Informational Summary Report of Serious or Near Serious CAL FIRE Injuries, Illnesses and Accidents

GREEN SHEET

Burn Injuries

November 8, 2018

Camp Incident

18-CA-BTU-016737

California Northern Region

SUMMARY

During the first 24-hour period of the Camp Incident in Butte County, California, two accidents occurred resulting in five (5) firefighters suffering serious burns. On November 8, 2018, at approximately 3:00 PM while preplanning and preparing for a firing operation, one (1) Fire Captain and two (2) inmate firefighters suffered burns and were transported to a burn center for treatment. During the same operational period, on November 9, 2018, at approximately 5:00 AM, a fire engine crew acting on a threatened residential structure were burned when a propane tank exploded. One (1) Fire Captain and one (1) Fire Fighter I suffered burns and were transported and treated at a local hospital.

A Board of Review has not approved this Informational Summary Report. It is intended to enhance safety and training, aid in preventing future occurrences, and to inform interested parties. Because the report is published in a short time frame, the information contained herein is subject to revision as further investigation is conducted and/or additional information is developed.

CONDITIONS

The following conditions provide an overview of the changing fire environment leading up to and including the events on November 8, 2018, and November 9, 2018.

Weather Narrative

Dry conditions were in place for several weeks before the Camp Incident began. In early October, the northern Sierra foothills received a small amount of rain amounting to approximately 0.25" of precipitation. Prior to that, it had been over seven months since the last significant rainfall over 0.50" of precipitation. (See Figure 1 & 2)

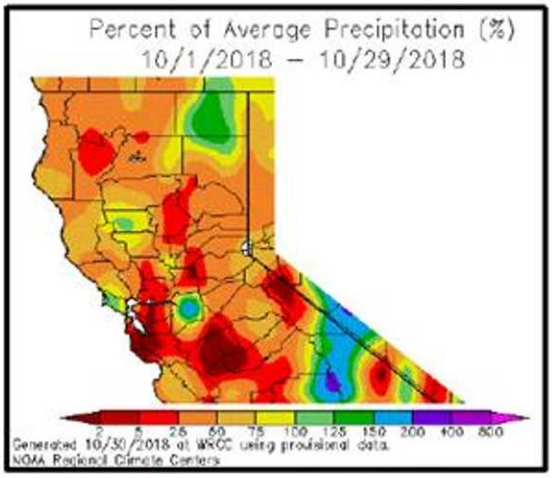


Fig 1: October Precipitation (% of Ave.)

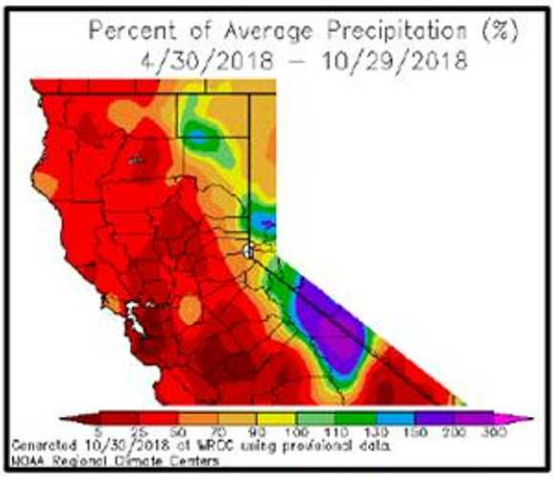


Fig 2: Pcpn (% of Ave.) past 6 months

In October and early November there were several north wind events across Northern California that brought poor humidity recoveries and warmer than normal conditions especially within thermal belts. The communities of Paradise, Concow and Magalia all reside within a thermal belt. (See Figure 3)

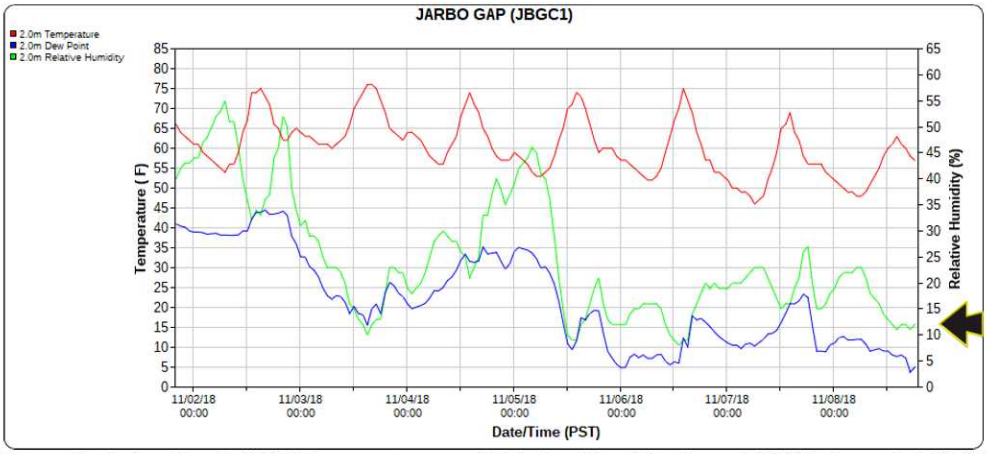


Figure 3. Jarbo Gap RAWS Temperature and Relative Humidity from 11/2/18 through 11/8/18

There was a significant north wind event affecting Northern California beginning on the night of Wednesday, November 7 and continued through Friday, November 9, 2018. The Jarbo Gap Remote Automated Weather Station (RAWS) recorded gusty easterly winds developing around 7:00 PM on Wednesday evening and becoming very strong by 9:00 PM. These winds were roughly 25 to 30 mph sustained, with gusts of 45 to 50 mph. The strongest winds over the area were between 2:00 AM and 6:00 AM. (See Figure 4)

