Rapid Lesson Sharing

Event Type: Engine Burn Damage/Fire Behavior in Exceptional Drought

Engine Burn Damage Date: July 14, 2021

Engine Burn Damage Location: Log Fire, Oregon

This RLS tells the story of how a sudden flare-up engulfed an engine and its crew. To appreciate the lessons from this incident, this RLS also frames this story in the context of the bigger picture—the exceptional drought that now faces wildland firefighters across the United States.

The Engine Captain recalls that the "*trees lit like grass*" as the winds changed 180 degrees and 30- to 40-foot flames advanced toward the engine.

When the fire hit the engine, the windows started making cracking and popping noises. The fire rolled over the engine like a wave.

"The record dryness of the fuels combined with the hot, dry and breezy conditions is cause for explosive conditions. I don't recall conditions like this so far in my over 20-year career." **– Bootleg Fire Meteorologist**

Background

Extreme Weather and Fuels

The 2021 fire season began early for south central Oregon. The Bureau of Land Management (BLM) stopped prescribed fire operations in January and resources on the Lakeview BLM District and the adjacent Fremont-Winema National Forest began responding to fires in March.

On July 1, the Energy Release Components (ERC) for Central Oregon began climbing above 98%. These early July ERC levels mirrored the conditions from September 2020, when two large fires started on the Fremont-Winema National Forest.

During the early 2021 fire season, fires that normally reach only a few acres in size quickly grew to 50-100 acres before being contained.

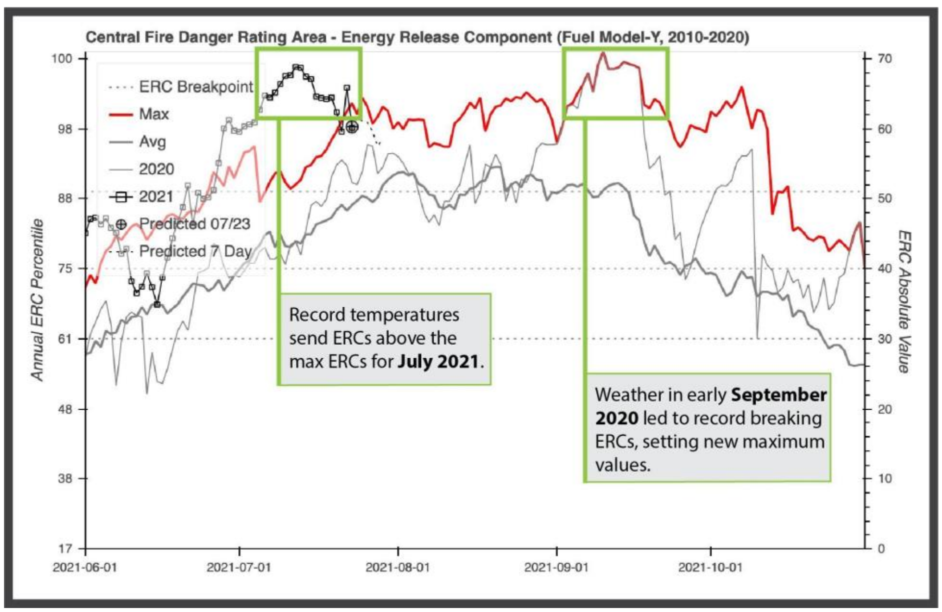


Figure 1. Emergency Release Component (ERC) relates live and dead fuel moistures to potential fire intensity. Indices climbed late August into September 2020, setting new records and culminating in explosive fire growth during a rare east wind event around Labor Day. In late June 2021, the Pacific Northwest experienced record-breaking high temperatures, causing a steep increase in ERCs just before the start of the Bootleg Fire.

This RLS includes a special lessons section on page 6: "Lessons from the Fireline – Including Questions for You and Your Crew"

The Bootleg Fire

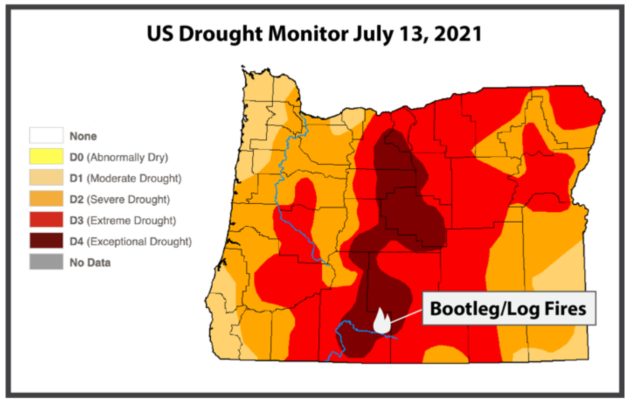


Figure 2. The Bootleg and Log fires are located in the D4 area.

