National Park Service
U.S. Department of the Interior

Division of Fire and Aviation

Chimney Tops 2 Fire Review
Individual Fire Review Report

Table of Contents

The primary goal of this review is to understand the decisions that were made based on the conditions that existed and to identify and share lessons learned both within the National Park Service and the interagency fire community.

1. Executive Summary

During the final week of November 2016, a fire began within Great Smoky Mountains National Park. Due to unusual drought conditions across the Southeast Region of the country, wildland vegetation was susceptible to fire, with a number of fires burning throughout the fall fire season. Initially, the fire in the park was not considered a threat to civilian life or property as firefighters in the park engaged the fire. On the afternoon of November 28, 2016, a severe wind event struck the region. These winds exacerbated the fire's spread and dramatically altered the threat to the adjacent Gatlinburg area. With wildfire approaching Gatlinburg from the park, and new fire ignitions within the city limits caused by downed powerlines from the heavy winds, firefighters struggled to contain the fires. Ultimately, 14 lives were lost, many were injured, and up to $2 billion in property was damaged or destroyed, though figures provided vary widely depending on the source.

The following report is a review of the Chimney Tops 2 fire as ordered by William Kaage, Division Chief of Fire and Aviation Management for the National Park Service, conducted by an interagency fire review team. This review team's focus was on National Park Service preparedness and response to the Chimney Tops 2 fire as it originated and burned within the park's boundaries up to the time the fire left the park near 1800 hours on November 28, 2016.

Discovery of the CT2 Fire

On the evening of November 23, 2016, as the Thanksgiving Day Holiday began, the Great Smoky Mountains National Park fire crews responded to a report of a vehicle fire within the park boundary.

Enroute to this incident, the request was cancelled. While looking for a smoke column from the vehicle fire, the fire management officer (FMO) spotted smoke in the area of the two peaks in the park known as the Chimney Tops.

For reference purposes in this report, these two peaks are identified as Chimney Tops 1 (CT1), the south peak, and Chimney Tops 2 (CT2), the north peak. The trail ends at the base of CT1 where a sign cautions hikers about continuing beyond this point due to difficult terrain. The sign warns of treacherous footing and for people to proceed with caution—at their own risk. There is no further access to CT2 unless one chooses to ignore the warning signs and statements about the trail ending.

The FMO, hiked into the Chimney Peaks area with one other firefighter. That firefighter, due to the hazardous terrain, chose to remain at CT1. On the northeastern side of CT2, the FMO spotted a creeping smoky fire in the dark of night and realized that hiking out to his current location put him in danger. He recognized that the possibility of safely accomplishing suppression action was out of the question in this treacherous terrain at this late hour in the dark. The FMO determined that crews needed to return in the daylight the following day. The FMO, who is now the incident commander, hiked out of the fire area with the other firefighter. They closed the trail to protect the public from the wildfire.

Fire Suppression Plan Developed

After the FMO ascertained the extent of the fire, senior park leadership and the FMO/incident commander developed a fire suppression plan to contain the Chimney Tops 2 Fire at approximately 400 acres using an indirect attack "box" suppression strategy.

Work to scout these indirect fire lines began on Thursday, November 24. The majority of these indirect suppression lines that created the box were based on natural and pre-existing features such as trails, drainage bottoms, and natural features that—within the local experience of the personnel involved—would hold the fire. However, there was no action taken on constructing lines until Sunday, November 27. Under such drought and fire weather conditions, the fire lines that needed to be constructed were difficult and the likelihood of success of the box to hold the fire, in the opinion of the review team, was very low.

Fire Gains Momentum; Additional Suppression Resources Arrive

Early in the morning hours of Saturday, November 26, a Hazardous Weather Outlook forecast high winds and rain for the afternoon/evening of Monday, November 28.

On Sunday November 27, the Chimney Tops 2 Fire gained momentum. A distinct smoke column could be seen from the surrounding towns of Gatlinburg and Pigeon Forge. As a result of the change in fire behavior, air support was ordered, with the first helicopter requested at 1235 hours, and two additional helicopters ordered at 1530 hours. The helicopters began dropping water on the fire's edge, which was still inaccessible to ground crews for direct attack without significant risk.

Updated weather reports continued to confirm that high winds were predicted for the following day and rain remained in the forecast.

Due to the increase in fire behavior, on Sunday the FMO—also functioning as the incident commander (IC) and duty officer (DO)—ordered additional resources via phone calls to adjacent fire resource units. Some of these additional resources began to arrive Sunday night at approximately 1900 hours.

Fire Becomes the Largest in Park History

On Monday morning, November 28, maintenance workers reported fire in the Chimneys Picnic Area north of the last known location of the fire. Based on this information, the FMO/IC/DO estimated that the fire had grown to approximately 250 to 500 acres.

Fire crews responded to the Chimneys Picnic Area. While scouting out this increased fire activity coming off CT2, crews observed an established spot fire across Newfound Gap Road, approximately one mile from CT2.

Over the ensuing hours, the forecasted wind event arrived with even greater intensity than predicted. Thereafter, the Chimney Tops 2 Fire became the largest wildland fire in the history of Great Smoky Mountains National Park. At approximately 1800 hours on November 28, the fire reached the park boundary and merged with other wildland fires, collectively referred to as the Sevier County Fires. With the wind event downing powerlines, which created additional fires, crews from various agencies involved struggled to contain the overall wildfire that now threatened populated areas.

Summary of Findings

The review team concluded that a lack of wildland fire preparedness during a period of drought conditions favorable to wildfires overwhelmed National Park Service response to the CT2 fire. Though the review team concluded that the firefighting decisions made by the personnel involved were commensurate within their knowledge and experience in fighting wildland fires in the region, this report recommends enhanced preparedness and fire planning based on fire-conditions assessments, and adherence to the National Park Service wildland fire program and policies. These recommendations will likely enhance the capability of the Great Smoky Mountains National Park to respond to a wildfire event with similar or greater fire weather conditions in the future.

2. Introduction

On November 23, 2016 a human-caused wildland fire started in the Chimney Tops area of Great Smoky Mountains National Park. Over the course of the next five days, the fire, known as the Chimney Tops 2 Fire, would grow and under extreme weather conditions leave the park on November 28, 2016.

High winds and dry fuels would push the fire from the park and merge with other wildland fires outside the park. As these fires merged together they were referenced as the "Sevier County Fires,"[1] with the ultimate loss of 14 lives and 2,545 structures.

This report is a review of the Chimney Tops 2 Fire as ordered by William Kaage, Division Chief of Fire and Aviation Management for the National Park Service. An interagency fire review team was ordered to review and compile their findings on the fire. This review team's focus was on National Park Service preparedness and response to the fire.

The review team first mobilized in December 2016. However, due to the ongoing criminal investigation at the time to determine the fire's cause, was stood down. The review team mobilized again on February 6, 2017 and began working on the review.