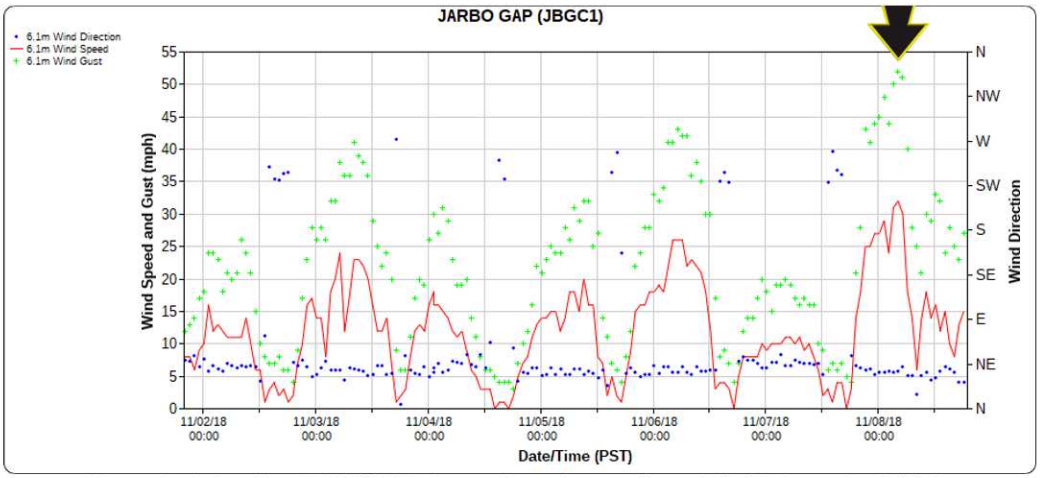


Figure 4. Jarbo Gap RAWS Wind speeds and gusts from 11/2/18 through 11/8/18

Wind direction was almost exclusively from the northeast, which was directly responsible for the wind-driven footprint of the Camp Incident moving from the northeast toward the southwest. Relative humidity at the time of ignition was around 23% which rapidly fell to approximately 10% by Thursday afternoon. Wind gusts during the day on Thursday were around 25-35 mph with sustained winds around 12 to 20 mph from the northeast. (See Figure 5)

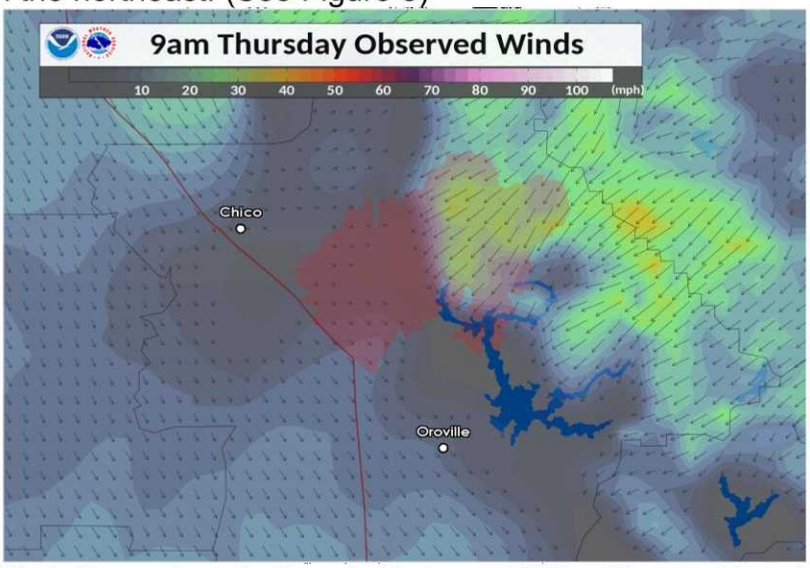


Figure 5. Winds Observed over the Camp Incident around 9AM on Thursday, November 8, 2018

Drought Conditions

Fuels in the area of the Camp Incident have been subjected to multiple years of drought. The drought period of 2012-2016 not only left fuels very dry, but caused smaller branches and whole plants and trees to die during those five years. The winter of 2016-17 in Northern California was more "normal" in terms of rainfall, but 2017-18 again was about 50% of normal. (See Figure 6) Rainfall during the later spring allowed for a heavy grass crop, described as 150% of normal loading in the fine fuels by the Northern California Predictive Services Unit. On November 6, 2018, the U.S. Drought Monitor for California labeled the Butte County Area as D1-Abnormally Dry drought intensity (yellow). (See Figure 7)

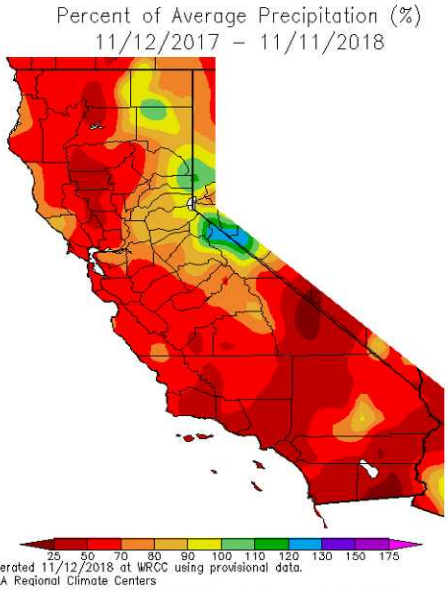


Figure 6. Percent of Average Precipitation

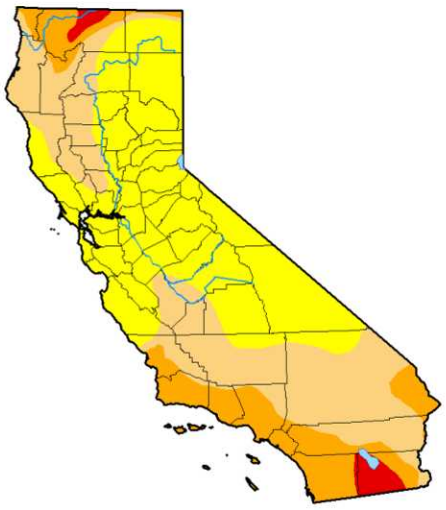


Figure 7. U.S. Drought Monitor on November 6, 2018

Fuels Description

It is very unusual to have fuel moisture levels so low in November within Butte County. In most years, significant rain would have fallen by this date, dampening fine fuels and lowering ignition risk and fire hazard. It was over 200 days since 0.50" or more of rainfall was received at the lower elevations of Butte County. 1000-hour fuel moisture levels measured at Pike County Lookout, located southeast of the fire, were at 5% on November 1, 2018. The average 1000-hour fuel moisture level in November is 17% for the Northern Sierras. Live fuel moisture of manzanita was measured at 74%. The critical live fuel moisture level for manzanita is 80% and the average live fuel moisture for manzanita in this area during November is 93%.