By the time the lightning-ignited Bootleg Fire was reported on July 6, the area was in the most severe drought category (D4: Exceptional). Over the previous winter, the Lakeview BLM District had received only 60-70% of their average moisture.

In late June, a "heat dome" settled over Oregon, bringing a prolonged period of record-high temperatures. The effects of this weather pattern were evident in the local community: farmers getting only one cut of hay before irrigation was shut off and log trucks carrying 2-3 more logs per load without going overweight due to the lack of moisture in the logs.

On July 1, 2021, 1,000-hour fuels were 7% in Chiloquin, Oregon (23 miles west of the Bootleg Fire's point of origin). Local fire resources reported fuel ignition without preheating and rapid fire spread without wind.

The Bootleg Fire has shown the effects of severe drought and high temperatures. Pyrocumulus clouds formed seven out of the first nine days. Fuel and weather conditions allowed the Bootleg Fire to double in size nearly every day during the fire's first week.

The local units were involved in a "loan/lease" practice with the Bootleg Fire, sending resources to assist with ground tactics for short periods. Local fire management leaders had clarified initial attack responsibilities with the Type 2 Incident Management Team (IMT) by the time the Log Fire was discovered in the early morning hours on July.

The Log Fire

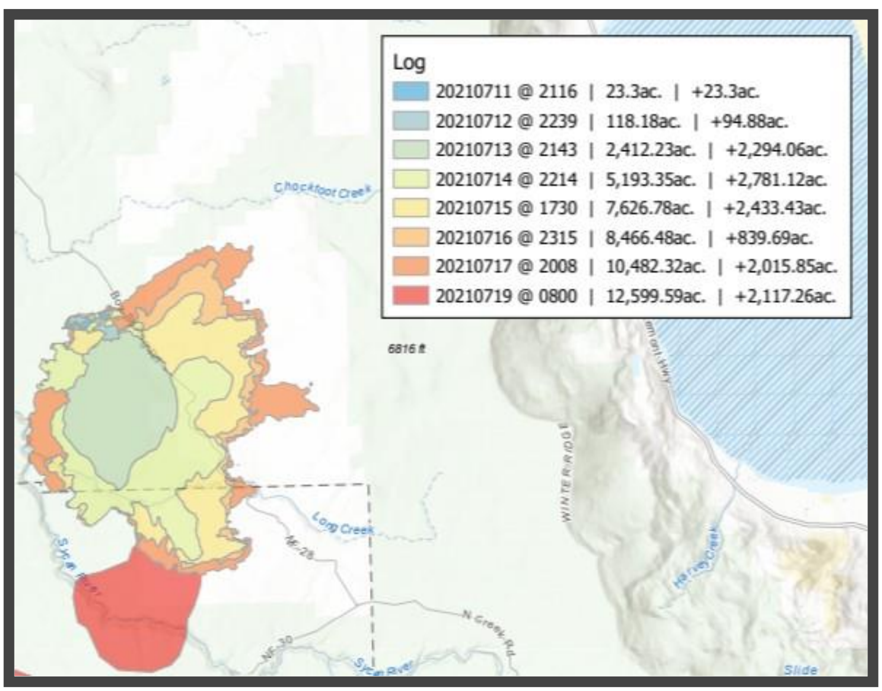


Figure 3. The Log Fire grew 2,433 acres in one day—from July 14 to July 15.

The Log Fire ignited nine miles northeast of the (then) 150,000-acre Bootleg Fire, within the Type 2 IMT's geographic area of initial attack responsibility. It began as four small fires that grew together (cause still under investigation).

Two Type 1 IMTs were shadowing the Type 2 IMT the day the Log Fire was discovered. The Type 2 IMT, running low on resources, asked the local units to respond to the fire during the first operational shift.

