

TECHNICAL SPECIALIST'S REPORT – BURNED AREA EMERGENCY RESPONSE

Resource: Engineering
Fire Name: Hayden Pass **Month/Year:** 7/2016
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I. OBJECTIVE

Field investigations of existing values within the boundary and influenced watersheds of the Hayden Pass Fire on the Pike and San Isabel National Forest were conducted from July 22-27th, 2016. The fire perimeter totals 16,520 acres on the San Isabel National Forest with the remainder on other agency and private land.

The purpose of this engineering investigation was to assess potential negative effects on roads, bridges, culverts and other hydraulic structures attributable to the post-fire condition of affected watersheds. This report will provide a general summary of the values at risk, observations and findings, and recommendations resulting from the investigation.

II. POTENTIAL VALUES AT RISK

Potential values at risk identified and addressed in this report include: Forest Service System Roads and Trails, trail bridges, county roads, private residence roads, irrigation ditches and reservoirs. Expected risks attached to these values include threats to Life and Safety, Property and Natural Resources.

Roads

There are **17** miles of NF system roads impacted by the fire. There are approximately **6** miles of unclassified and user-created roads within the fire perimeter.

System roads assessed for potential risk from burned areas include:

- NFSR 6 [Hayden Creek]
- NFSR 6.2A [Coaldale CG]
- NFSR 6.3B [Hayden Creek CG]
- NFSR 6.3C [S. Prong Hayden Creek]
- NFSR 35 [Mosher Creek]
- NFSR 40 [Big Cottonwood]
- NFSR 198 [Lake Creek]

Unauthorized roads assessed include:

- To Rainbow Trail in Little Cottonwood Drainage
- To Rainbow Trail in Deep Gulch Drainage
- To Rainbow Trail in Oak Creek Drainage

Other roads assessed include:

- County Road 6 at Hayden Creek crossing
- County Road 39
- Private: Eagle Peak Circle, Fox Creek

Trails & Trailheads

Note: Trails will be addressed in the Recreation Specialist Report.

Trail Bridges

- Coaldale CG
- Rainbow Trail at NFSR 6.3B [Hayden Creek CG]
- Rainbow Trail above NFSR 6.3C [S. Prong Hayden Creek]
- Rainbow Trail at Big Cottonwood Trailhead at end of NFSR 40 [Big Cottonwood]

Other Values at Risk assessed

- Mosher Creek Reservoir
- Little Cottonwood and Oak Creek Irrigation Ditch
- Balman Reservoir
- Rainbow Lake
- County culverts on Hayden Creek, Eagle Peak Circle, Fox Creek

III. RESOURCE CONDITION ASSESSMENT

- **Condition of Identified Value at Risk**
 - **Existing/Expected Consequences of the fire on resource**

Roads

- NFSR 6 [Hayden Creek]: No direct fire damage to the road, limited burned slopes above the road near the pass (high clearance segment), two AOPs observed at the Middle and North Prong of Hayden Creek (neither have burned area contributing to their watersheds).
 - Because of the high bench of the road, low burn impact on the adjacent slope and limited interaction with Hayden Creek, the threat is judged to be unlikely.
- NFSR 6.2A [Coaldale CG]: no direct damage, in close proximity to the South Prong of Hayden Creek (highly impacted watershed upstream.) Noted existing fill slope erosion and past attempts to armor with gabion baskets and riprap.
 - Due to close interaction with Hayden Creek and an already threatened fill slope, high rates of erosion and fill destabilization are expected with the projected flow increases and full or partial loss of the road is judged to be very likely.



Figure 1: NFSR 6.2A [Coaldale CG]

- NFSR 6.3B [Hayden Creek CG]: No direct damage was observed to the road and negligible levels of burn occurred in the above drainage.
 - Due to location outside of impacted drainages, the threat is judged as unlikely.
- NFSR 6.3C [S. Prong Hayden Creek]: No direct damage was observed on the road but the above drainage was highly impacted. The South Prong of Hayden Creek comes close to the road in several locations and has low elevation differences with the road.
 - Increased flows are expected to enter the road prism, causing erosion of the road and sedimentation in the creek. Threat is judged as possible.