The Energy Release Component (ERC) of the National Fire Danger Rating System, a measure of fuel dryness and flammability, was trending slightly above average all summer for the Northern Sierras, but in early October it began trending well above average to the day of the fire when it was above the historic record for the date. (See Figure 8)

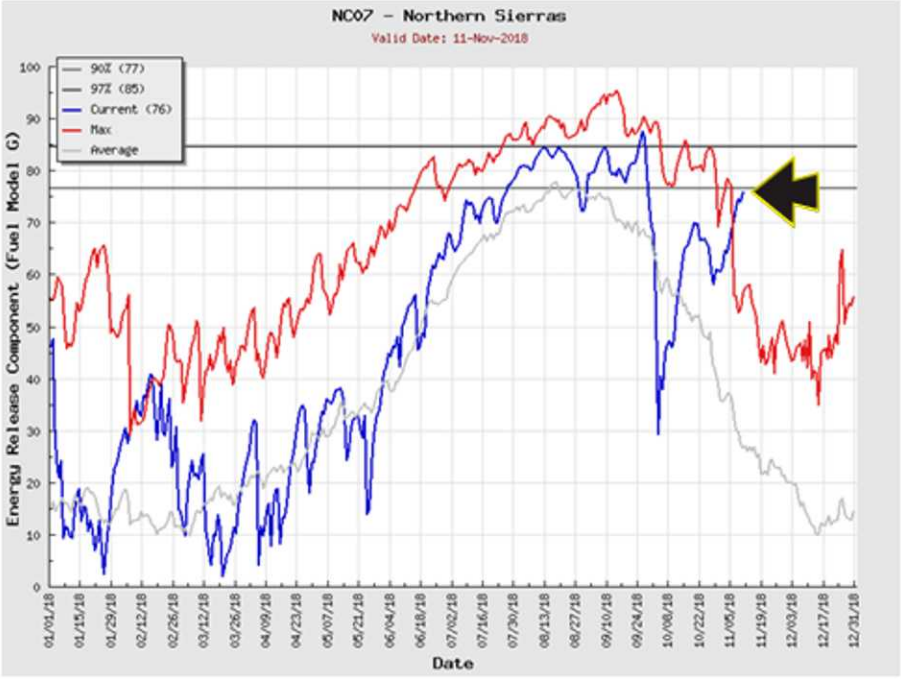


Figure 8. Energy Release Component, Northern Sierras from January 1 through December 31, 2018

Fuels near the point of origin of the Camp Incident and downwind toward Paradise consisted of heavy conifer timber with a brush understory. At lower elevations, grass under oaks and brush was the primary carrier of the fire. The area near the origin had burned previously in 2008. But when the fire crossed the West Fork of the Feather River, it entered fuels that had not burned in recorded history. Timber had very narrow crown spacing with heavy manzanita and oak cover underneath. When the fire reached the town of Paradise, an urban firestorm began to spread from building to building, independent of the vegetation, similar to the firestorm that consumed Hamburg, Germany in 1943. In a significant number of locations in Paradise, including the site of the BLEVE, tree canopies are mostly intact above destroyed structures, indicating the strength of the wind in these areas. It is evident in many areas occupied by high densities of residential and commercial structures that the heat from the fire was transferred horizontally to other structures and ground vegetation by strong winds.

Burn Over Fuels
Moderately grazed grass indicative of fire behavior Fuel Model 1.

BLEVE Fuels
Mixed conifer forest indicative of fire behavior Fuel Model 10. The fuels at this location were significantly supplemented with significant fuel loading provided by residential structures, out buildings, and vehicles. The BLEVE was the result of a partially filled 250-gallon residential propane tank exposed to direct flame impingement and radiant heat.

Topography Narrative

The terrain around the Camp Incident was characterized by steep, deeply dissected river canyons surrounded by relatively flat volcanic benches. The fire started in the Feather River Canyon and climbed the west wall of the canyon rapidly. The fire moved across the Concow Basin and then crossed the West Fork of the Feather River. The fire then travelled downslope with the wind into the lower elevation areas and agricultural areas east of Chico. It also progressed westerly with a flanking spread across Butte Creek Canyon. (See Figure 9)

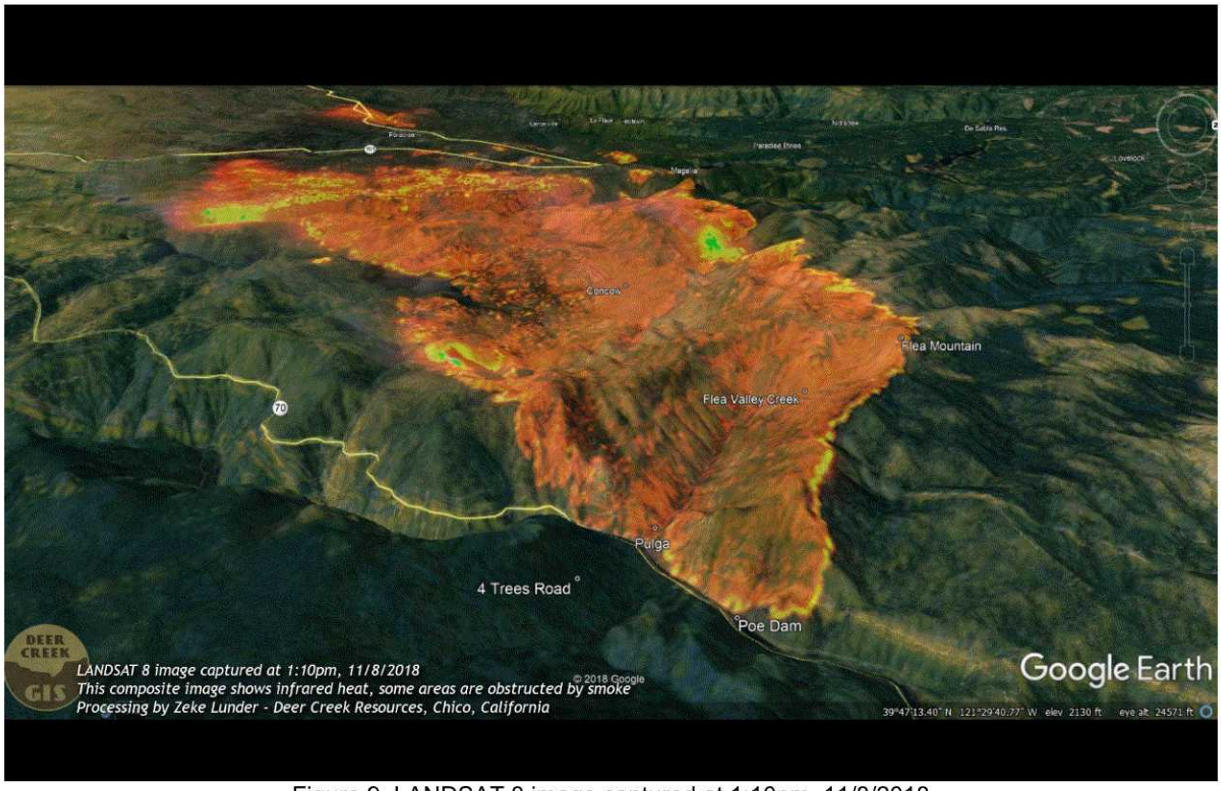


Figure 9. LANDSAT 8 image captured at 1:10pm, 11/8/2018

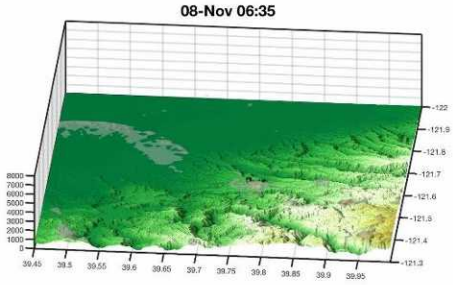
Burn Over Topography

Slope: 5%
Aspect: southwest
Elevation: 500'

