Blue Cut Fire Engineering BAER Report

Resource Specialty: Engineering- Transportation and Dams
Fire Name: Blue Cut, San Bernardino NF
Month and Year: August, 2016
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I. Potential Values at Risk (identified prior to the on-the-ground survey)

A. Critical Values: (1) Property: National Forest System Roads (NFSR) within and adjacent to burned area, (2) National Forest Dams, (3) Cooperator roads on NF lands, (4) State highways and roads, (5) Human Life and Safety, (6) Natural Resources-Water Quality

B. Resource Condition Assessment

a) Resource Setting

The Nation Forest transportation system consists of approximately 77 miles of National Forest System Roads (NFSR) within the fire perimeter. Of the 77 miles of NFSR within the fire perimeter, approximately 41 miles are suitable for passenger cars (maintenance levels 3-5) and 36 miles are suitable for high-clearance vehicles and/or are administrative use only (maintenance level 2). Main highways within the burned area include State highway 15 and 138 and include approximately 24 miles within the burned area. Main county roads in and near the burned area include: Lytle Creek Road, Swarthout Canyon Road, Cajon Blvd. (old Route 66), Keenbrook Road, and Lone Pine Canyon Road. Approximately 120 miles of County and local roads exist within the burned area.

Four railroad lines exist within the burned area and are operated by BNSF and Union Pacific (UP). The existing railroad alignments pass through moderate to high burn severity and consist of one single line (Union Pacific) on the westerly side and three tracks on the easterly side. Original construction of the railroads date back to the 1880's.

Other infrastructure surveyed in this report includes the Keenbrook Dam and Sheep Canyon Dam. The Keenbrook dam was believed to have been installed in the late 1930's or 1940's as a flood control structure. The Sheep Canyon Dam was installed in the 1940's as a flood control structure. Both dams are on the Forest dam inventory.

b) Findings of the On-The-Ground Survey

The field survey was conducted over the course of 4 days from August 25-Augusts 28, 2015. State, County, National Forest System, local, and cooperator roads were assessed in order to determine the probability and magnitude of road damage or loss as a result of the changed watershed condition. Public safety on roads in the burned area is also an equally important consideration. Non-NFS

roads were surveyed since their failure can have negative impacts on water quality and other infrastructure if they were to fail.

Many NFS roads suitable for passenger cars and high-clearance exist within and adjacent to the burn area. Refer to Appendix 1 for a list of NFS roads. Many cooperator roads are NFS roads open to the public and maintenance is either shared or accomplished by the individual cooperators. Many cooperator roads and spur roads are not on the NF road system and most still require formal cooperative road maintenance agreements. It is highly recommended that cooperators are engaged to ensure their roads are adequately storm-proofed prior to the rainy season. Appendix 2a through 2c shows the list of NFS roads not proposed for treatments, NFS roads proposed for treatments, and recommended treatments for roads primarily maintained by Forest Service cooperators.

The road infrastructure within the burned area is at increased risk of damage and failure due to:

1. Additional erosion damage as a result of increased storm water runoff velocity and volume on and across the roads.
2. Potential degradation of road surfaces resulting from fire suppression activities if not properly rehabilitated during suppression rehab.

Other cooperator spur roads exist within the burned area, which are used to access critical infrastructure in the area. Not all cooperator roads were surveyed, however coordination of road storm-proofing is needed due to the potential impacts these roads can have on water quality and surrounding infrastructure if they suddenly fail during a storm event.

Keenbrook Dam is located just up channel from the Union Pacific and BNSF rail lines. The Forest is unable to confirm the original construction date, however it is believed the dam was constructed for flood control purposes after the 1938 floods. The forest does not have records of the dam being maintained or cleaned in its history and the basin is completely full of sediment with no storage capacity. The existing concrete spillway has some scour at the outlet that could be exacerbated by the increased runoff. An existing side channel is directing flow toward the southern embankment section of the dam with a mostly moderate to severely burned tributary drainage. Large trees are located just upstream of the spillway and could contribute to woody debris in the channel. The culvert below the UP rail line is large (10 feet in diameter) and capable of passing large storm events and debris, however there are some issues with embankment erosion above the culvert and the current headwall is inadequate.

The Sheep Canyon Dam is located in Sheep Canyon above Applewhite road. The original timber spillway burned in 2009 during the Sheep Fire and was repaired and armored in 2010-11. The dam basin was cleared at that time to increase storage capacity. Many of the slopes in Sheep Canyon had a moderate burn severity, although most of the slopes did not burn as hot since the vegetation was previously burned in the Sheep Fire. The channel upstream of the dam is gradual and has a long runoff length.

c) Consequences of the Fire on Values at Risk

The potential consequences of the burned area on infrastructure are:

1. Potential damage and localized failures to road surfaces, road fill slopes, road drainage structures, dam embankment and spillway, rail embankments, rail tracks, and rail drainage structures.
2. Potential secondary impacts to adjacent watersheds and other infrastructure as a result of infrastructure damage and/or failure.
3. Reduced public safety due to increased hazards resulting from destabilized rock slopes, falling trees, potential debris flows and flooding, and damage to traffic safety structures.

