 30%
Soil burn severity class: moderate, high
Probability that sediment yield will be exceeded: 10%

The results from the ERMiT runs were used to estimate untreated and treated sediment delivery potentials in tons/acre specific to the Lolo Creek Complex. Treated and untreated sediment delivery potentials were recorded for years one and two following the fire. Treatment results considered mulch applied at a coverage rate of 1 ton/acre. Results for treated and untreated sediment delivery potential are displayed below for both high and moderate severity, for slopes of 10%, 30%, and 60%.

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Results of ERMiT modeling for sediment delivery potential in tons/acre.

	Moderate Soil Burn Severity				High Soil Burn Severity			
	Erosion Year 1	*Erosion Year 2*	*Mulch (1T/ac): Erosion Year 1*	*Mulch (1T/ac): Erosion Year 2*	*Erosion Year 1*	*Erosion Year 2*	*Mulch (1T/ac): Year 1*	*Mulch (1T/ac): Year 2*
Silt Loam, 10% avg slope	0.41	0	0	0	1.2	0.3	0	0
Silt Loam, 30% avg slope	4.9	2.5	0.12	0.12	6.4	3.5	0.21	0.92
Silt Loam, 60% avg slope	3.2	1.1	0	0	6.3	2.9	0.19	0.26
Average t/a	2.8	1.2	0.0	0.0	4.6	2.2	0.1	0.4

Hydrologic Response

Runoff response to precipitation will likely be robust through the remainder of 2013 and in the runoff season of 2014 due to water repellant soils and reduced vegetative canopy and ground cover vegetation. Although much of the water repellency should break down over the winter and spring, runoff response will likely remain elevated throughout the next three to five years, or possibly longer in high intensity areas depending on regrowth of groundcover vegetation (Neary et al., 2008).

Pre and post fire storm flow modeling was used to calculate storm water runoff rates for sixteen Lolo Creek complex watersheds of concern. The Forest Service provided hydrologic modeling for the entire

fire area, including eight drainages with structures on private land which could potentially be at risk of damage from post-fire flooding and debris torrents.

In order to estimate post-fire storm flow runoff for the remaining watersheds (all less than 5,000 acres), the unit hydrograph and runoff curve number (RCN) methods were used to develop stream hydrographs (SCS, 1973). The unit hydrograph method is one of the most widely used empirical techniques in the western United States for small watersheds. This method estimates peak rates of discharge and associated runoff volumes and factors in storm precipitation duration and intensity, soil type, land use, cover condition, and average watershed type. Since soil type and land cover condition are factored in, the unit hydrograph method is useful for estimating changes in storm flow resulting from wildfire induced soil and land cover changes. While widely used in this capacity, the unit hydrograph method is a simplistic approximation of complex natural and physical processes, and should be used with an understanding of its limitations. The RCN method requires an estimate of burn severity by area. Each watershed was divided into low, moderate, and high severity classes using satellite imagery, field assessments, and GIS data. A map derived from SPOT satellite infrared reflectance imagery provided initial estimates of burn severity. Forest Service and NRCS field scientists refined the burn severity map at 56 individual soil plots. Surface ground cover, soil structure, root viability, and water repellency were recorded at each plot. Visual observation, including a complete aerial reconnaissance of the fire area, was also used to evaluate burn severity. These field observations were used to refine the burn severity map. Once this was completed, drainages above values at risk were delineated, and burn severity was calculated for each drainage. Runoff curve numbers for the dominant vegetation type in the burned area were derived from standard values (SCS, 1973) and were refined based on previous experience with similar wildfires in the area and field assessment of the burned area (Table 2). Hydrologic Soil Group (HSG) for the fire was predominantly B with significant portions of A in the southwestern corner of the fire.

Runoff curve numbers used for post-fire discharge estimates.