BLEVE Topography

Slope: 5 - 10%
Aspect: west
Elevation: 2,340'

Fire Behavior Narrative
The fire started near the community of Pulga on Hwy 70 at 6:29 AM on November 8, 2018 and the fire spread with incredible speed. In the first 12 hours, the fire had covered nearly 15 miles downwind and burned an area over 55,000 acres. This translated to about 76 acres per minute of area growth or a rate of spread of about 100 chains per hour. A major mechanism of fire spread was embers from both natural vegetation and residential as well as commercial structures. Spotting during the fire was reported up to a mile ahead of the main fire. Spot fires described by the NIROPS aircraft at 6:00 PM grew to 200 acres within minutes. Some fire traveled through the crowns of trees but the wind kept the fire on the surface for most of the fire area. Flame geometry was mostly horizontal making flame length difficult to describe.



Neil Lareau on Twitter
twitter.com
“Radar-derived rendering of #CampF plume from ignition through devastati of #Paradise. Radar proving invaluab in understanding plume dynamics an fire progression. Maybe for issuing warning too? #CAfire #CAwx https://t.co/cbjiCK9L67”
https://twitter.com/i/status/1062860892621045760

Camp Fire from Cal State Oroville Camera 9 AM to 9:51 AM
m.youtube.com
Time lapse of the Camp Fire from 9:00 to 9:51 AM this morning before power and fiber connectivity was interrupted to Oroville State Parks by a burn through of infrastructure...

Burn Over Weather
Temperature: 61° Fahrenheit
Relative Humidity: 12%
Winds: 10 mph, NE, gusts of 28 mph
Visibility: Good

BLEVE Weather
Temperature: 49° Fahrenheit
Relative Humidity: 18%
Winds: 30 mph, NE, gusts of 46 mph
Visibility: Low

SEQUENCE OF EVENTS

Burn Over
On Thursday, November 8, 2018, at approximately 6:33 AM Oroville Emergency Command Center (ECC) received reports of a vegetation fire in the vicinity of Camp Creek Road, near the community of Pulga in Butte County, California.

On November 8, at approximately 12:00 PM, a CAL FIRE hand crew strike team (STG1) was assigned to the Camp Incident in the Butte Unit and reported to staging at Butte College.

At approximately 12:45 PM, STG1 was assigned to Butte College Contingency Group.

At approximately 1:30 PM, STG1 strike team leader (STLG1) scouted driveways, roads and structures in the area of Clark Road and Rattlesnake Flats Road.

At approximately 1:55 PM, STLG1 had an operational briefing with CAL FIRE hand crew Fire Captain B 1 (FCB1) and CAL FIRE hand crew Fire Captain B 2 (FCB2).

STLG1 left FCB1 and FCB2 at the east end of Rattlesnake Flats Road at approximately 2:00 PM. STLG1 took three inmate firefighters from hand crew 2 (CRW2) to assist one of the engine crews on Clark Road.

At approximately 2:15 PM, STLG1 met with multiple fire line personnel and organized a plan to fire out Rattlesnake Flats Road. The plan was going to utilize STG1 and a CAL FIRE engine strike team (STC1). STLG1 had secured two CAL FIRE engines from STC1 to assist with the firing operation. Winds were favorable for the firing operation that was going to take place along the east side of Clark Road and the north side of Rattlesnake Flats Road. The fire was estimated to be one quarter mile north of Rattlesnake Flats Road backing to the south with small isolated slope driven runs.

FCB2 took his crew and walked west on Rattlesnake Flats Road towards Clark Road. FCB2 intended to wait for the engine crew to bring fire east from Clark Road to his location before firing east to FCB1.

At approximately 2:45 PM, the wind suddenly changed direction and significantly increased velocity, pushing the fire south. FCB2 estimated the winds to be 25 miles per hour with 10’ to 15’ flame lengths. The fire crossed Rattlesnake Flats Road to the

west of FCB2. In response to being cut off to the west, FCB2 and CRW2 attempted to retreat east, but were again cut off by fire crossing Rattlesnake Flats Road. FCB2 instructed CRW2 to start defensive firing creating a buffer between the advancing fire front and their location.

At the same time, CRW1 experienced increased fire activity and FCB1 instructed CRW1 to begin defensive firing. Approximately 20' of firing was completed before the advancing fire front quickly overtook CRW1's egress and they were forced to seek refuge through or over the barbed-wire fence south of Rattlesnake Flats Road towards the Emergency Crew Transports (ECTs).

Inmate Firefighter 1 (IFF1) ran the opposite direction of the remaining CRW1 members. IFF1 attempted to run through the advancing flame front into the burn forgetting there was a fence on the north side of Rattlesnake Flats Road. As a result, IFF1 collided with a barbed-wire fence and was subsequently burned. IFF1 followed the barbed-wire fence until he found an opening. IFF1 went through the opening and found refuge in the burn on the north side of Rattlesnake Flats Road.

At the same time IFF1 ran north, Inmate Firefighter 2 (IFF2) ran south towards the ECTs. IFF2 jumped over the barbed-wire fence on the south side of Rattlesnake Flats Road. IFF2 had a second hand tool secured to his web gear that became hung-up in the barbed-wire fence causing IFF2 to fall face down on the ground. The fire front overtook IFF2 igniting his hair, beard and mustache resulting in burns to his face and neck.

FCB2 and CRW2 walked east on Rattlesnake Flats Road towards the ECTs. FCB2 observed FCB1 had been burned and immediately attempted to broadcast "emergency traffic" on the assigned command and tactical frequencies. FCB2's call unanswered due to the amount of radio traffic.

At approximately 3:00 PM, STLG1 returned to Rattlesnake Flats Road and drove east to STG1 where he observed inmate firefighters attempting to provide medical care to FCB1. STLG1 evaluated and confirmed FCB1 had been burned. STLG1 requested an ambulance respond to the intersection of Clark Road and Rattlesnake Flats Road.