II. Risk Assessment

A. Summary

Risk ratings were determined using the BAER Risk assessment matrix in Forest Service Manual 2520. Risk ratings are based on the probability of damage or loss of a critical value at risk and the magnitude of consequences if the value is damaged or a complete loss. Forest Service Roads, cooperator roads, dams, and railroads are considered critical property values on National Forest land. Other critical values taken into consideration with roads and infrastructure include protection of human life and safety and protection of water and other natural resources. An emergency determination was made for critical values with a high to very high risk rating of failure or damage. Treatments are proposed to mitigate the level of risk to a more acceptable level for values with an emergency determination.

B. Emergency Determination

Imminent hazards to the roads system within the burned area and within NF lands. These hazards vary from minor sloughing and culvert blockage to partial or total loss of road template. A risk assessment was conducted on the potentially affected roads. The tables below shows the Forest Service roads and cooperator roads determined to be an emergency and have a high or very high risk of failure:

Table 1: Risk Assessment of NFS roads

Road	Assessment	Risk
2N53	Level 3 (passenger car) road. Public and LADWP transmission tower access road (shared use)	Very High
3N06	Level 4 (passenger car) road.	High
3N24	Level 2 access road, OHV route. West section low burn intensity and located on ridge. East section low to moderate burn severity.	High

3N29	Level 2 (High Clearance) road. Located in moderate to high burn severity.	Very High
3N31	Level 3 road open to public. Shared use with SCE. Ridge road with some moderate to high burn intensity above road.	High
3N31Y	Level 3 access road. Located on ridge. Low to moderate burn severity.	High
3N33	Level 2 road. Moderate to high burn severity. Steep and erodible slopes.	Very High
3N49	Level 3 road open to the public. LADWP transmission tower access road.	High

Table 2: Risk Assessment of Cooperator Maintained Roads

Road	Assessment	Risk
2N52	Level 2 (High Clearance) road open to public. LADWP transmission tower access road.	Very High
2N61	Private Road and SCE transmission tower access road. Gated.	Low
2N87	Level 2 admin. road. Gated. SCE transmission tower access road	Intermediate
2N89	Level 3 road open to public. Road parallels train track. Union Pacific railroad access road.	Very High
3N49	Level 3 road open to the public. LADWP transmission tower access road.	High
3N55	Level 2 and 3 road. LADWP transmission tower access road.	High
Swarthout Cyn. Road	S.B. County road located in and adjacent to burned area drainages.	High
Lone Pine Cyn. Road	S.B. County road located in and adjacent to burned area drainages.	High
Lytle Creek Road	S.B County road located adjacent to burned area drainages	High
Interstate 15	Caltrans interstate freeway	Intermediate
Highway 138	Caltrans State highway	Intermediate
SCE access spur roads	Located off of primary routes to tower pads	High
LADWP access spur roads	Located off of primary routes to tower pads	High
So Cal Gas access roads	Access roads to high pressure gas line infrastructure.	High

Additional information on the high/very high risk roads is listed in appendix 2b and 2c. Other roads in the fire area not listed in the above table are shown in Appendix 2 and were determined to be a low to intermediate risk. Prescription of treatments is not proposed for values at risk with a low to intermediate risk and the roads do not pose an imminent threat or emergency.

Imminent hazards to the Keenbrook Dam and infrastructure downstream exist and constitute an emergency. Potential consequences to the infrastructure due to the burned area include increased sedimentation and debris in existing drainages and potential for partial or total loss/failure of the dam and downstream railroad infrastructure. Because of the likely probability and potential for major magnitude of consequences of damage or loss, it was determined the Keenbrook Dam has a "Very High" risk rating. Treatments are proposed for Keenbrook Dam to mitigate the level of risk to a more acceptable level.

The Sheep Canyon Dam was determined to have an intermediate risk of damage or loss. The probability of damage or loss is possible and the magnitude of consequences would be moderate if the dam failed. Because recent storm-proofing of the spillway and cleanout of the basin was performed, no treatments are proposed. Post-storm inspections should be performed while performing road inspections to ensure

C. Treatments to Mitigate the Emergency

Roads

Road drainage features are at risk from adjacent burned watersheds. Increased runoff and sediment from the burned areas can negatively affect the road prism, damaging the road, eroding land downslope of the road and routing flow and sediment directly to stream channels. Road failure can also contribute to failure of infrastructure downstream. Culverts associated with these roads are at risk of plugging from debris carried down channels from burned watersheds. Some culverts are undersized for the expected increases in peak flows and are at risk of failure from overtopping. Culvert failures may increase the magnitude of flood, sediment and erosion hazards of downstream infrastructure and private lands and increase scouring of stream channels on NFS lands.

a) Treatment Types: Proposed road treatments include: drainage structure cleaning, additional drainage structure overside drains, culvert repairs and removal, culvert inlet modifications, public safety warning and road closure signs, road closure gates, rolling dips, and riprap armoring of slopes and drains. A summary of treatments for each road are noted in *Appendix 2a and 2b - Evaluation and Assessment*.

b) Treatment Objectives: The primary objectives of the road treatments are to:

1. Protect and stabilize the transportation system roads at risk of damage as a result of increased sedimentation and erosion from the fire.
2. Increased protection of water quality by reducing risk of road damage and failure.