The review team's Delegation of Authority (see Appendix 1) directs the team to examine the period of time from when the Chimney Tops 2 Fire began on November 23, 2016 until it reached the park boundary at approximately 1800 hours on November 28, 2016. As a result, conclusions about the Chimney Tops 2 fire's relationship with the other fires that ultimately became the Sevier County Fires are beyond the scope of this review and report.

Purpose: Learn and Develop

The primary goal of this review is to understand the decisions that were made based on the conditions that existed and to identify and share lessons learned both within the National Park Service and the interagency fire community. These areas include but are not limited to:

Leader's Intent and Sensemaking

It is important to understand the considerations and factors for each decision that was made surrounding this incident. This review examines how these decisions were informed by existing conditions—including fuels, weather, an individual's experience, leader's intent, as well as other elements that contributed to the fire's progression.

It is equally important to assess where improvements are needed in decision-making and programs in order to reduce the potential of negative outcomes in the future. As a culture, learning from mistakes and strengthening weak areas will help identify what was done well and what needs to be corrected or improved.

[1] Data obtained from Sevier County.

Identify Facts and Make Recommendations

The review team was also charged with identifying the facts that led up to the incident and to make recommendations on planning, operational or managerial issues (locally, regionally and/or nationally), and to help the National Park Service (NPS) learn from this event.

As part of the review process, the review team followed the policy in the following documents. Policy and direction for fire management within the National Park Service can be found in RM-18[2] in Chapter 17 in which fire reviews are addressed with the following language:

> *"All wildland fires and fire-related incidents must also be reviewed at some scale, whether it is a tailgate after-action-review or at the other end of the spectrum, a formal review conducted by a team. This includes all prescribed fires, which will also be reviewed as appropriate. Reviews are conducted for one or more of the following purposes:*
>
> - *To examine the progress of an on-going fire incident and to confirm effective decisions or to correct deficiencies.*
> - *To identify new or improved procedures, techniques, or tactics.*
> - *To compile consistent and complete information to improve or refine Park, Regional, or National fire management programs.*
> - *To examine anomalous fire-related incidents in order to determine cause(s), contributing factors, and where applicable, to recommend corrective actions; if negligence is indicated, the circumstances will be reported and investigated in accordance with applicable regulations, policies, or guidelines.*
> - *To determine the cost effectiveness of a fire operation."*
>
> *"All reviews will be conducted as constructive critiques aimed at determining the facts related to the specific fire or fire management program. Reviews will identify commendable actions, techniques, and decisions, as well as areas that need improvement. Reviews are intended to resolve operational issues, not impose punitive actions.*
>
> *All wildland fire incidents which result in human entrapment, fatalities, or serious injuries, or result in incidents with potential, will be investigated and reviewed."*

The guidance for large fire reviews, located in Chapter 18 of the *2016 Interagency Standards for Fire and Fire Aviation Operations* (Red Book), states:

> *"Individual fire reviews examine all or part of the operations on an individual fire. The fire may be ongoing or controlled. These reviews may be local, state/regional, or national. These reviews evaluate decisions and strategies, correct deficiencies, identify new or improved procedures, techniques or tactics, determine cost-effectiveness, and compile and develop information to improve local, state/regional, or national fire management programs."*

[2] RM-18 represents the most detailed and comprehensive guidance on implementing agency-wide wildland fire management policy for the National Park Service (NPS). It provides NPS field employees' legal references, operating policies, and standards and procedures to assist them in carrying out management policies and Directors Order #18: Wildland Fire Management.

Chimney Tops 2 Fire Review Team Members

The National Park Service assembled the following team to review the Chimney Tops 2 Fire:

Joe Stutler – Team Lead; Senior Advisor, Deschutes County (Oregon)

Tim Reid – Superintendent, Devils Tower National Monument; National Park Service

Shane Greer – Assistant Fire Director of Risk Management, Region 2; U.S. Forest Service

Miranda Stuart – Fire Management Specialist, National Interagency Fire Center; National Park Service

William Grauel – Fire Ecologist, National Interagency Fire Center; Bureau of Indian Affairs

Jimmy Isaacs – Fire Chief; Town of Boone, North Carolina

Mike Lewelling – Fire Management Officer, Rocky Mountain National Park; National Park Service

Paul Keller – Technical Writer-Editor, Wildland Fire Lessons Learned Center

Review Team Explores Several Key Areas

The fire review team was specifically tasked with reviewing the Chimney Tops 2 Fire within the boundaries of Great Smoky Mountains National Park.

The review team explored the following key areas:

A. The park's adherence to NPS fire management policy.

B. The quality of the fire management plan.

C. The quality of the Step-Up Plan and Severity Plan and how these plans are/were implemented prior to the ignition and during the Chimney Tops 2 Fire.

D. Management evaluation looking at such areas as initial response, dispatch, management efforts, and an understanding of where and why these efforts may not have been successful.

E. Evaluating the safety and operations from the point of detection until 1800 hours on November 28, 2016.

F. Interagency communication and cooperation, particularly with the Gatlinburg City Fire and Tennessee Division of Forestry as well as with the additional surrounding partners.

G. The decision-making process for tactics, resource ordering, communication and implementation of the plan.

H. The pre-fire weather monitoring as well as the five days (November 23-28) of the fire.

I. The interagency communication with local, regional, and national level resources, including the local public through public information outreach and how these communications transpired.

Terminology

The **Fire Management Officer** (FMO) is responsible for the oversight of a fire program on a management unit.

The **Incident Commander** (IC) is responsible for the overall management of the incident (i.e. fire, all-hazard) and reports to the Agency Administrator for the agency having jurisdiction for the event.

The **Agency Administrator** (AA) is the managing officer of an agency, division or jurisdiction having statutory responsibility for incident mitigation and management. (Example: park superintendent, U.S. Forest Service forest supervisor, or Bureau of Land Management district manager.)

The **Duty Officer** (DO) provides operational oversight for monitoring unit incident activities and ensuring compliance with NPS safety policies; coordinates and sets priorities for unit suppression actions and resource allocation; informs the AA, suppression resources and Information Officers of the current and expected situation; plans and implements actions for required future needs; and documents all decision and actions. DOs will not fill any incident command functions connected to any incident.

To access the National Wildfire Coordinating Group (NWCG) glossary:

https://www.nwcg.gov/glossary/a-z

See Appendix 2 for a summary timeline of the Chimney Tops 2 Fire.

3. Narrative

The Chimney Tops 2 Fire began on the evening of November 23, 2016 at the end of a popular hiking trail in Great Smoky Mountains National Park.

At approximately 1700 hours that day, the fire management officer (FMO) for the Great Smoky Mountains National Park received a call from National Park Service (NPS) law enforcement personnel about a possible vehicle fire below Newfound Gap within the park.

Because of the potential threat of the vehicle fire to spread into the park, the FMO and a park firefighter responded, along with law enforcement personnel. Because the park does not have the structure firefighting training or proper protective equipment to suppress vehicle fires, the Gatlinburg (Tennessee) Fire Department (GFD) was also dispatched.