FCB1, IFF1 and IFF2 were appropriately triaged, treated and were transported by advanced life support at approximately 3:30 PM to the appropriate care facilities for further treatment.

BLEVE

On Thursday, November 8, 2018, a CAL FIRE Type III engine strike team was assigned to the Camp Incident in Butte County. Engine 1 (E1) was staffed with a Fire Captain (FC1), and two Fire Fighter I's (FF1 and FF2).

At approximately 8:00 AM, E1 arrived at a staging area on Highway 70 and waited for the remaining engines of their strike team.

At approximately 9:00 AM, E1 arrived in the town of Paradise and assisted with civilian evacuations and structure protection.

At approximately 12:00 AM, E1 was assigned to structure protection in Magalia.

On Friday, November 9, 2018, at approximately 4:50 AM (fourteen hours after the burn over on Rattlesnake Flats Road), E1 was told there was a need for structure protection on Ponderosa Way.

At approximately 5:00 AM while driving west on Ponderosa Way, E1's crew observed actively burning structures on the east side of Chestnut Circle. FC1 saw a small 5' x 5' spot fire on the west side of Chestnut Circle.

FC1 positioned E1 north of the intersection of Ponderosa Way and Chestnut Circle. FF1 deployed the reel-line from the driver's side of E1 and attempted to protect the two nearest uninvolved structures by extinguishing the spot fire. FF2 stood approximately 16' from the engine and assisted in pulling hose from the hose reel.

FC1 saw an additional spot fire develop between a structure and a detached garage on the west side of Chestnut Circle. FC1 went to the rear driver's side of E1 and attempted to deploy a 1 ½" hose line hanging from the wildland urban interface (WUI) bracket.

Simultaneously and without warning, a 250-gallon propane tank experienced a boiling liquid expanding vapor explosion (BLEVE), approximately 212' east of E1.

While still standing at the rear of E1, FC1 was hit with burning sticks, branches, pine cones, bark and molten aluminum.

During the explosion FF1 turned to the right and was hit with embers and pieces of fence. FF1 was knocked to one knee and became momentarily disoriented.

FF2 was standing west of E1 partially shielding FF2 from the explosion.

FC1 returned to the cab of E1 and disengaged the pump while FF1 and FF2 rolled up the reel line. FF1 and FF2 waited briefly on the west side of E1 until conditions allow them to enter E1.

At approximately 5:05 AM, FC1 drove E1 approximately 150' north on Chestnut Circle and stopped in an unburned area. The crew of E1 extinguished and removed burning debris from the hood of the fire engine. FC1 and FF1 discovered they received minor burn injuries from the BLEVE.

FC1 drove E1 to a commercial shopping center parking area in Magalia where they were further evaluated to determine the extent of their injuries. FF2 was reassigned to a different engine while FC1 and FF1 drove E1 to Butte College.

FC1 and FF1 were appropriately triaged, treated and transported to a local hospital for further treatment.

INJURIES/DAMAGES

Burn Over

- FCB1 suffered burn injuries to the hands, arms, face and neck.
- IFF1 suffered burn injuries to the face and neck.
- IFF2 suffered burn injuries to the face and neck.

BLEVE

- FC1 suffered burn injuries to the face and neck.
- FF1 suffered burn injuries to the face and neck.

SAFETY ISSUES FOR REVIEW

Personal Protective Equipment worn appropriately would have prevented the injuries suffered on this incident.

Standard Fire Orders

- Base all actions on current and expected fire behavior.
- Identify escape routes and safety zones, and make them known.
- Maintain prompt communications with your forces, your supervisor and adjoining forces.
- Give clear instructions and insure they are understood.

Watch Out Situations

- Wind increases and/or changes direction.

Common Denominators of Fire Behavior on Tragedy Fires

- In relatively light fuels, such as grass, herbs, and light brush.
- When there is an unexpected shift in wind direction or in wind speed.
- Critical burn period between 2:00 PM and 5:00 PM.

INCIDENTAL ISSUES/LESSONS LEARNED

Lessons Learned

- Safety through leadership prevented further injury.
  "I had safety briefings throughout the day as we came up with plan A, plan B, plan C."

- Personnel identified a rapidly changing environment with increased fire behavior and took definitive defensive action.
  "The wind exploded, I maintained control of the crew and started defensive firing."

- Properly worn PPE prevented further injury.
  "When performing structure protection, I always wear my shroud and goggles."

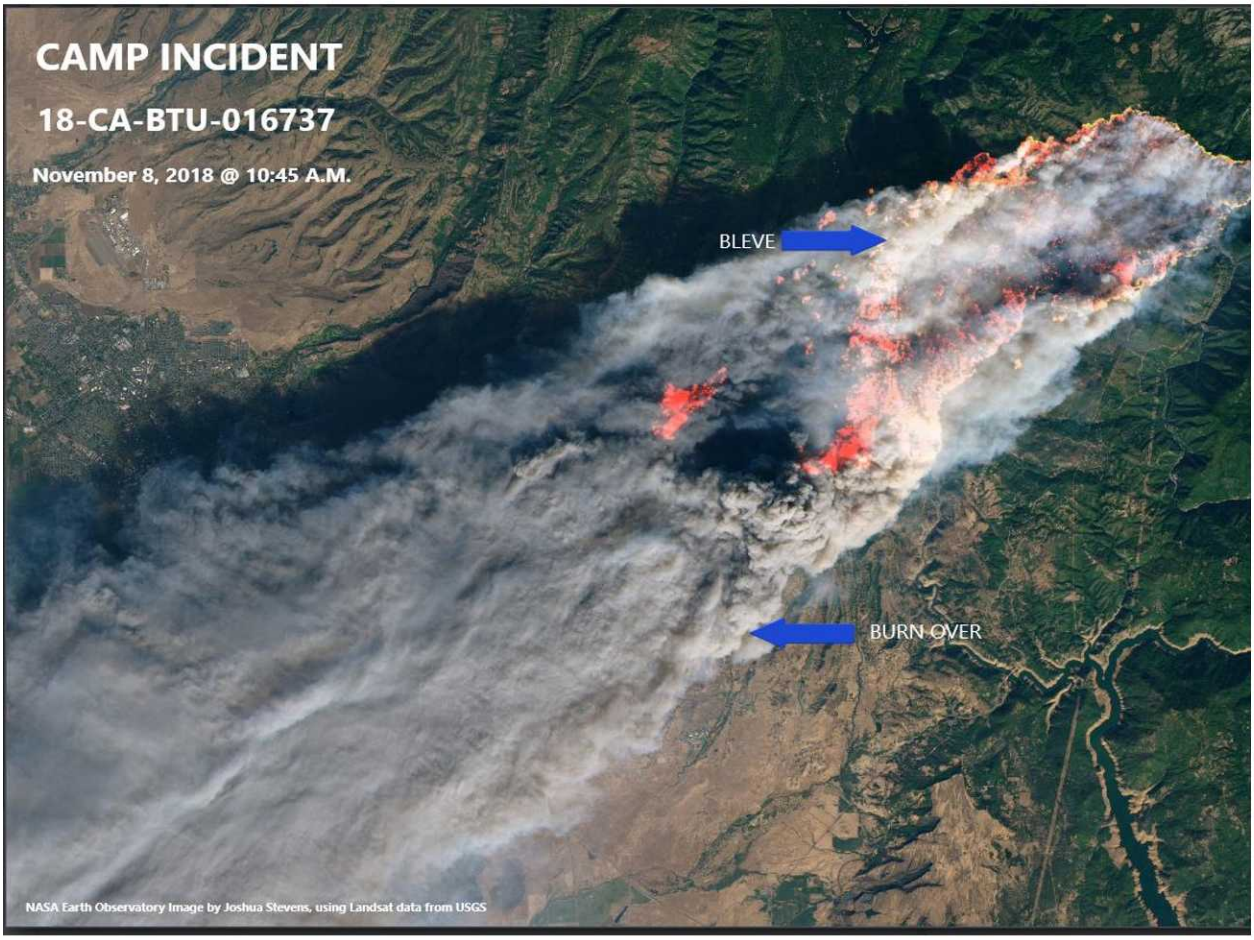
- Maintaining control of forces limited additional injuries.
  "I wanted my crew to see my eyes while I yelled at them to stop."