Land Cover Description and Condition	**HSG**	**RCN**
Unburned	B	60
Low Severity Burn	B	65
Moderate Severity Burn	B	75
High Severity Burn	B	82

Design storms and precipitation intensities were evaluated using the Precipitation Frequency Atlas of the Western United States—Montana (NOAA, 1973) for the entire Lolo Creek area for 6 hour and 24 hour storms. Shorter duration amounts for the 1hr, 30 minute, and 15 minute were calculated with equations in the 1973 atlas. Although the precipitation data are somewhat dated, they are the only readily available dataset and are still representative of potential conditions. Results are displayed below. Although the NRCS template for the RCN method uses 6 and 24 hour precipitation values, the actual rain event applied to the watershed uses a SCS Type 2 storm distribution with the peak flow derived from the most intense part of the event. This technique provides a reasonable approximation of 30 to 60 minute storm intensities, which are most commonly associated with large post-fire runoff events (Cerelli, 2000). Ray Nickless (NWS Missoula) advised that he has observed a post wildfire threshold for debris flows in western Montana and NE Idaho of about 0.3 to 0.5 inches in 30 minutes which corresponds to only about a 2 year recurrence interval.

Design Precipitation for Lolo Complex Fire area (NOAA, 1973).

Return interval years	24hr inches	6hr inches	1hr inches	30min inches	15min inches
2	1.9	1	0.50	0.42	0.34
5	2.3	1.3	0.92	0.79	0.64
10	2.7	1.5	1.09	0.94	0.75
25	3.2	1.7	1.32	1.14	0.91
50	3.6	1.9	1.48	1.29	1.02
100	4.1	2.1	1.28	1.11	0.88

A spreadsheet version of the unit hydrograph procedure was used to perform the RCN calculations for watersheds in the Lolo Complex fire area (Cerelli, 2002) .The RCN method assumes even precipitation intensity for an entire watershed. The Missoula NWS (Ray Nickless, Hydrologist) advised that the heaviest precipitation distribution area for large thunderstorms in western Montana is about 3000 acres. Therefore for the Woodman Creek and West Fork Butte Creek drainages), USGS regression equations with watershed basin characteristics (Parret & Johnson, 2004) were used to estimate pre-fire flows. These flows were adjusted for post-fire conditions using a method commonly used in the northern Rockies that increases runoff for moderate and high severity burned areas within a watershed (Derby fire, 2006).

Lolo Creek Fire Complex estimated pre- and post-Fire Peak Flows

Watershed	Area (acres)	Assessment method	Pre-fire flow (cfs)						Post-fire flow (cfs)		
			2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	2-yr	5-yr	10-yr
Chickaman East	317	RCN	1	3	6	11	24	42	2	4	11
Chickaman	632	RCN	2	6	12	21	43	75	10	29	64
Westerman	1290	RCN	4	12	23	40	78	135	16	44	98
Lick	262	RCN	1	2	5	9	20	36	9	20	36
Anderson	805	RCN	3	7	15	26	53	92	15	44	91
Woodman	5101	USGS	58	98	128	170	203	238	62	104	136
School House	174	RCN	1	2	3	6	14	25	1	3	8
Burned Gulch	175	RCN	1	2	3	6	14	25	8	21	38
Camp	2251	RCN	7	20	39	68	128	217	16	35	80
Gerald	197	RCN	1	2	4	7	15	28	17	35	57
West Fork Butte	11433	USGS	136	216	274	352	415	482	140	222	282
2171 switchback	92	RCN	0	1	2	4	8	15	9	19	31
4328 West	44	RCN	0	0	1	2	5	8	0	1	3
4328 East	49	RCN	0	1	1	2	5	9	7	13	20
17122	46	RCN	0	0	1	2	3	9	3	7	13
2171 West	106	RCN	0	1	2	4	9	17	7	16	28

Post-fire 10-year flows are expected to increase by 3 to 1400 %. depending on the amount of burned area. The watersheds with the largest flow increases include Chickaman, Anderson, Burned Gulch, Gerald, 2171, 4328, and 17122 watersheds. Nine of the 16 watersheds were evaluated at the request of the NRCS Missoula office to provide information about potential risk to residential structures on alluvial fans below the fire perimeter (Chickaman, East Chickaman, Westerman, Lick, Anderson, Woodman, School House, Burned Gulch, and Camp). This report does not specifically assign risk or provide suggested mitigation measures for these watersheds.