FMO Observes Smoke from a Wildland Fire

While the FMO and park firefighter were enroute, it was determined by resources on scene that the vehicle fire posed no threat to the surrounding park.

The wildland fire on Chimney Tops 2 (CT2), the north peak, was detected by the FMO as he was looking for smoke from the vehicle fire. As he was driving, he noticed a smoke column rising between Chimney Tops 1 (CT1), the south peak, and CT2. He pulled his vehicle over in a turnout along the Newfound Gap Road. A second firefighter pulled in with the FMO. Together, they hiked into the Chimney Tops area. Night was already falling. The trail is approximately two miles up steep terrain.

The maintained trail ends at the base of CT1 where a warning sign indicates that the path ahead is treacherous and hikers should proceed with caution. The trail completely ends at the top of CT1. Only those who choose to disregard the warnings proceed farther.

Dangerous Terrain and Limited Access

When the FMO reached the base of CT1, the firefighter hiking with him expressed concern and did not want to hike farther. From here, the FMO proceeded solo to the top of CT1. At this point, the FMO had to drop his pack to descend down between the two peaks.

It was windy, with winds coming out of the east, blowing embers over the rocks to the west side of the summit. By now,

it was dark. The fire was below the top of CT2, positioned along the northeast side of the summit where the terrain drops off quickly.

The FMO looked for ways to try to contain the fire but it was burning in deep duff, flanking off the top and slowly backing down the slope. The FMO estimated the winds were blowing out of the east at 10 mph. Using a hand tool, he attempted to contain the fire. However, fuels, footing, terrain, the darkness, and heavy smoke made this work difficult and dangerous.

As he tried to work his way around the fire, the FMO realized that this was a poor and risky choice and that nothing could be accomplished safely in the dark. Therefore, he made his way back to the base of CT1 and the FMO and firefighter hiked out.

Trail closures were put in place for the Chimney Tops Trail and public notifications were made regarding these closures and smoke in the area. Based on what little glow could be seen at that time, this smoldering fire was estimated to be less than one acre in size.

Unfolding Events:

Thursday November 24, 2016

"The fire is approximately two acres on the northeast side of the second summit. The fire is smoldering and creeping around. The area is too steep for attack. Will consider Air Ops tomorrow. It is unknown if [FMO] could even get aircraft with all of the other fires."

Text message from chief ranger to deputy superintendent for the park—sent on November 24 at 1237 hours.

[The following information—from Thursday November 24 to Sunday November 27—has been obtained from: the fire management officer's statement to the Chimney Tops 2 Fire investigators, transcripts of text messages, the timeline provided by Great Smoky Mountains National Park to the review team, and the PowerPoint presentation provided for the review team in-briefing, in addition to interviews conducted by the review team with critical incident participants.]

The FMO had assumed command of the fire and was functioning as its Incident Commander. Due to the Thanksgiving Holiday, most of the fire staff was on leave. Other than a Type 6 engine and two firefighters brought in with severity funding, the FMO had not staffed extra resources to cover leave requests and no leave requests had been cancelled, even with the park in severity status. National parks can use wildland fire suppression funds (severity) for additional staffing based on elevated fire danger and weather forecasts identified in Step-Up Plans. (See Appendix 3 for a detailed Step-Up Plan description.) As a result of this staffing situation, the FMO was also functioning in the role of duty officer (DO).

On Thursday November 24, Thanksgiving Day, at approximately 0800 hours, The FMO/IC met with four other NPS firefighters to continue work on the fire. The group hiked in along the Chimney Tops Trail from the trailhead parking area to the NPS "not to proceed" warning sign along the east slope of CT1 and held a briefing. Three of the NPS firefighters in the group decided they were not comfortable climbing over CT1 and CT2 to the fire.

Because there was no other way to access the fire, the FMO/IC and one NPS firefighter left the others and hiked toward the area of the fire. After having to lower their packs down and over a 10-15 foot drop, they continued on to the fire without their packs, carrying only their fire tools, radios, and water. As they arrived on the scene of the fire, the FMO/IC noted that the fire had not grown much from the night before. Conditions at the time were calm winds. It appeared the area had received a small amount of rain overnight.

The FMO/IC and NPS firefighter began looking for ways to directly attack the fire. Now, in the daylight, the severely steep, near vertical, and uncertain stability of the rocky terrain became even more apparent than it had appeared the night before. It was evident that building direct fire line in the boulders, cliffs and duff would be impossible.

After deciding that direct line construction was not going to be effective, the FMO/IC notified park dispatch of his observations via radio. At this point, the FMO/IC began to assess options to contain the fire by identifying natural and human-made barriers.

The fire was smoldering in the duff and, in places, was also burning minimal amounts of leaf litter. The FMO/IC and the NPS firefighter collected their packs and climbed back to CT1. After a short meeting about planning options with the NPS firefighters who had stayed behind at the bottom of CT1, everyone hiked back to the trailhead and Newfound Gap Road.

Returning to the parking area, the FMO/IC had a brief meeting with NPS law enforcement personnel regarding the fire's cause and origin. He relayed that the fire had only grown slightly in size from the day before and there was no active flame or fire, except the smoldering duff, which had caused the fire to only slightly increase in size. They discussed the difficult terrain and safety concerns and that they had possibly received some rain overnight. After reconsidering the fire location, size, and how to direct attack it, the FMO/IC described how he was planning an indirect attack due to the inability to do a direct attack safely and effectively.

Development of the Box

The FMO/IC developed an indirect strategy to hold the fire within an approximately 400-acre "box." This box was delineated on paper using topographic/natural barriers and relying on the drainages to contain the fire. A portion of this box located on the south and west side of CT2 would require constructed fire line. However, after scouting the proposed fire line, it was recognized that completion using the existing resources (people) would be difficult due to high brush, dead logs (fuel), and steep terrain.

This indirect strategy was discussed with the chief ranger and the deputy superintendent who supported the strategy, with the belief that the fire would never reach the perimeters of the box based on historical fire behavior in the park, coupled with the forecast of rain on Monday, November 28.

From November 24-28 the box was scouted but no significant indirect line construction occurred. A small section of hand line was constructed off of the Chimney Top Trail, according to the FMO/IC on November 27. The crews described the drainages that were scouted as "having moss on the rocks that was so dry it turned to dust upon contact." However, the FMO/IC remained confident that if needed, they would hold the fire's spread, based on the fire behavior he expected.