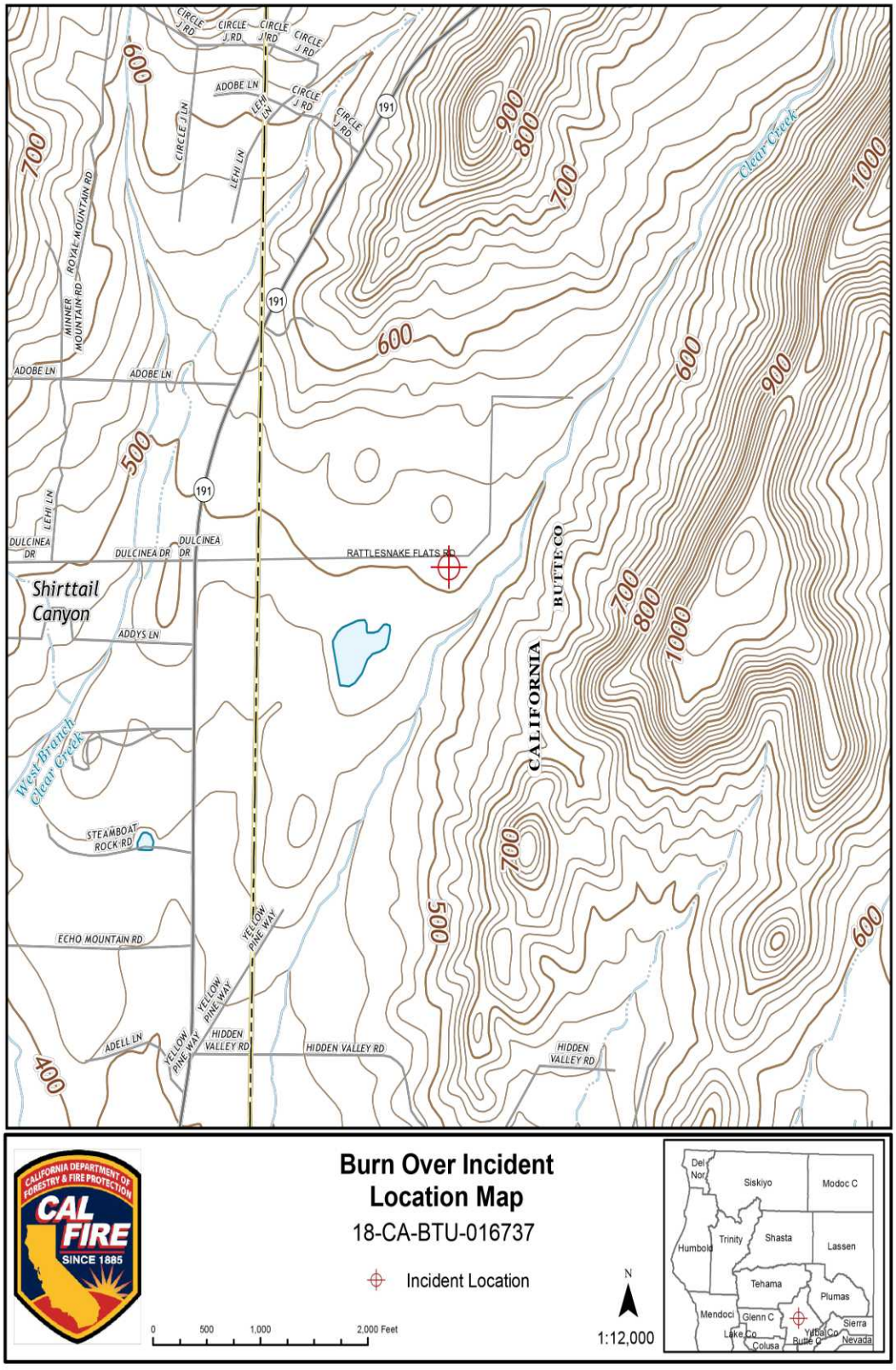
- Wear appropriate PPE.
  "If I had my shroud down, I would have only had a singed shroud."
  "Wear your gloves."

- Have clear objectives and an understanding of your leader's intent.
  "Everything my strike team leader passed on to me we had conversations on."

- Consider physical barriers effecting your egress to identified safety zones, and mitigate prior to suppression operations.
  "I hurdled over the fence, the tool in my pack caught the fence, I fell face down."