Culverts on National Forest roads potentially affected by increased flows were evaluated to determine their capacity to convey post-fire design-storm flow events. Field data were collected on September 6-12, 2013 by Forest Service crews. Crews collected field data required for culvert hydraulic analysis, which included culvert and road prism dimensions, GPS coordinates, culvert condition, and photos. Following field data collection, crossing capacity was estimated using HY-8 Culvert Hydraulic Analysis Program (FHWA, 2010). The analysis assumed that inlets and outlets were clear of debris.

Six culverts were judged to be undersized and at risk of failure due to the post-fire peak-flow design event. Hydraulic modeling indicates that none of the culverts will convey a post-fire 10-year flow.

Site	**Drainage area (ac)**	**Culvert diameter (in)**	**Outlet depth fill above pipe (ft)**	**Current capacity (cfs)**	**Post-fire 10-year flow (cfs)**
Woodman	5101	36	5.3	48	136
2171 SB lower	93	18	6.3	6	31
2171 SB upper	93	18	6.2	6	31
4328 East	49	18	17.2	6	20
17122	46	18	6.5	6	13
2171 West	106	18	2.3	6	28

Culverts recommended for replacement were sized by considering the bankfull width of the channel, and both the pre-fire 100 year flow and the post-fire 10 year flow. The higher of the two flows was selected as the design flow with additional allowance to handle a 25 year post fire flow. All of the recommended culvert sizes are capable of handling a 25 year post fire flow to allow increase discharge stage from sediment bulking. None of the culverts are large enough to handle a debris flow event but most of the new culverts will have armored dips installed adjacent to the culvert for potential post fire events that exceed culvert capacity. A round 36 inch culvert was used as a minimum replacement size, to enhance the capability of passing post-fire debris. Since, none of the culverts are large enough to handle a debris flow, most of the new culverts will have armored dips installed adjacent to the culvert for potential post fire events that exceed culvert capacity, These dips should be armored along the road surface and fill slopes with large gravel to small cobble-sized material.

Treatment recommendations for culverts within the Lolo Complex Fire perimeter.

Site	Current diameter (in)	Current capacity (cfs)	Post-fire 10-year flow (cfs)	Recommended replacement structure	Design capacity (cfs)
Woodman	36	36	136	60 inch culvert*	350
2171 SB lower	18	18	31	42 inch culvert	62
2171 SB upper	18	18	31	42 inch culvert	62
4328 East	18	18	20	36 inch culvert	48
17122	18	18	13	36 inch culvert	47
2171 West	18	18	28	36 inch culvert	45

* Alternative structures, including a 77” x 52” arch culvert, or a partially buried 72” culvert are acceptable

Burned hillslopes within the Lolo Complex Fire are expected to increase road surface erosion by delivering additional runoff to road surfaces. Roads are also vulnerable to elevated surface erosion from blading and heavy use during suppression operations. In order to mitigate potential elevated post-fire road-surface erosion, surface drainage would be improved along roads throughout the burned area.

Rolling dips would be installed at spacing appropriate to the road gradient and road surface material. Dips should not drain directly into stream channels. Berms exist along many miles of road. These berms should be removed to avoid channeling runoff along the road grade.

Runoff response to precipitation will remain elevated through 2013 due to reduced ground and canopy cover. Runoff response will likely remain elevated throughout the next three to five years, or longer depending on regrowth of groundcover vegetation (Neary et al., 2008). Although large increases in runoff not anticipated, it is recommended that action be taken to reduce potential runoff.

Road Infrastructure

Assuming that all roads within the burned area are rehabilitated appropriately, there is a relatively low risk for failure to the majority of the road system. The majority of the roads in the burned area are owned by Plum Creek and all of the roads reviewed by the BAER team for restoration are jointly owned/ maintained cost share roads (with exception of 0.26 miles of Rd. #5458). Most of the roads reviewed are located behind year round closures and are used by the Lolo National Forest for administrative purposes and with cost share partners for commercial logging. The cost share roads 2171, 17122, 4328, & 504 (behind the road closure) all are located on steep hillsides that experienced moderate soil burn severity with pockets of high soil burn severity. Lolo Creek Complex fire roads will be impacted with increased runoff from the adjacent burned slopes which will be channelized down the road system causing rutting and possible washouts. The road system needs drainage infrastructure maintained throughout the length of the roads to prepare it for increased post fire runoff. The maintenance items include the following:

- Drainage Structure Reshaping
- Culvert Cleaning
- Culvert Catch Basin Repair
- Culvert Headwall Repair

A few locations within the road system at stream or draw crossings have been identified as high risk and are recommend for treatment prior to heavy runoff. A draw on Rd. #2171 at MP 0.7 does not have a functioning drainage structure. This draw burned with moderate soil burn severity with anticipated increased flows and road damage. . Two undersized stream crossings on Rd. #2171 have a high probability of being overtopped and plugging the 18” culverts currently in place. In the Gerald Watershed a draw at mile 0.39 on Rd. #4328 currently has an 18” culvert. This watershed has been identified as a high risk due to the proximity of private residences below. Woodman Creek has a road crossing at MP 3.6 that is currently undersized for the calculated pre-fire Q100 flows and the post-fire Q10. The current 36” culvert is located approximately 600’ upstream from a privately owned man made irrigation pond/ reservoir (Approx. 0.4 acre) with potential breaching causing significant damage to private property and residences below.

The drainage of 17122 and 2171 west above the culverts burned with moderate soil burn severity with a large area of high soil burn intensity. Currently the 18” culverts are not able to handle pre-fire Q100 flows and would not be able to handle the runoff of the post-fire condition. This is a moderately steep sided draw with a high potential for rolling debris and debris flow to the culvert inlets causing them to plug.

The majority of the roads in the Lolo Creek Complex fire are state, county, or private roads. Assuming that all roads within the burned area are rehabilitated appropriately, there is a relatively low risk for failure to the majority of the road system. However, a few locations within the road system have been identified on National Forest as high risk and road treatments are recommend prior to heavy runoff.

Road and Road-Stream Crossing Emergency Determination
Engineering and hydrology findings all indicate high concern should post-fire precipitation and runoff occur

Fisheries

Fisheries on the northern portion of the incident consist of Bear, Camp, and Woodman Creeks. All three streams contain pure populations of westslope cutthroat trout with the addition of eastern brook trout, rainbow, and browns within Bear Creek. Habitat conditions in these streams are qualitatively rated as low to moderate quality based on the amount and location of roads and harvest units. A high proportion of ownership of these streams is private industrial lands (>50%) with NFS ownership in the headwaters. The fisheries south of the highway 12 consist of the mainstem of Lolo Creek, South Fork Lolo, and West Fork Butte Creek which is a tributary to South Fork Lolo. All of these streams contain all five trout species: westslope cutthroat, bull, rainbow, eastern brook, and brown trout, in addition to several nongame species. Lolo Creek and South Fork Lolo are designated as bull trout critical habitat by the USFWS. Habitat conditions are qualitatively rated as low to moderate based on impacts from Hwy 12, forest roads (private, industrial, and Forest), harvest, and grazing. The Lolo Creek fire poses some sediment concerns to Bull Trout habitat in West Fork of Butte Creek which can be moderated with the proposed road BAER treatments.

Weed Infestation

Five main weeds species of concern occur on National Forest lands within the perimeter of the Lolo Creek Complex fire. These include spotted knapweed, cheatgrass, oxeye daisy, Canada and other thistles, and leafy spurge). These species are present along access roads, roads within the perimeter, within the interior of the fire, and at least 50 feet either side of the road, mostly on the fill and cut slopes. Seed dispersal is probable for all species. Infestation levels were determined to be low (1-5%) to high (>25%) based on weed infestation levels in unburned areas near the fire perimeter. The burned area has never been inventoried for precise determination of weed acreage.

The Lolo Creek corridor, including Highway 12, runs through the fire's perimeter. Oxeye daisy, spotted knapweed and cheatgrass are well established along the highway and would be considered a threat to invading the burned area of the Lolo Creek Complex fire. Most of the noxious weed species reproduce by seed transported by wild, wildlife, and human activities. Overall, the presence of known weed infestations within the fire perimeter and adjacent to the area pose a high risk for weed introduction into the area.

Common mullein and common tansy were also observed during site inspections at low levels. These species are considered moderately invasive. Given the level of previous invasion, they are considered a low risk. Additionally, weed control efforts for the other three species would be effective as control or suppression of these species as well.