- NFSR 35 [Mosher Creek]: No direct damage observed on private or BLM but the watershed upstream is affected by the fire. The road transitions to admin only access at the forest boundary and is directly impacted by the fire for roughly one mile.
 - Some drainage features exist but increased flows and erosion are expected on the road. Private roads were observed below with homes adjacent to creek. Due to the current condition of road drainage and the contributing watershed, threat is judged as possible.
- NFSR 40 [Big Cottonwood]: No direct damage to the road but portions are in close proximity to Big Cottonwood Creek which drains the above highly impacted watershed. Poor drainage features in the road are inadequate to direct flows back to the creek and existing bank erosion compromises the road at several locations due to position in floodplain. Homes were observed adjacent to creek with several private bridges spanning Big Cottonwood Creek.
 - The road is expected to be at risk to increased flows, sediment and debris due to up-gradient burned area. Minimal shoulder and elevation difference exists in several areas adjacent to the creek. During storm flows, water is very likely to enter the prism and high rates of erosion are expected in the fill slopes of the road.



Figure 2: NFSR 40 [Big Cottonwood]

- NFSR 198 [Lake Creek]: Very rocky road with good drainage and little use. Some direct damage of roadbed but minimal area of burned land contributing to flow over the alignment.
 - The road is not expected to see much change in flow conditions and threat is judged to be unlikely.

Other roads assessed included:

- County Road 6: large bench and fill slope, unlikely to be threatened by increased flows. Large culvert on county, not judged to be at risk from increased flow and debris.
- County Road 39 & 40: downstream of highly impacted Big Cottonwood Drainage, multiple private bridges spanning creek and some homes close to floodplain.
- Eagle Peal Circle (Private) at Oak Creek: Drainage is dry due to irrigation diversions upstream. At risk to increased flows and debris if above irrigation ditches fail.

Trails

Note: Trails will be covered in the Recreation Specialist Report but trail bridge condition surveys and treatment recommendations will be addressed here.

Trail Bridges

- Trail Bridge on the Rainbow Trail above NFSR 6.3C [S. Prong Hayden Creek]: 25' Glu-laminated timber bridge spanning the South Prong of Hayden Creek on rock gabion abutments. 4.0' freeboard.
 - The freeboard is inadequate to pass projected flows and expected debris due to substantial burned area upstream and low slope in the cross section. Damage to or failure of superstructure is likely.



Figure 3: Trail Bridge on the Rainbow Trail above NFSR 6.3C

- Trail Bridge on the Rainbow Trail at trailhead on NFSR 40 [Big Cottonwood]: 20' timber bridge spanning Big Cottonwood Creek. Rock gabion abutments with some damage. Stream currently flowing in and around one abutment. 4.0' freeboard.
 - The upstream watershed (including Wolf Creek) is highly impacted by the burn and increased flows are expected. Gabion condition and the constricted channel make abutment failure (and subsequent bridge loss) very likely due to snagged debris and flow impact on the stacked rock.



Figure 4: Trail Bridge on the Rainbow Trail at trailhead on NFSR 40

- Hayden Creek Campground Trail Bridge: 25' Glu-laminated timber bridge spanning the Middle Prong of Hayden Creek on rock gabion abutments. 3.5' freeboard.
 - Minimal burn impact upstream (if any) and no flow increases expected. Damage or failure of bridge is unlikely.
- Coaldale Campground Trail Bridge: 22' timber bridge on concrete wing-wall abutments. 20' span across Hayden Creek with substantial burned area above. 5.5' freeboard, accesses walk-in sites at Coaldale Campground.
 - Freeboard is adequate to pass the increased flows predicted (>400 cfs) but with inadequate excess to allow any debris in addition. Damage to superstructure possible. Abutments in good repair and well situated to deflect flows and debris.