PHOTOS/SITE DIAGRAMS/MAPS




CIRCLE J RD
ADOBE LN
LEHI LN
CIRCLE J LN
ROYAL MOUNTAIN RD
MINNER MOUNTAIN RD
191
DULCINEA DR
RATTLESNAKE FLATS RD
Shirttail Canyon
ADDYS LN
West Branch Clear Creek
Clear Creek
STEAMBOAT ROCK RD
ECHO MOUNTAIN RD
YELLOW PINE WAY
ADELL LN
HIDDEN VALLEY RD
CALIFORNIA
BUTTE CO
600
700
800
900
1000
500
400
Burn Over Incident
Location Map
18-CA-BTU-016737
Incident Location
N
1:12,000
0
500
1,000
2,000 Feet
Del Nor
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Modoc C
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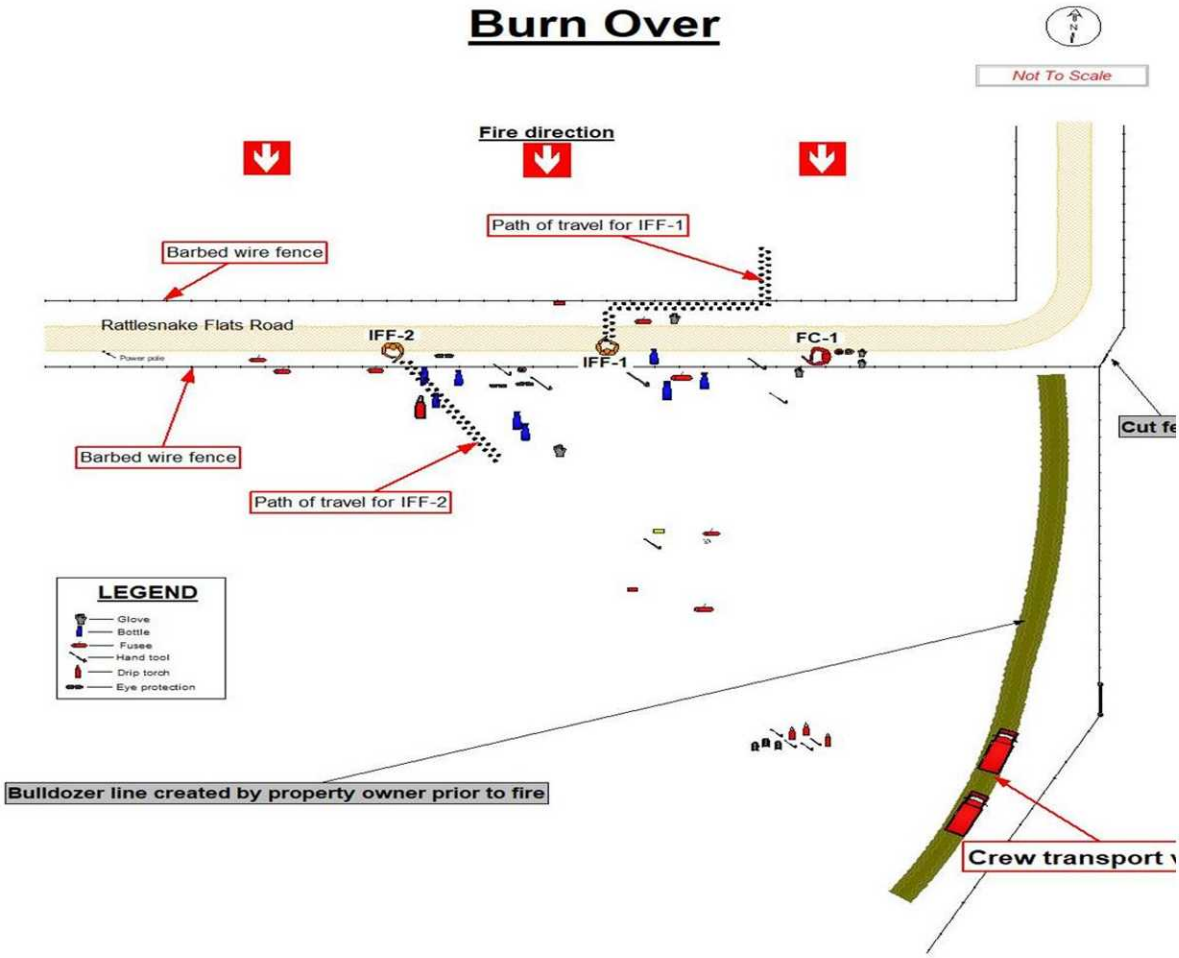
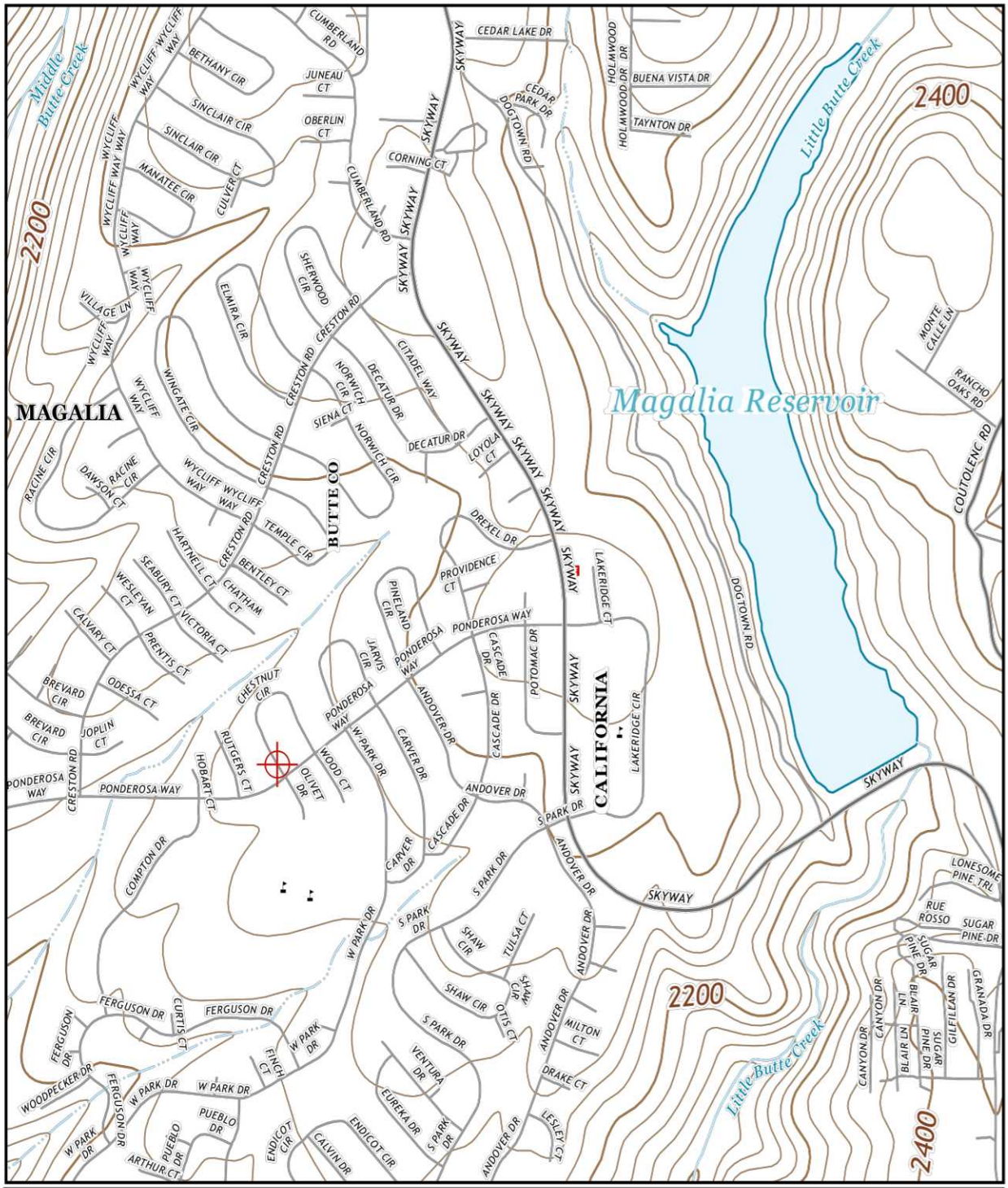