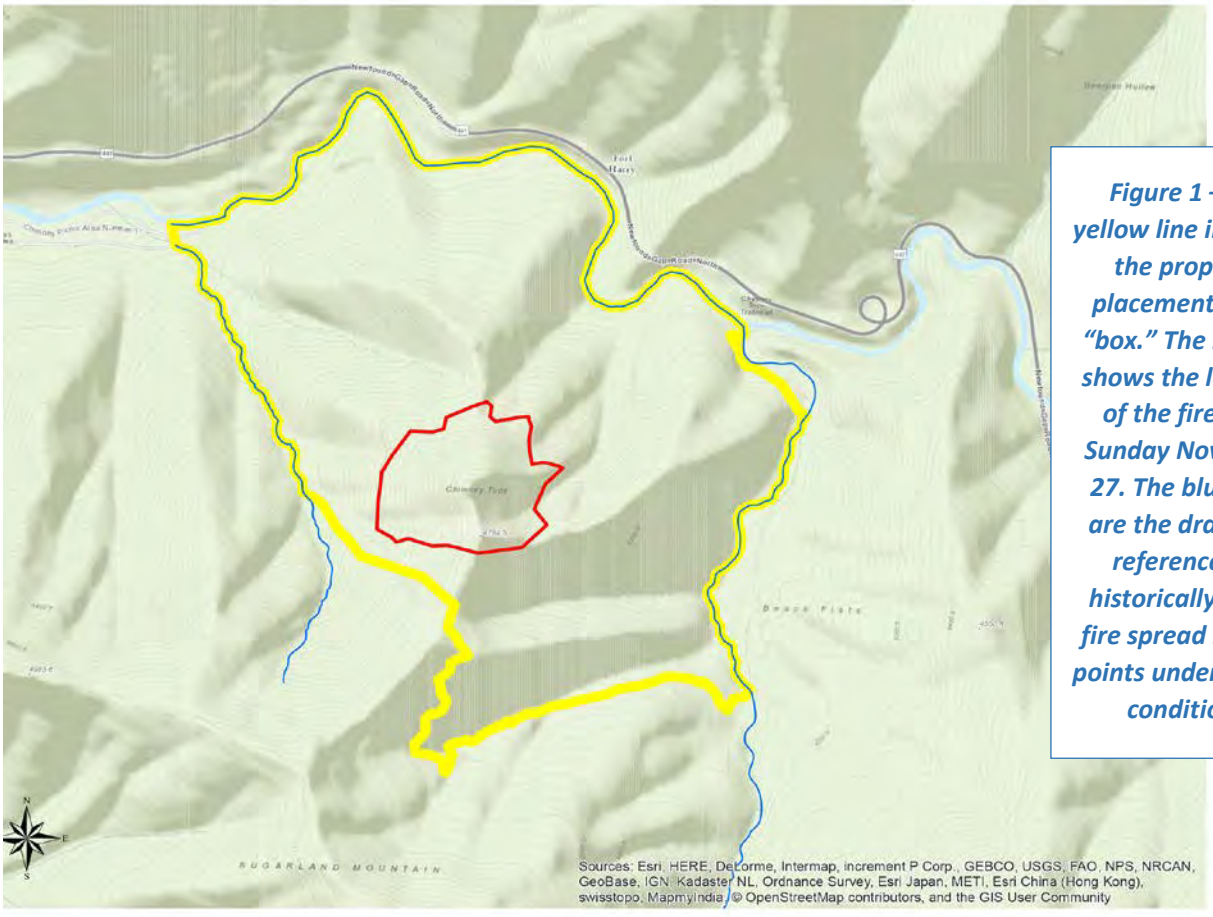


Figure 1 – The yellow line indicates the proposed placement of the "box." The red line shows the location of the fire as of Sunday November 27. The blue lines are the drainages referenced as historically sound fire spread holding points under normal conditions.

Friday November 25

On Friday November 25, the Chimney Tops were fogged in, with fog or clouds covering them for much of the day. Overall, the FMO/IC and NPS firefighters (six people total) spent the day scouting the bottom below the fire to look for other options for containing the fire to the west, south, and north.

At approximately 1200 hours, the FMO/IC scouted the area below the Chimney Tops for containment locations. The other NPS firefighters spent the day scouting from the Chimneys Picnic Area along two unnamed prongs of the Little Pigeon River that extended southeast toward the base of the mountain, searching for areas that were suitable for fire containment lines.

Their scouting mission included identifying an abandoned user trail that extended from the West Prong of the Little Pigeon River near the Chimney Tops trailhead at Newfound Gap Road toward the summit of CT2, as well as areas located to the south and west. However, all of these potential options were discovered to be very steep, rugged, and unsuitable for effective fire line construction.

During these scouting missions, no fire was discovered burning along the drainages at either of these areas to the west, north, or northeast of CT2.

In addition to scouting the areas below the Chimney Tops for containment lines, the FMO/IC and his NPS firefighters worked on trail closures and public safety information/closures due to the fire and smoke (see Figure 2). They also assessed the number of roads and trails that were still open to the public that could potentially be affected by the fire in the future.

That morning, the FMO/IC briefed the park deputy superintendent, public information officer and chief ranger in a conference call about the current situation and what was planned that afternoon. The FMO/IC was following-up on the previous briefing concerning the goal of building indirect containment lines and to conduct direct attack on the fire if possible.

At approximately 1740 hours, the FMO/IC gave an updated briefing on the progress that had been made on the fire throughout that day to the park deputy superintendent and chief ranger, as well as to the park superintendent.

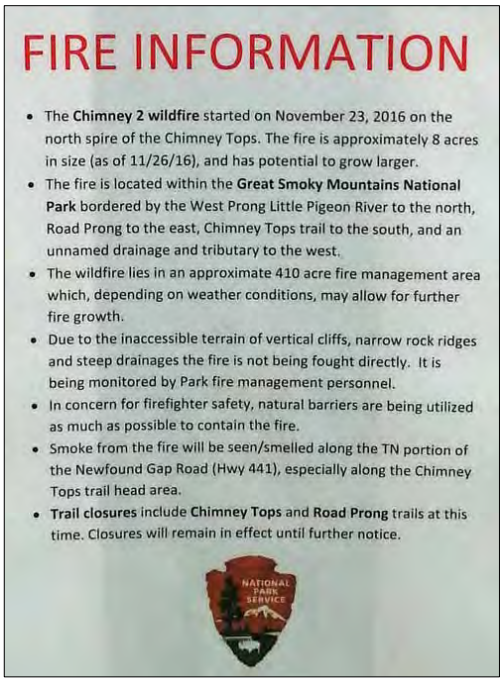


Figure 2 – Public safety information and trail closure announcement.

Saturday November 26

A Fire Weather Planning Forecast was issued at 0311 hours and followed at 0321 with a Hazardous Weather Outlook and a Zone Forecast at 0323. All referenced incoming high winds on Monday and rain for Monday night for November 28.

At approximately 0800 hours, the FMO/IC met and briefed the NPS firefighters, now a group of eight individuals. With these additional firefighters, the FMO/IC sent three NPS firefighters into the bottom area near the Chimneys Picnic Area to further scout the "two unnamed drainages" off the west/northwest side of CT2 for line construction.