3. Mitigate public safety hazards associated with hazard trees, flooding, rock fall, and debris flows along NFS roads.

c) Treatment Descriptions: Descriptions for proposed road treatments for each road are located in Appendix 6.

d) Treatment Costs: Proposed road treatment costs were estimated for each road and are shown in Appendix 3.

e) Probability of Completing Treatment Prior to First Damaging Storm Event

All High/Very High Risk Roads: 80%

f) Probability of Treatment Success

Risk Level	Year 1	Year 2	Year 3
High/Very High Risk Roads	85%	80%	70%

Dams:

The Keenbrook Dam is at high risk of damage or failure from the above watershed, which was almost entirely moderate to high burn severity. Dam failure poses a very high risk to the downstream railroad infrastructure failure. Specific treatment measures have been identified that will help reduce the risk of damage to the dam and other infrastructure below the dam.

a) Treatment Types: Proposed dam treatments include: removal of upchannel loose woody debris and earthwork movement to redirect side and main channel away from the dam earthen embankment.

b) Treatment Objectives: The proposed treatment objectives are: to protect and stabilize the dam infrastructure and to reduce the risk of failure, reduce risk to railroad infrastructure below the dam, and increased protection of water and other natural resources.

c) Treatment Description: The proposed treatments are:

1. Earthwork reshaping and relocating with a mechanized dozer. Move material deposited from south side channel next to dam and direct channel away dam rembankment. Reshape the main channel to direct toward the center of the dam reservoir. Move some material out of the channel located directly above spillway. Estimated dozer time is two working days.
2. Removal of loose woody debris upstream to reduce plugging to culvert downstream of dam spillway. Estimated two days with a small hand crew of 5 people.

Cooperator Roads:

Many cooperator roads are at a high to very high risk of damage or failure as a result of the burned watershed condition. Initial coordination has taken place with Southern California Edison (SCE), Los Angeles Dept. of Water and Power (LADWP), and Union Pacific. Recommended treatment descriptions are located in appendix 2c. Continued coordination will be needed to help facilitate review of treatments on NF lands and to ensure treatments are implemented in a timely manner prior to the rainy season. The treatment cost for coordination and Forest Service staff time has been incorporated in the interagency coordination section of the main BAER report. Initial coordination has also taken place with Caltrans and San Bernardino County Public Works to discuss potential impacts and treatments to the public roads they manage.

III. Discussion/Summary/Recommendations.

The majority of National Forest roads are built with native materials, ranging from bedrock to decomposed granite (DG) and alluvial deposits. The NF roads within the burned area are primarily native surface, with a few roads having asphalt surfacing. Native surface roads are at an increased susceptibility to erosion from the burned watershed condition as a result of the fire. Additionally, lack of routine maintenance on many of the roads is a serious concern and has resulted in significant surface and template degradation in many locations. Forest Service dams are also rarely cleaned out or maintained, thus offering far less protection than when they were initially installed.

Although BAER road treatments are not intended to correct past maintenance deficiencies, the drastically changed conditions resulting from wildfire impose urgency for correction on high and very high risk roads. The proposed road and dam treatments are necessary to protect and stabilize National Forest infrastructure against increased erosion and sedimentation from post-fire storm water runoff. Additionally, several road treatments are intended to mitigate potential public safety hazards from potential debris flows within and adjacent to National Forest system roads. Road Treatment recommendations and associated cost estimates are noted in the Appendices.

Coordination with cooperators with infrastructure in and near the burned area is critical to increase awareness of the potential impacts post-fire storm effects can have to their infrastructure. Lack of maintenance of drainage structures was a common theme on all cooperator, state, and local roads in and near the burned area. Cleaning and storm-proofing of existing drainage structures prior to the rainy season is recommended for all National Forest, cooperator, state, and local roads and other infrastructure in and near the burned area. Additionally, it is recommended entities review and update their storm inspection and response plans for maintaining infrastructure in and near the burned area.

IV. References

A. FSM 2500, Chapter 2520 – Watershed Protection and Management, 2523 – Emergency Stabilization-Burned Area Emergency Response
B. Standard Specifications for the Construction of Roads and Bridges on Federal Highway Projects, FP-03
C. FSM 7700 – Travel Management, Chapter 7730-Road Operation and Maintenance
D. Appendices