Unauthorized Roads and Trails

- Unauthorized 2-track roads in the Little Cottonwood drainage were observed accessing the Rainbow Trail from private lands. Roughly 2 miles are along ridge tops and will have little impact in post burn conditions but another 4 miles travel in floodplains or directly up slopes. Lack of drainage features paired with poor alignment has entrenched these roads under existing flow conditions.
 - These roads and trails are in a highly impacted watershed and are expected to be exposed to greatly increased flows. Water and debris will be caught by these incised "channels" and instigate excessive erosion and sedimentation along adjacent slopes and down the watershed. Water quality, soil productivity, slope integrity and hydrological function are very likely to be negatively affected.



Figure 5: Unauthorized roads in Little Cottonwood Drainage

Other Values at Risk

- Balman Reservoir and Rainbow Lake: no direct impact, minimal burned area is contributing to the watershed.
 - Threat is judged to be unlikely for both.
- Mosher Creek Reservoir: dam wall directly impacted by the fire, vegetation loss upstream and downstream. The reservoir is fed by the Little Cottonwood Creek ditch and the Oak Creek ditch. Vegetation (small trees) growing in the emergency spillway with minor erosion noted. Operation is by a hand crank and 12" metal pipe which outlets at the toe of the dam.
 - The reservoir is down-drainage of high and moderate burn severity and is expected to receive increased flow and debris even in the event that the irrigation ditches are shut or fail. Vegetation on the emergency spillway could cause retention of debris and blocking of the spillway and eventual overtopping of the dam. Threat to the dam structure and downstream drainage is possible.

IV. EMERGENCY DETERMINATIONS ADDRESSED

The Values at Risk with immediate threat and recommended for emergency response include: USFS roads, trail bridges, irrigation ditches, reservoirs and watersheds with unauthorized roads. Individual threats are discussed below.

- a. Threat to Life and Safety on vulnerable roads, trails and incidental infrastructure
- b. Threat to the Properties outlined in previous section
- c. Threat to Natural Resources in regards to water quality and supply, soil productivity and hydrological function

The following conditions describe in detail the consequences of the fire on the indicated Values at Risk:

- a. The Risk to Life and Safety may occur at segments of roads in close proximity to creeks and at major drainage crossings if people are traveling on the road during a significant flood event and washouts occur. Risk to life may occur on trail bridges during storm events or on compromised structures after such events. Risk to life may occur if irrigation ditches fail and affect the stability of slopes upstream of homes or habituated areas.
- b. The Risk to Property may occur in response to increased flows and debris that may washout road and trail prisms, damage or destroy trail bridges or cause failure in irrigation ditches or reservoirs.
- c. The Risk to Natural Resources may occur where roads, trails and unauthorized roads interact with natural drainages and capture flows or discharge sediment to watersheds. Risk may occur if irrigation ditches fail and cause excessive erosion and slope instability or if emergency spillways on reservoirs clog and cause overtopping.

V. TREATMENTS TO MITIGATE THE EMERGENCY

1) ROAD MAINTENANCE, DRAINAGE IMPROVEMENTS

- Objective: Restore drainage features in the road prism and expedite return of flows to adjacent drainages with minimal erosion of the road and sedimentation of the stream. Improve such features where they are inadequate to handle expected flood flows.
- Description: Cleaning of waterbars and drain dips, cleaning of ditches, redistribution of surfacing to aid drainage and removal of pooling areas. Usually accomplished with a dozer or skid-steer.

2) STREAM CHANNEL ARMORING AND ROADSIDE STABILIZATION

- Objective: Protect fill slope and roadbed on roads which are at immediate risk from erosion due to increased flows and debris in adjacent streams.
- Description: Placement of riprap backed by geotextile on highly exposed fill slopes, usually at the outside bend of a stream where it runs parallel to the road. Typically achieved with an excavator or min-ex with thumb attachment and operator assistants.

3) ROADSIDE HAZARD TREE REMOVAL

- Objective: Remove trees near roads or infrastructure which pose a substantial threat to either the public or to USFS employees and contractors.
- Description: Fell and scatter any such trees outside of the road prism or other indicated infrastructure. Usually accomplished with a hand crew.

4) ROADWAY STORM INSPECTION AND RESPONSE

- Objective: Monitor road drainage improvements, fill slope armoring and maintenance treatments as they respond to significant storm events and subsequently repair damages that compromise the effectiveness of these efforts.
- Description: Inspection of road by the area engineer or other qualified persons and determination of damages. If substantial, engineer to coordinate with USFS personnel or contractor to repair damages and return value to the respective treatment.