Burn Over
Not To Scale
Fire direction
Path of travel for IFF-1
Barbed wire fence
Rattlesnake Flats Road
IFF-2
IFF-1
FC-1
Barbed wire fence
Path of travel for IFF-2
LEGEND
Glove
Bottle
Fusee
Hand tool
Drip torch
Eye protection
Bulldozer line created by property owner prior to fire
Crew transport

Rattlesnake Flats Road looking east.

Looking east towards accident site.



BLEVE Incident Location Map

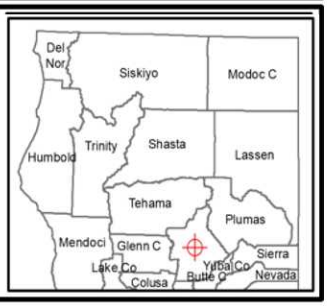
18-CA-BTU-016737

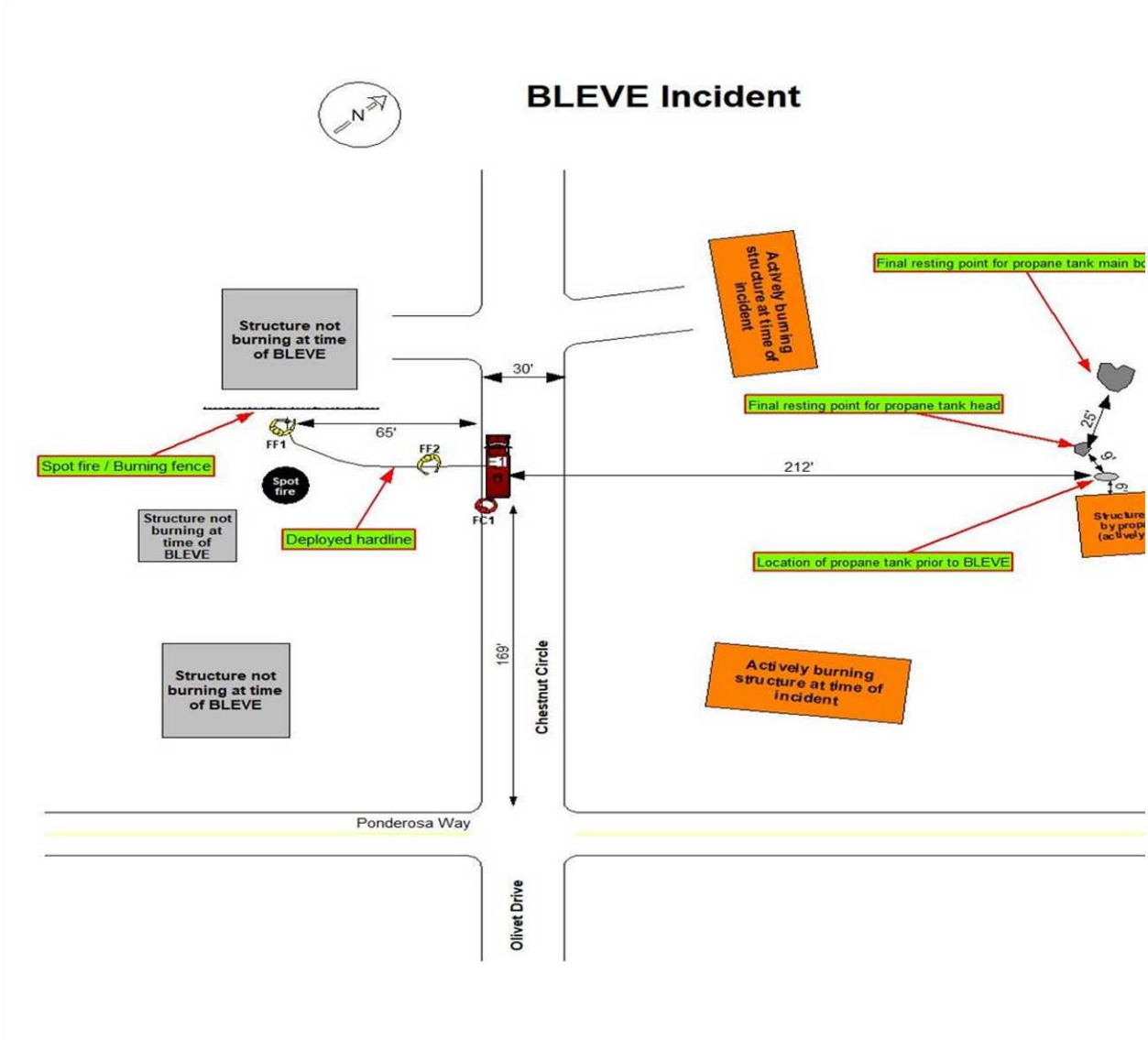
Incident Location

0 500 1,000 2,000 Feet

N

1:12,000




BLEVE Incident
N
Structure not burning at time of BLEVE
Actively burning structure at time of incident
Final resting point for propane tank main bo
30'
Final resting point for propane tank head
25'
65'
FF1
FF2
Spot fire / Burning fence
Spot fire
212'
Structure not burning at time of BLEVE
Deployed hardline
FC1
Location of propane tank prior to BLEVE
Structure not burning at time of BLEVE
169'
Chestnut Circle
Actively burning structure at time of incident
Ponderosa Way
Olivet Drive

Propane tank's original location looking towards E1.

Propane tank after BLEVE.

References and Links

BLEVE Demo: https://youtu.be/sl-JgyQA7u0

Mike Rowe - Safety Third - Whaaat??: https://youtu.be/s0RrhkMk2zY