The Lolo Creek Fire reduced or eliminated crown canopy, shrub, and forb cover in high and moderate severity (vegetative based on BARC) burned areas on 10,092 acres of National Forest, Plum Creek Timber Company, and private lands. These disturbed areas are highly vulnerable to weed invasion or weed spread from existing infestation or adjacent sources

Overall, the presence of known weed infestations within the fire perimeter and adjacent to the area pose a very high risk for weed introduction into the area.

For most noxious weed species identified, disturbed sites and dry potential vegetation types are the most at risk from invasion and spread. Disturbed areas include roads, dispersed recreation sites, game trails and where ground disturbing fire suppression actions occurred (i.e. dozer lines, hand lines, and drop points). Burned sites can have altered soil structure and reduced organic matter content creating a more favorable germination substrate for weed seeds. Undisturbed areas in drier vegetation types of the fire area are also at risk.

Fig. 1 – Sum of National Forest acres at high or moderate ecological risk of weed infestation or spread, by habitat type.

Habitat Types at High or Moderate Ecological Risk	Sum of TSMRS_ACRE	Species
	2012	Spotted knapweed, cheatgrass, Canada and other thistles, leafy spurge, oxeye daisy

Cultural Resources

Cultural Resources include archaeological and historic sites that are listed on, or are considered potentially eligible for, the National Register of Historic Places (NRHP), as well as those that have not been formally evaluated. At least 5 cultural resources are located within or adjacent to the fire perimeters that could potentially be affected by wildfire. Prehistoric site types include the Nez Perce Trail and the Fort Fizzle area. Historic sites types include the Woodman schoolhouse, Fort Fizzle, and mine sites.

Site Number	In burn area/severity	Fire effects/threat	BAER Risk Rating	Treatment
24MO0056 Mining Cabin	Moderate	Burned moderately through the drainage. Steep drainage connecting above the site, has high potential to remove surface artifacts.		Flake out 10 straw bales to provide surface stability and improve vegetation re-growth for summer of 2014.
24MO0057 Chickaman Mine (private land)	Low	Burned on north side of road, cabin untouched by fire	0	None
24MO0104	Low	Burned over some portions of the trail. Hand line and dozer line were advised to stay off the documented trail area. At the Fort Fizzle area, the Lolo Trail segment that was modified into the Lolo Stage Coach road was burned over, no fire suppression actions were observed over the old road.	0	None

24MO0126 Woodman School House (private)	Unburned	None	0	None
24MO0129 Fort Fizzle (Eligible)	Low	Fire was put down in site on the north side of Highway 12 from the developed recreation trail near the approximate location of the barricade. Fire was hand ignited to burn up the slope creating a fire break.	0	None.
24MO0312 Historic Mining	Moderate	Fire burned moderately through the ridge.	0	None

Site 24MO0056, "Lawyers Combination" is a historic mining cabin with three burned structures, historic debris, and at least five adits, lies within the burned area on the central portion of the fire. This site is located on both sides of Woodman Creek along Forest Service Road # 5458. Structures were built on an alluvial fan and outwash downhill from a no-named tributary. The tributary was heavily burned and has a high potential to erode and move historical debris from its current location. Proposed treatment is to have five straw bales of hay spread over the site in the alluvial fan to prevent surface erosion and overflow which could move historic debris from the original location.

Values at Risk:

In accordance with the revised Forest Service manual, the risk matrix below, Exhibit 2 of Interim Directive No.: 2520-2010-1, was used to evaluate the Risk Level for each value identified. Only treatments that had a risk of Intermediate or above are recommended for BAER authorized treatments. For the Lolo Creek Complex Fire risk levels by resource included weeds/sensitive plants, roads, road-stream crossings, and private land infrastructure immediately adjacacent to NF.. Only roads, road-stream crossings, and weeds/sensitive plants had risk levels of intermediate or greater and therefore are the only resources recommended for BAER funded treatments. Other than cost share roads this BAER plan in not recommending specific treatments on non-federal lands.

Values at Risk Matrix.