5) TEMPORARY GATE CLOSURE

- Objective: Prevent threat to life and safety on at-risk roads and trails and avoid natural resource degradation in impacted drainages.
- Description: Installation of gate at determined point, public notification of closure, signing of access change and development of turn-around locations, enforcement of closure through USFS personnel and other agencies.

6) UNAUTHORIZED ROAD DECOMMISSIONING W/ ARCHEOLOGY COSULTATION

- Objective: Obliterate entrenched non-system roads and trails which are likely to capture increased flows and debris during storm events on impacted burn slopes. Increase infiltration and decrease flood flow concentrations and resulting erosion and sedimentation.
- Description: Ripping or overturning of road/trail bed, reincorporation of side cast material or berms, tree felling and boulder placement against existing alignment and slight re-contouring where necessary. Achieved with a backhoe, dozer, skid steer or hand crew depending on location and need. Cultural clearance is required for any ground disturbing activities on un-surveyed federal land per Section 106 of the NHPA.

7) TRAIL BRIDGE REMOVAL AND REINSTALLATION

- Objective: Anticipate damage and/or failure of trail bridges and temporarily remove from vulnerable locations.
- Description: Partially disassemble bridge and remove to safe location until risk of flood flows decreases. Accomplished with hand crew to disassemble and backhoe/loader to transfer away from channel.

8) DITCH REINFORCEMENT AND SPILLWAY MAINTENANCE

- Objective: Prevent irrigation ditch failure and mass wasting on vulnerable slopes and restore design capabilities of spillways on threatened dams.
- Description: Reinforcement of ditches with CMP, armoring or fill stabilization depending on area. Accomplished with hand crew and/or light trail equipment. Clearing of vegetation on and around spillway with hand labor and armoring of nick points with native rock.

The outlined treatments were chosen to minimize or mitigate:

- Threat to life and safety on vulnerable roads and trails and incidental infrastructure
- Road and trail property loss due to impact from up-gradient burn areas and resulting flood flows and debris
- Damage to natural resources due to increased flows and subsequent erosion and sedimentation

VI. RECOMMENDATION SUMMARY

The recommended treatments for roads, trail bridges, irrigation ditches and reservoirs are detailed in previous sections and are summarized per location below and in the attached maps.

1. Road Maintenance, Drainage Improvements

- NFSR 6.2A [Coaldale CG]
- NFSR 6.3C [S. Prong Hayden Creek]
- NFSR 35 [Mosher Creek]
- NFSR 40 [Big Cottonwood]

2. Stream Channel Armoring and Road Stabilization

- NFSR 6.2A [Coaldale CG]
- NFSR 40 [Big Cottonwood]

3. Roadside Hazard Tree Removal

- NFSR 35 [Mosher Creek]

4. Roadway Storm Inspection and Response

- NFSR 6.2A [Coaldale CG]
- NFSR 40 [Big Cottonwood]

5. Temporary Gate Closure

- NFSR 6.2A [Coaldale CG]
- NFSR 6.3C [S. Prong Hayden Creek]
- NFSR 40 [Big Cottonwood]

6. Unauthorized Road Decommissioning and Archeology Consultation

- Trails and 2-tracks in Little Cottonwood Drainage (see Map)

7. Trail Bridge Removal and Re-Installation

- Coaldale Campground
- Trail Bridge on the Rainbow Trail above NFSR 6.3C [S. Prong Hayden Creek]
- Trail Bridge on the Rainbow Trail at trailhead on NFSR 40 [Big Cottonwood]

8. Ditch Reinforcement and Spillway Maintenance

- Oak Creek Irrigation Ditch and Little Cottonwood Irrigation Ditch
- Mosher Reservoir

VII. REFERENCES

- *Burned Area Emergency Response Treatments Catalog* December 2006 National Technology & Development Program Watershed, Soil, Air Management 0625 1801-SDTDC
- *Cost Estimating Guide for Road Construction* March 2012 USDA Forest Service Intermountain, Southwestern, Rocky Mountain Regions

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