During the second shift on July 13, a fire whirl 100 feet in diameter formed atop a pocket of dense fuel. Winds near the fire whirl spiked from 5-10 mph to 18-25 mph and lofted embers into the air. Two dozers working in the area were immediately brought out to the road and moved out of the way.

The IR (Infrared) Flight that evening mapped the Log Fire at just over 2,400 acres, reaching the edge of Forest Road 28.

Engine 1 and Engine 2 Assigned to Suppress Spot Fires

The next day, on July 14, local fire units sent five engines and a Task Force Leader (TFLD) to help boost the efforts being made on the Log Fire. The fire was flanking Forest Road 28, heading south. Five to 10 mph winds fanned 2-3-foot flame lengths, which spread in short pulses. The fire completely consumed all the light fuels and 100- and 1,000-hour fuels burned actively. There was occasional single tree and small group torching in what was described as an "overstocked" young ponderosa and lodgepole pine plantation.

Engine 1 (Eng1) arrived at 1532. The local TFLD instructed them to keep spot fires from establishing east of Forest Road 28. Engine 2 (Eng2) arrived on scene at 1553 after a three-hour drive from the BLM Klamath Falls Field office. They met with the TFLD on the north end of the fire who punched in the four radio channels assigned on the fire.

Eng2 was instructed to join Eng1 on the south end of the fire. They checked-in with the Eng1 crew, who were gridding for spots on the green side of the road. Eng2 continued past them to turn around. When they returned, a skidgine was moving south along the road, cooling down the fire with its monitor as the flames approached the road edge.

Because the assigned Heavy Equipment Boss (HEQB) was managing multiple resources on the fire, the Captain of Eng1 provided some direction to the skidgine operator, but remained with Eng1 because there was not another qualified Engine Boss (ENGB) on the crew.

As it worked along the fire's edge, the skidgine had to angle its nose toward the black to spray, blocking most of the Forest Road 28. Eng2 pulled to the east side of the road, south of both the skidgine and Eng1, pointing north toward the black. Drainage ditches and rocks along the road prevented Eng2 from getting around the skidgine. They began providing water for their crewmembers gridding for spots.

The winds changed 180 degrees and 30- to 40-foot flames advanced toward the engine.