The FMO/IC took the other five NPS firefighters back to the Chimney Tops area. Three of the NPS firefighters from that group scouted another abandoned user trail leading from near CT1 to the Sugarland Mountain Trail to the southwest for possible use as a fire containment line. (While this abandoned user trail is not maintained, used or recognized as a NPS trail, it connects the Chimney Tops Trail to the Sugarland Mountain Trail to the south/southwest.) The FMO/IC was looking at the drainages west of the Chimney Tops Trail as possible fire line locations.

Later that morning, the FMO/IC took one of the NPS firefighters out to the fire to assess the fire's status. They used the abandoned user trail along the east side of CT1 to get up to the NPS warning sign located in that area. They skirted around the eastern side of CT1 to the saddle and hiked out to CT2.

When they arrived at CT2 at approximately 1030 hours, the FMO/IC observed an inverted cloud layer below the fire. He saw frost on the remaining vegetation, a wet hoar frost around CT2, which encompassed the entire west side of the mountain. The fire had not yet burned onto the slopes directly west of CT2 and CT1, but had continued burning slightly to the south and along the east sides of CT2 and CT1.

The FMO/IC noticed that the fire had swung around slightly to the west and was starting to come into alignment with the drainages. Fire activity was mostly light, burning in some small fuels such as sand myrtle, which would catch fire and torch out. At this time, the FMO/IC estimated the fire to be approximately 6-8 acres in size.

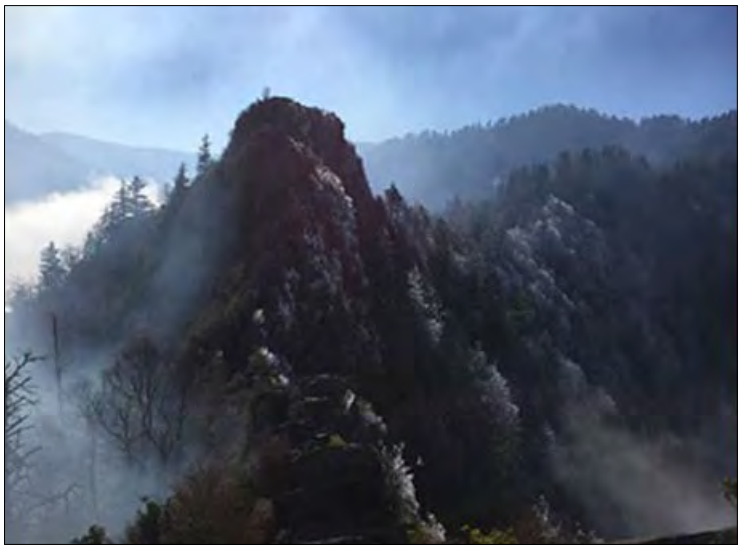


Figure 3 – Fire activity on Saturday November 26 at 1059 hours.

No Change in Fire Behavior

The morning inversion layer had lifted by approximately 1200 hours on Saturday with no real change in fire behavior. While the sand myrtle vegetation was catching fire and burning, it was still a smoldering fire in the duff surface. The FMO/IC still believed that they could catch and hold the fire in the drainage bottoms using a containment strategy of natural and human-made features based on historical fire events and practices in the park.

The FMO/IC also believed that the weakest defense area was along the west and south sides of CT1 and CT2.

The FMO/IC descended about 500 feet down the slope into the drainages southwest of CT1 near where he had the three NPS firefighters scouting the abandoned user trail from east to west near the Sugarland Mountain Trail throughout the day. He recognized that the vegetation, terrain and conditions in this area were also unsuitable for direct fire line construction.

After scouting the proposed fire line in the abandoned user trail, the crews reported to the FMO/IC that completion with the existing resources (people) would be difficult due to high brush, blowdown, dead logs (fuel), and steep terrain.

During the afternoon, the NPS firefighters along the bottom drainages reported leaf blowers could be used to put in fire line, but because of the steep terrain farther up slope, it would require extensive work and was less defensible because of the vegetation and steep terrain. They told the FMO/IC how this area presented an ever-changing safety problem to firefighters if the fire burned down into this area.

At this time, the FMO/IC was considering if he could hold the fire up along the west side of the mountain at CT1 and CT2 using aviation resources, while also using the West Prong of the Little Pigeon River, Newfound Gap Road, the Chimney Tops Trail, and other breaks along the wildland fire's northwest, north, northeast, east and southeast sides.

At approximately 1700 hours, the FMO/IC and the NPS firefighters left CT1 for the trailhead. Later that evening, the FMO/IC briefed the deputy park superintendent and chief ranger through text message on actions taken and the plan of action for the next day.

Sunday November 27

Figure 4 – View of the fire on Chimney Top 1 from the air attack plane on November 27 at 1532 hours.

On November 27, the FMO/IC arrived at work at approximately 0730 hours. He went to the Chimney Tops trailhead around 0800 hours, observing blue sky and smoke near the fire. He estimated from his observations from below that the fire appeared to have grown in size to about ten acres. However, because he was not on the ground beside the fire, he could not confirm this size estimate.

The FMO/IC's observations led him to believe that the fire had become more active overnight and that they needed to be more proactive.

He returned to headquarters. After briefing his crew, he sent three NPS firefighters to the Chimney Tops to provide additional information regarding fire size, location, and behavior. He estimated that they arrived at the fire at approximately 1100-1130 hours.

The FMO/IC remained in the office and began ordering additional fire resources—both ground and aerial fire assets—including a Type 1 helicopter and an air attack plane. The FMO/IC ordered the following resources:

1. One NPS wildland fire module. (A wildland fire module consists of 7-10 people fully capable of being inserted on a fire. They support themselves with transportation and tools and have a minimum standard of qualifications within their personnel.) This order was not placed through ROSS[3] but communicated directly to the home units via phone call from the FMO/IC requesting help.
2. One Type 1 helicopter capable of bucket drops. ROSS orders confirm that this order was placed at 1235 hours.
3. Two Type 6 engines from the Bureau of Indian Affairs (BIA) with three crewmembers each. This order was not placed through ROSS but communicated directly to the home units via phone call from the FMO/IC requesting help.
4. One interagency air attack fixed-wing aircraft, confirmed by ROSS.
5. Two Type 1 helicopters, which were helitankers (all three ships would be committed to water drops). These two helicopters were ordered at 1530 hours, confirmed by ROSS.

[3] In the United States, the National Wildfire Coordinating Group (NWCG) operates a nationwide, web-based database system for managing wildland firefighting resources. The system, called the "National Interagency Resource Ordering and Status System" or "Resource Ordering and Status System" (ROSS), improves efficiency of borrowing and the sending home of fire equipment in a large, campaign-type fire. ROSS coordinates equipment movements across bureaucratic lines, making state and federal resources look more like a single pool of equipment and staff.

On November 27 at 1532 hours, air attack over the fire described the fire as active on all flanks with a slight SE to NW wind. The Air Tactical Group Supervisor told the review team that he "was surprised that no action was being taken on the fire perimeter" and was aware that "there were plenty of resources available since many of the large fires were nearing containment."