Probability of Damage or Loss	Magnitude of Consequences		
	Major	Moderate	Minor
	RISK		
Very Likely	Very High weeds/native plants	Very High	Low
Likely	Very High roads	High soil erosion, pvt land infrastructure	Low
Possible	High	Intermediate heritage	Low
Unlikely	Intermediate	Low fish habitat	Very Low

B. Emergency Treatment Objectives:

Threats to natural resources from culvert failure, increased sediment delivery, damage to private land residences and outbuildings, and establishment of noxious weeds exist as a result of the Lolo Creek Complex Fire. The primary treatment objectives are:

- Mitigate effects under changed post-fire watershed response, particularly where Forest roads cross drainages with undersized culverts and where roads on steep ground are unstable

- Minimize the increased potential for the spread of invasive and noxious weeds from known pre-existing weed infestations to National Forest lands.

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

Land **80** % Channel **80** % Roads/Trails **80** % Protection/Safety **N/A**

D. Probability of Treatment Success

	Years after Treatment		
	1	3	5
Road	85	90	90
Channel			
Land/Weeds	80*		
Protection/Safety	85	90	95

*Only one year of detection and treatment is allowed using BAER authorization.

E. Cost of No-Action (Including Loss): $1,400,000

F. Cost of Selected Alternative (Including Loss): $458,072

G. Skills Represented on Burned-Area Survey Team:

[x] Hydrology	[x] Soils	[X] Geology	[ ] Range
[ ] Forestry	[ ] Wildlife	[ ] Fire Mgmt.	[x] Engineering
[ ] Contracting	[ ] Ecology	[X] Botany/Weeds	[x] Archaeology
[X] Fisheries	[X] Research	[ ] Landscape Arch	[x] GIS

Team Leader: Mark Story, Traci Sylte

Email: mark@story2.name, tsylte@fs.fed.us

Team Members:

- Ann Hadlow- Soils
- Kelsey Davis- GIS
- Karen Stockman- Weeds
- Brian Story-Hydrology
- Dustan Baker -Engineering
- Shane Hendrickson- Fisheries
- Traci Sylte – co-team leader/hydrology/multiple resources
- Erika Karuzas – Archeology

H. Treatment Narrative:

Proposed Road Treatments

The Lolo CreeK BAER assessment 2500-8 includes request for $89,000 to perform the following treatments needed to protect existing infrastructure, aquatic habitat, and protect public safety):

Proposed Emergency Treatments for road-related risks

Treatment/Work Item	Treatment Narrative – Work Requirements - Rational
Culvert Replacement in Tributary to W. Fork Butte Creek	Two road- stream crossings will be replaced to eliminate the substantial risk of culvert plugging, overtopping, and breaching. The watershed above to the culverts is 90 acres in size, with moderate soil burn intensity with pockets of high soil burn severity. Replacing the two 18" culverts on the stream with 48" culverts (approximately a 25 year burned recurrence interval) will allow it to handle post fire runoff events combined with a moderate amount of debris flow.
Draw Culvert on Rd. #2171 @ MP 0.70	The watershed above the culvert all has moderate soil burn intensity with pockets of high soil burn intensity There would be a 24" culvert installed at this location to handle the post fire condition of the draw. A drain dip would be installed in close proximity as to protect from channelization down the road in case of culvert plugging.
Woodman Creek Culvert Replacement	This existing 36" culvert upgraded to a 72" culvert countersunk by 2' to provide for the bank full width of the stream and for the anticipated post-fire flow events. Replacing the culvert will also lessen the chances of sending a surge of water downstream that could damage the pond/ reservoir on private lands below.
The Drainage of 17122 and 2171 West	These two 18" culverts would be replaced with 36" culverts to decrease the chance of plugging and/ or not passing handle to the post-fire runoff. Armored drain dips would be installed in close proximity as to protect from channelization down the road in case of culvert plugging.
Gerald Watershed Culvert	The current 18" culvert would be upgraded with a 36" culvert. This would adequately provide for post-fire runoff conditions as well as the calculated pre-fire Q100 conditions. This upgrade would

	decrease the chance of plugging, failure of the road, and the potential of sending a surge of water downstream to the private residences below.
Catch Basin Repair/ Reconstruction	Catch basins in many road segments will experience raveling of soil and rolling debris and need to be widened with back slopes stabilization to prevent culvert inlet plugging.
Road Drainage Maintenance	Road drainage on all roads would be maintained by cleaning and shaping all road drainage features such as drain dips, culvert inlets and outlets, and ditch cleaning. A few cross drainage or additional ditch relief culverts will be installed to handle the additional post fire runoff.