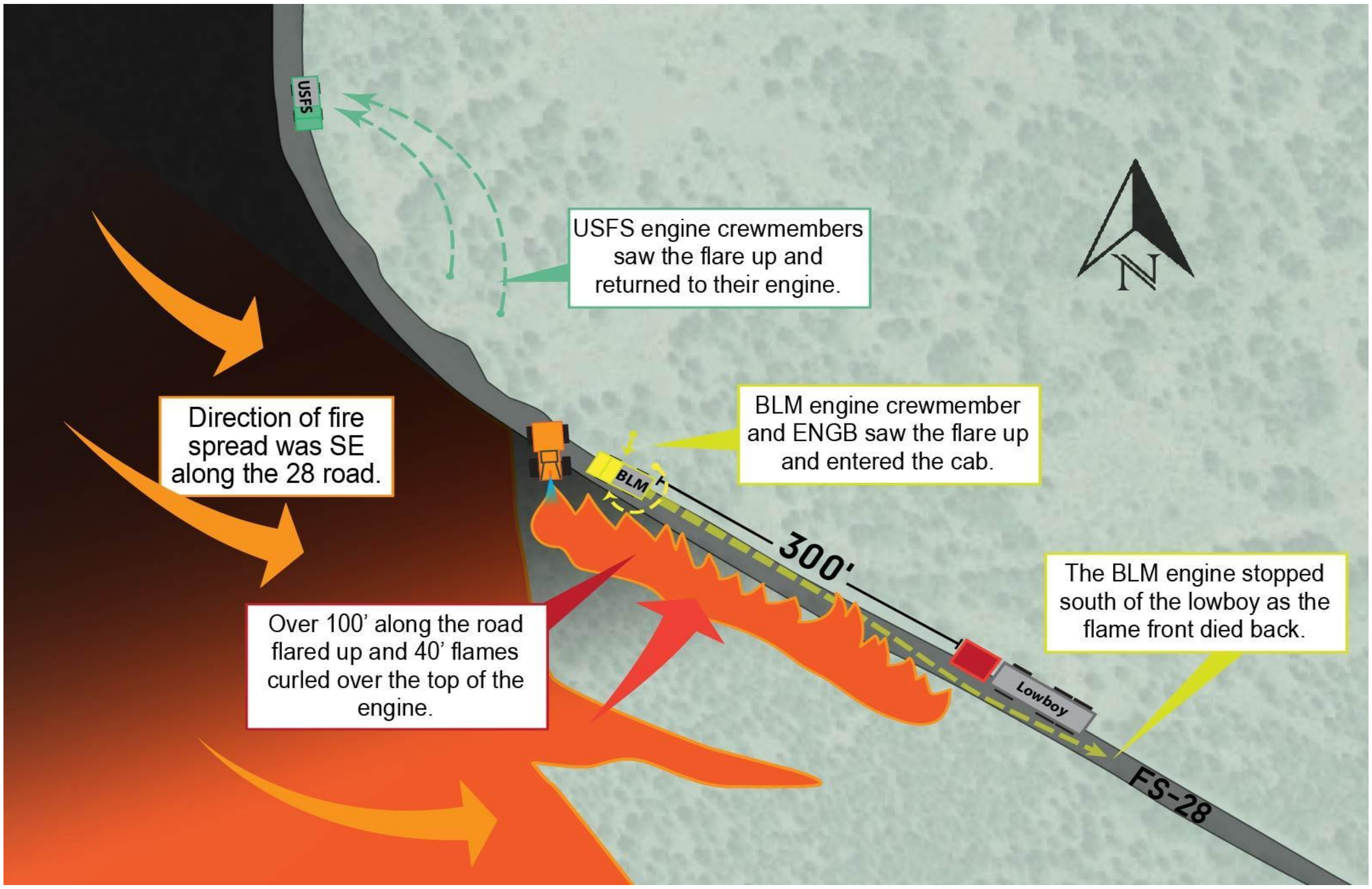
Fire Slams the Road—and Engine

About an hour after arrival, while spraying the large fire brands coming down in the needle mat, one of the Eng2 crewmembers heard a crackle. About two chains off the road, the low flames flared up "*super-fast*" into the trees. The crewmember rolled-up the hose and quickly got into the engine's cab, as did the Engine Captain.

The Engine Captain recalls that the "*trees lit like grass*" as the winds changed 180 degrees and 30- to 40-foot flames advanced toward the engine. The previously flanking fire had turned into a wide section of head fire that "*slammed the road*."

Unable to pull forward because of the skidgine, the engine driver concentrated on backing south down the road. The Engine Captain calmly talked to the driver and instructed him on backing out. A few seconds later, a second wall of flame hit the road. When the fire hit the engine, the windows started making cracking and popping noises. The fire rolled over the engine like a wave.

Image 1. A screen shot from a video taken from inside the engine. The engine's back passenger described the flames like a "cloud of fire coming around the engine" and said that it looked like liquid.



"It got super hot in the vehicle very quickly."

Engine Driver

The engine's back passenger described the flames like a "*cloud of fire coming around the engine*" and said that it looked like liquid. "*It got super hot in the vehicle very quickly*," recounted the engine driver.

Once out of the flames and in a safer location, the engine crew exited out the passenger side. They were unharmed.

The paint on the driver-side doors was still on fire. The Engine Captain tried to start the pump—but it wouldn't start. Next, he grabbed the fire extinguisher to put out fire on the truck.

As they surveyed the damage to the engine, the driver noted that it "*definitely smelled cancerous.*"

Overhead Arrives on Scene

During this short fire run—estimated to have lasted only 60-90 seconds—several spots ignited in the green.

The fire's overhead had been on the road north of the flare up. They saw this sudden fire activity, but didn't realize that the engine had been impacted. Within minutes, the overhead arrived on scene. The local TFLD asked the crew to move the engine to a staging area to the north, where it would be towed to the BLM District's auto shop.

Transportation for the crew to a nearby BLM field office was arranged and they were released from the fire.