6. One Long-Term Fire Behavior Analyst (LTAN). Not an order placed through ROSS, this individual was located in the vicinity and offered to assist the park.

Two more firefighters from Great Smoky Mountains National Park had returned to duty and available for work on this day. These firefighters staffed a Type 6 engine and were staged for initial attack response in the Blue Ridge area.

At approximately 1300 hours, the first helicopter arrived at the park and began using a bucket to drop water—taken from the West Prong of the Little Pigeon River—on the fire near CT1 and CT2 to prevent the fire from moving farther northwest.

An air tactical group supervisor (ATGS) and trainee arrive in an air attack plane and began providing additional information regarding the fire's size, now estimated at 25 acres by the FMO/IC. The ATGS observed the fire as active on all flanks with a slight SE to NW wind. The ATGS was advised there were no people directly on the fire perimeter and those helicopters were clear to drop water.

The ATGS offered additional fixed-wing retardant aircraft to support the effort with both direct and indirect placement of retardant. That request was rejected by the FMO/IC due to the high costs of retardant and the potential natural resource issues because of the close proximity of the retardant drops to the West Prong of the Little Pigeon River, which is a water supply for Gatlinburg and/or Pigeon Forge.

While these two aircraft were working, two additional Type 1 helicopters arrived at approximately 1500 hours and began working the same fire edge with their helitanker capability—able to make water drops similar to fixed-wing air tanker style deliveries.

The FMO/IC estimated that the initial helicopter bucket operation delivered 10-11 drops over the west side of the fire, finishing this mission at approximately 1500 hours. This is when the two newly arrived Type 1 helicopters resumed work with their helitanker capabilities, delivering a total of only six drops due to the lengthy flight time to Lake Fontana to draft water.

The purpose of this day's water suppression helicopter work was to prevent the fire from backing down the slope into the area southwest of CT1 and CT2 and west into the Chimneys Picnic Area, including the tops of the drainages immediately above the picnic area.

During this same time period, a second fixed-wing aircraft flew with an infrared camera to take the first infrared images of the wildland fire for mapping purposes. This is referred to as a Multi-Mission Aircraft (MMA). At approximately 1530 hours, the images indicated that the fire perimeter was near the edge of the southwestern line of the "box." At approximately 1630 hours, due to weather-related flight restrictions, all air operations ceased when daylight ended.

Plan to Contain the Fire

While some of the fire resources were directing helicopter bucket drops on CT2, other crewmembers were constructing hand line. They started building an indirect containment hand line near the first prominent switchback along the CT1 Trail where it topped the ravine southeast of CT1. The FMO/IC had other hand crews deployed scouting trails and the general area for potential indirect line construction and containment line areas.

The FMO/IC confirmed that the focus of his concern was along the southwest area (the area to the southwest of the Chimney Tops) across the area west of the Chimney Tops, and into the area northwest of the Chimney Tops. His plan was to attempt to construct indirect containment lines in those drainages and to tie into, if necessary, the Sugarland Mountain Trail to the fire's southwest. This would redefine the indirect strategy and the "box" in an effort to contain the fire that was backing away from CT1 and CT2.

At approximately 1900 hours, the additional NPS wildland fire module that had been ordered that day arrived at park headquarters. The FMO/IC briefed them on the fire's status and the suppression operation. At approximately 2000 hours, the module and the FMO/IC arrived at an overlook northwest of the Chimney Tops to observe the fire. They were located below the fire, near the Newfound Gap Road tunnel just above the grade above the Chimneys Picnic Area.

The FMO/IC described how *"you couldn't even see the fire except for a couple glowing areas."* He said that visible fire behavior appeared minimal from this vantage point and this "glowing area" was located along the northwest side of CT2 and CT1 where there was some visible fire activity. The FMO/IC said that there *"wasn't a whole line—25 acres backing down."* In other words, there was no continuous line of fire visible, and no fire lines had been built in this visible area.

The MMA flight, at 1445 hours that day, had mapped the fire at 35 acres in size.

All fire personnel were released by the FMO/IC and departed the area by 2015 hours due to the FMO/IC's perception that the fire appeared quiet. This decision was based on the FMO/IC's observation of minor torching and active flame on the ridges west and northwest of CT2.

Monday November 28

On Monday November 28 at approximately 0700 hours, the FMO/IC arrived at work knowing that winds were forecasted to come up during that day. The night before, the FMO/IC had planned to use firefighters and engines to establish containment lines—as best they could—beginning at the Chimneys Picnic Area to the south, using the drainages and any wet areas they found to control the fire's spread.

The plan was to remove the leaf litter from the surface and move as far up the mountain as they could reasonably do so. The FMO/IC also intended to use additional aviation resources, as he had done the previous day, in attacking the fire's western edges to prevent fire spread down into the bottoms toward the Chimneys Picnic Area.

According to dispatch logs (0701 hours) the FMO/IC and his crew received a radio call from maintenance crews working normal road operations that fire was burning in the bottoms near the Chimneys Picnic Area. This was an area beyond the "two unnamed forks" near the upper loop (see Figure 5).

The FMO/IC contacted the NPS wildland fire module lead (WFM Lead) and ordered him to take the wildland fire module (crew) and one engine to the picnic area to investigate this report. This module

totaled six persons, plus one wildland Type 6 engine. The FMO/IC indicated that there might have been additional engines sent due to the number of firefighters involved in the assignment.

At approximately 0730 hours, the deputy superintendent, chief ranger, and chief of resource management and science arrived on-scene at the picnic area to evaluate the situation. The WFM Lead was on-scene working with the NPS module and two BIA engines, which had been deployed to the