Proposed Weed Treatments;

As part of the BAER treatment efforts for invasive weeds control, both ground and aerial treatments are necessary within and immediately outside of the fire perimeter to be successful. Treatments for weed related risks (contract admin and people days included in cost estimate).

Priority	Description	Estimated Units	Estimated Cost per Unit	Target Weed Species	Prescription	Estimated Cost
1	Ground Application (broadcast) (contract)	25 acres	$37.00/acre	Spotted knapweed, other broadleaf road side weeds	1 pt/acre Picloram	$925
2	Ground Application (spot, ATV) (contract)	30 acres	$93.00/acre	Leafy spurge	12 oz/acre Imazapic	$2,790
3	Aerial Application	951 acres	$40.12/acre	Spotted knapweed, other broadleaf cheatgrass	5 oz/acre of Aminopyralid and 6 oz/acre of Imazapic	$38,154
Total Herbicide Cost						$41,869
Biological Control Agents		3 releases	$44/acre (five acres per release)	Leafy Spurge (releases 3 @ $220 (insects, plots est., labor)	*Apthona* spp.	$660
Total Bio-Control Costs						$660
Monitoring (agreement)		3 sites			Initial set up	$1,800
FS Monitoring/Sensitive Plant Surveys		5 days (GS-07)	$250/day* *estimate	Monitoring sensitive plants prior to herbicide application		$1,250
Total Monitoring Cost						$4,300
Total Contract Administration		10 days (GS-07)	$250/day*	Administer contracts = 4 days (2 days each contract)		$2,500

		*estimate	Inspect Contract = 4 days Aerial implementation = 2 days		
TOTAL REQUEST					$49,329

Continued monitoring of the Lolo Creek Fire burn areas is recommended to determine new infestations, treatment efficacy, and retreatment need.

Proposed Cultural Resource treatment

Site 24MO0056, “Lawyers Combination” is a historic mining cabin with three burned structures, historic debris, and at least five adits, lies within the burned area on the central portion of the fire. This site is located on both sides of Woodman Creek along Forest Service Road # 5458. Structures were built on an alluvial fan and outwash downhill from a no-named tributary. The tributary was heavily burned and has a high potential to erode and move historical debris from its current location. Proposed treatment is to have 40 straw bales of weed free wood straw spread over the site to about a 1”deep layer (similar to the heli-mulch treatment) in the alluvial fan to prevent surface erosion and overflow which could move historic debris from the original location.

I. Monitoring Narrative:

Weed Monitoring Weed treatment monitoring in the National Forest lands of the Lolo Creek Fire complex will be assessed for treatment efficiency in the spring and early summer of 2015. This monitoring will be after the BAER treament authorization has ended (September 2015) so will is not includedin the Part VI fund request table.

Part VI – EMERGENCY STABILIZATION TREATMENTS and SOURCE OF FUNDS

A. Land Treatments	Units	Unit Cost $	Number	$	Other $
Weed assessment and treatment *	Acres	46.59	1006	46870	
Cultural resource site mulching	each	800	1	800	
Subtotal Land Treatments				47670	
B. Channel Treatments	0	0	0	0	
C. Roads and Trails					
Culvert replacement	Each	6373	6	38237	
Road drainage and storm proofing	Miles	2984	14.8	44163	
Catch basin repair/reconstruction	Each	310	417	6600	
Subtotal Roads and Trails				89000	
D.Protection and Safety	0	0	0	0	
E. BAER Evaluation					
BAER team					34400
Supplies				1400	
Subtotal Evaluation				1400	34400
F. Monitoring					
Weed treatment Efficacy	Site				1800
Subtotal Monitoring	0	0	0	0	1800
Total Approved				138070	

PART VII - APPROVALS

/S/ DEBORAH L. R. AUSTIN
Forest Supervisor — September 17, 2013

2. _____
Regional Forester — September , 2013

Appendix A Treatment Map