Equipment Damage

Vehicle Damage

- Most plastic and rubber composite components on the driver's side melted to some degree from direct flame impingement. These damaged items include: trim molding, vehicle plug-in charging port, fender flare, diesel and DEF (Diesel Exhaust Fluid) caps, door handles, mirror assembly, and weather stripping. The following were discolored, blistered, and/or melted: lighting components including the driver's side headlight, marker lights, overhead scene light, and lightbar.
- The following were either delaminated, blistered, and or scorched: non-plastic components such as the chassis paint, flame resistant gel coating, package fiber composite, reflective stickering, and the stainless-steel storage compartment. The driver-side front and rear windows had cracked but remained intact due to the factory applied glass film tint coating. Multiple aluminum panels on the chassis body lost structural integrity and warped.
- Plastic control gauges on the face of the pump panel located on the rear of the vehicle had melted. During the incident, the pump operator reported that the pump would not start immediately after being impacted by flames. When tested on July 20, the pump panel was fully operational. An investigation is ongoing to determine why the pump would not start immediately after the flame front had passed.

Image 2. Photo of engine taken during initial vehicle inspection.

Image 3. Taken on FS Road 28 shortly after the engine was impacted by flames.

Gear Damage

- 2 IA packs positioned on rear step: heat damage, melted fabric, need replacement.
- 4 hose packs positioned on top of the passenger side of the truck: heat damage to bag, need replacement.
- Driver side protection hose: hose sections facing flame front melted, need replacement.

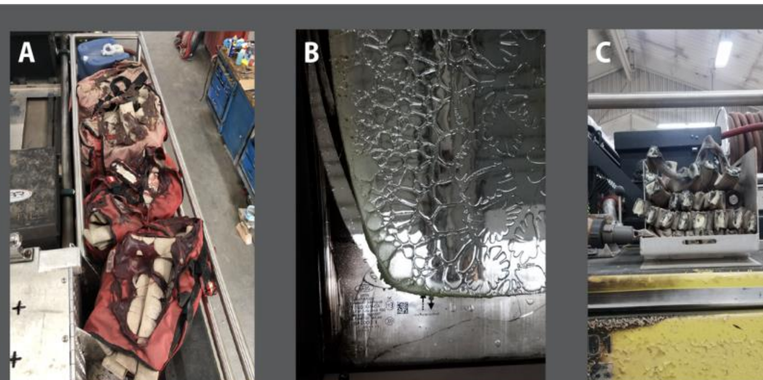


Image 4. (A) Hose packs on the passenger side of the engine were damaged. (B) A glass treatment bubbled the driver side windows, but the windows stayed intact. Additional cracking occurred when the vehicle was transported. (C) The driver side protection hose was burned.

Lessons from the Fireline – Including Questions for You and Your Crew

Monitoring Drought Conditions

The severe drought conditions and low fuel moisture are causing sudden, unexpected fire behavior.

What are the drought conditions in your area?
https://droughtmonitor.unl.edu/

Are there any current fuel advisories in your area?
https://www.predictiveservices.nifc.gov/fuels_fire-danger/fuels_fire-danger.htm

How do your current fire indices compare to historical norms?
https://famit.nwcg.gov/applications/WIMS/PocketCards/PocketCards

Large Fire Impacts on Weather

New fire starts in the vicinity of very large fires may experience unstable air.
Are there large fires nearby that might affect weather conditions?

Vehicle Entrapment

Best practices for fires need to be in place for safe suppression engagement. For example, a set traffic pattern might not have been needed for similar fires in the past, but now provides a wider margin if unusual fire behavior occurs.

Do you know what to do if you get entrapped in a vehicle?
https://www.nwcg.gov/committee/6mfs/vehicle-entrapment

Changing Tactics in Exceptional Drought

Resources need to step back before engaging and look at the big picture. Tactics that have worked safely in previous years may no longer be a good decision. With the current fire behavior in the exceptional drought (D4) areas, it is crucial to increase the ***time*** to implement the suppression plan and increase the ***distance*** of the fire control line location.

Engine 2 was only a few hundred feet from the black, parallel to the direction the fire was moving.

Which of the 10 Standard Fire Order and 18 Watch Out Situations apply to this situation? How does exceptional drought change how we look at the 10 & 18?

This RLS was submitted by:

Samantha Orient, Team Lead
Megan Saylors, Writer/Editor
John Petty, BLM Liaison
Jade Martin, Equipment Specialist

Do you have a Rapid Lesson to share?
Click this button:

Share
Your Lessons

Lessons from Previous Engine Entrapment Incidents

Sheep Fire Engine Entrapment and Burnover (2020)

Klamathon Fire Engine Entrapment (2018)

Chetco Bar Fire Engine Entrapment (2017)