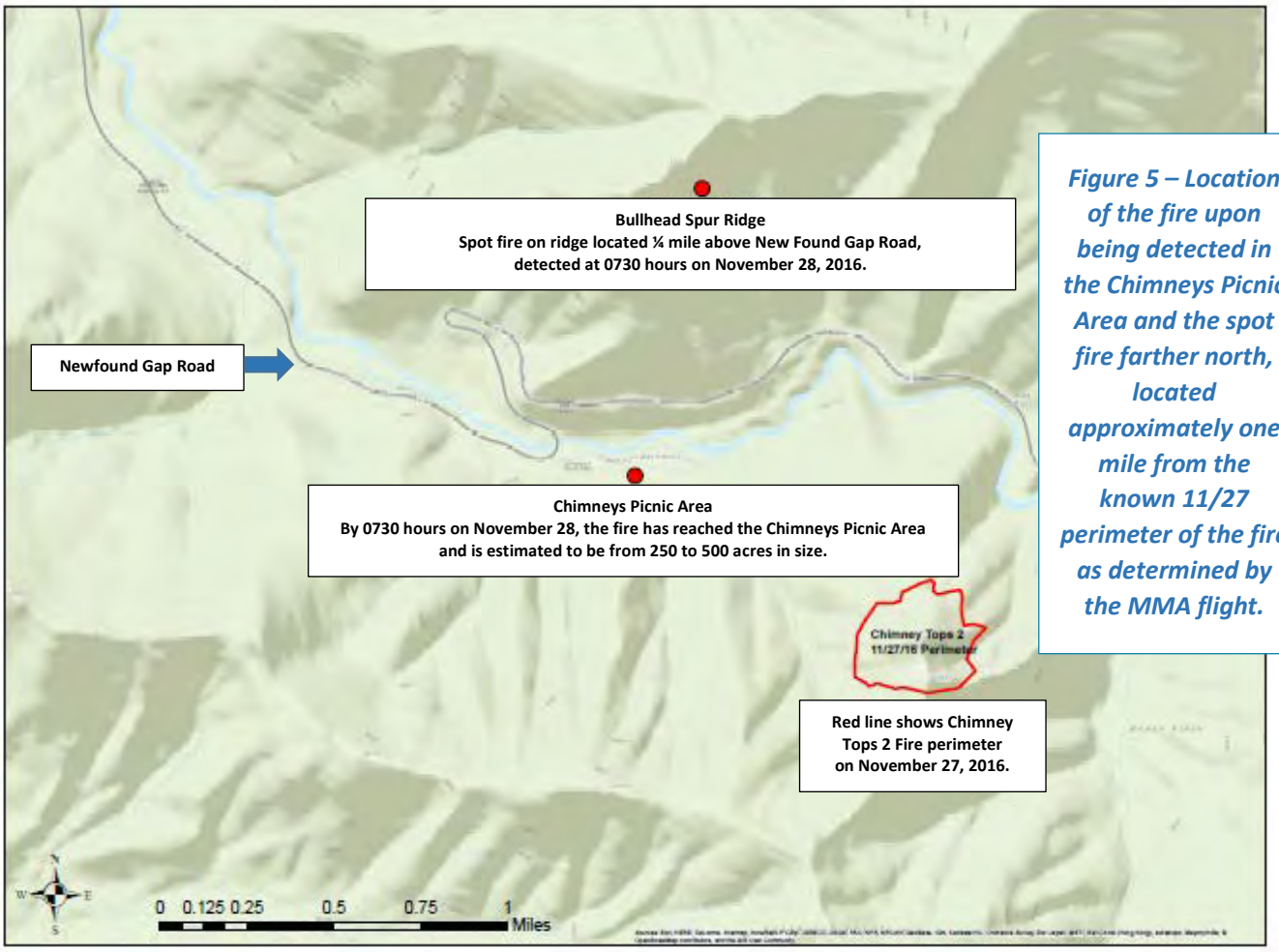


Figure 5 – Location of the fire upon being detected in the Chimneys Picnic Area and the spot fire farther north, located approximately one mile from the known 11/27 perimeter of the fire as determined by the MMA flight.

scene. They observed that the fire had moved or spread in a significant way from the night before. The FMO/IC estimated the fire size to now be 250-500 acres.

Besides observing the fire burning in the picnic area vicinity, the WFM Lead pointed out a spot fire (north on the map) across Newfound Gap Road in the vicinity of Graham Creek. This spot fire was located on a spur ridge south of Bullhead Ridge to the northwest of the main fire front burning on the Chimney Tops.

This group that had gathered at the picnic area (the deputy superintendent, chief ranger, and chief of resource management and science) was joined by the FMO/IC at approximately 0800.

The decision was made on-scene to order a Type 2 incident management team. Afterwards, the deputy superintendent, chief ranger, and chief of resource management and science returned to headquarters to brief the superintendent and the remainder of the park's management team.

At the picnic area, the engines and their crews were using leaf blowers to create fire-holding lines around the picnic area buildings. The FMO/IC scouted the fire and stated that the spot fire was no longer small in size as it had apparently been burning for a while. Size estimates among witness accounts varied due to smoke reducing visibility. These spot fire size estimates ranged from one-half acre to more than 50 acres in size.

More Crews and Incident Management Team Ordered

All information known at this time was that the fire had moved or spread in a significant way from the night before. The FMO/IC had contacted the Tennessee Interagency Coordination Center (TICC) requesting four 20-person fire crews and a Type 2 incident management team. A Type 3 incident management team was close by in Johnson City, Tennessee and could respond by 1800 on that day (November 28). The FMO/IC also ordered this team to respond.

The FMO/IC observed that the winds near the picnic area were blowing down the drainage. It seemed like they were coming from the south, blowing toward the north and northwest. Knowing the fire was now out of the planned containment area, the "box," and north of Newfound Gap Road, the FMO/IC drove back toward park headquarters to get cell phone reception.

While the FMO/IC did not believe that the fire would progress into Gatlinburg, he contacted the captain of the Gatlinburg Fire Department by phone to let him know about this wildland fire and the potential for its smoke to travel to the city.

Fire Reported at Twin Creeks

At about 1100 hours, the FMO/IC recalls hearing a dispatch report of wildland fire in the park near the Twin Creeks Picnic Pavilion, located approximately 1.5 miles from the Gatlinburg city limits. This fire was perceived to be a spot fire from the Chimney Tops 2 Fire. The FMO/IC described the area as being off of Cherokee Orchard Road, which is accessed by driving Newfound Gap Road back into the city and then back east along the road to Twin Creeks, where the road loops back inside the park. This Twin Creeks Picnic Pavilion area inside the park houses a science center, resource management offices, and fire offices.

Upon hearing the report of this fire, the FMO/IC contacted the Tennessee Division of Forestry (TDF) and requested two bulldozers to be dispatched to Mynatt Park, which is a subdivision area within the City of Gatlinburg near the Twin Creeks Picnic Pavilion.

The FMO/IC recalls that Dispatch contacted the Gatlinburg Fire Department asking for a response to the fire as it threatened NPS structures and all NPS fire resources were working around the Chimneys Picnic Area—away from this reported fire. Additionally, the NPS did not have structural equipment or structural firefighting personnel assigned to the park. The park relies on the Gatlinburg Fire Department for structure protection within the park under a written agreement.

In response to this Twin Creeks fire report, the FMO/IC recalls that the Gatlinburg Fire Department sent an engine and that all NPS fire resources were pulled from the Chimneys Picnic Area except one Type 6 engine and three firefighters, plus four persons off the wildland fire module. The remaining NPS resources were redirected to Twin Creeks to assist the Gatlinburg Fire Department. The wildland fire module lead was assigned the role of "Operations Supervisor" as this Twin Creeks incident continued to change and unfold.

Fire is 1.5 Miles from Gatlinburg City Limits

NPS resources remaining at the Chimneys Picnic Area were directed to hold and secure what they had worked on that morning. The engines and their crews were using leaf blowers to create fire lines around the picnic area and restroom buildings.

The FMO/IC requested a 15-person fire crew from the Cherokee National Forest and another engine, which he understood to be three hours away.

During this time, the FMO/IC met and briefed the chief ranger and others and began changing the overall operation to meet these new threats. He also stated that he talked with the Gatlinburg Fire Department captain and it was understood by both the city and the NPS that there was a now a wildfire at Twin Creeks. At this time, the FMO was still the incident commander. He met with the chief ranger, NPS law enforcement officer 1, the Gatlinburg Fire Department captain, as well as others at Mynatt Park in Gatlinburg. At the time, the fire at Twin Creeks (presumed to be a spot fire from Chimney Tops 2 because no other ignition sources were present), was approximately 1.5 miles from the Gatlinburg city limits.

As they waited for other fire resources to arrive at the city park, the FMO/IC learned from Fire Dispatch that the air attack fixed-wing aircraft had arrived at the fire. However, because the wind was too rough, no other air assets could fly and the air attack plane had returned to base.

Because of the new threat to structures and elevated need, the FMO/IC tried to get the air attack resources to return. The FMO/IC stated that while there was no fire within the city limits of Gatlinburg at this time, due to the threats against NPS structures and facilities at Twin Creeks, he made this request. But he was told that the air space was still too rough to fly in due to wind.

Figure 6 – The Gatlinburg Fire Department provides structure protection at Twin Creeks on November 28 at 1436 hours.

At this time, the Gatlinburg Fire Department and NPS fire personnel were being used to defend the structures inside the park boundary. The FMO/IC estimates that these events were occurring between 1100 and 1300 hours.

By no later than 1300 hours, all available resources were gathered and actively working at Twin Creeks. By 1330 hours, the FMO/IC again called and asked for air attack to return, along with additional fire resources. He recalled that the plane attempted to return to the park, but due to extreme wind turbulence, had to abort this second flight half way there—thereby cancelling out any helicopter or fixed-wing aviation assistance.

The Tennessee Interagency Coordination Center (TICC) offered the FMO/IC a Type 1 incident management team. The Type 2 incident management team that had been previously ordered was 4-5 days out. The offered Type 1 team could arrive by 1800 hours the next day, and the park accepted this offer.

The FMO/IC discussed the availability of other Type 1 and Type 2 fire crews, but they were still 12-24 hours away. At that time of year, it can be difficult to receive fire suppression resources due to the seasonal availability of bringing these types of crews together (some fire crews are laid off around the end of September) as well as the distance from where these resources are located (primarily out west).

Increased Winds Push the Fire on an "Intense" Run

The FMO/IC recalled that during this early afternoon period on Monday, November 28, the winds increased at the Mynatt Park subdivision area within the City of Gatlinburg, 1.5 miles from Twin Creeks. The FMO/IC stated that they were now receiving reports of spot fires at least five miles away from the main fire, which was last known to be located at the Chimneys Picnic Area, the Bullhead Spur area north of Newfound Gap Road, and Twin Creeks. Due to the smoke in the area, this was the only fire they could see.

According to the FMO/IC, the fire appeared to have *"bounced from ridge top to ridge top"* from Bullhead to Twin Creeks. He described how it had to have *"jumped road, jumped trails, jumped wet drainages and wide creeks. I mean there was no natural barrier" and "there's no way this stuff could be humanly stopped."* The FMO/IC said the fire *"was moving in so many different directions."* He described the fire behavior as *"very, very intense and very extreme. And then as the day progressed, the winds progressed and increased…through the whole day."*

The FMO/IC described the previously mentioned meeting at Mynatt Park as a unified command structure that occurred at approximately 1230 hours. However, there is some dispute over this description. Other agencies believe that a unified, or a joint command, was never established. The FMO/IC recalls briefing the following persons at that meeting: the Gatlinburg fire chief, the Pigeon Forge (Tennessee) fire chief, the park superintendent, NPS district ranger, Gatlinburg city manager, and city officials.

Multiple Agencies Organize to Defend Mynatt Park Subdivision from Approaching Fire

The purpose of this meeting was to gather external stakeholders and provide current fire information and the potential threat if the fire left the park. The main outcome of this meeting was described as *"a lot of concern, mainly about Mynatt Park"* being voiced. In addition, the Gatlinburg Fire Department had operational concerns because of their continued "mutual aid" response to assist the park with its wildfire and structure defense—now coupled with the growing threats of fire spread within the City of Gatlinburg.

The FMO/IC recalled that the Gatlinburg Fire Department was bringing in "all kinds of apparatus and equipment" to protect the city and adjacent areas. He said those fire officials present were discussing the current situation and potential problems. He described how the Tennessee Division of Forestry had arrived at the Mynatt Park subdivision and were starting structural protection preparation and plowing dozer lines to protect the wildland-urban interface. He described the Tennessee Division of Forestry's capabilities as similar to that of the NPS for wildland fire purposes. Therefore, the Gatlinburg Fire Department took the lead on structure protection—as well as wildland fire suppression, if needed.

According to the FMO/IC, at this time the National Park Service, Tennessee Division of Forestry, and Gatlinburg Fire Department and its cooperators were all actively working together to protect NPS structures, structures within Gatlinburg, and to engage the wildfire as it continued to spread toward the

Mynatt Park subdivision. The fire appeared to be at Twin Creeks, approximately 1.5 miles away from Mynatt Park.[4]

During this meeting, evacuation of the area was mentioned. The FMO/IC states that he recommended that they start voluntary evacuations of the Mynatt Park subdivision area. He said that he did this because he believed this would be the first area to receive the wildfire if it made it out of the park.

After the meeting, they began assigning or reassigning the resources they had. The FMO/IC and a captain with the Gatlinburg Fire Department used a Gatlinburg Fire Department command vehicle to ensure that all NPS and Gatlinburg Fire Department assets could have cross-communications with each other for command purposes. Together, they began looking at the best use of fire assets and where to deploy and use them most effectively.

When asked to describe the weather and wind behavior at that time (1330-1400 hours) the FMO/IC said the winds were blowing around in multiple directions but *"prevailing out of the south."* He explained how the winds would *"squirrel around, drop to the east and then would go to the west."* The FMO/IC said these winds were *"kinda funneled through drainages and around ridges"* with an "*eddy effect*." He described the leaves *"rolling across lawns and through/across streets,"* but said that, overall, the wind had a *"southerly movement [from the south]."*

The FMO/IC described how he and the Gatlinburg Fire Department captain looked at the Mynatt Park subdivision area and where to place fire engines in the neighborhood around the city park nearest the NPS boundary to protect structures if needed. He said that *"the state [Tennessee Division of Forestry] was there"* cutting dozer lines with at least two dozers, supported by a 20-person crew, which was *"doing prep work"* by blowing leaf litter away from structures, moving flammable materials and furniture away from the buildings, and evaluating other things like propane tanks or other hazards.

Actions Taken to Protect Twin Creeks and Mynatt Park in Full Motion by 1330 Hours

The meeting and actions taken to protect the NPS structures and facilities at the Twin Creeks Picnic Pavilion and Mynatt Park subdivision's private structures was in full motion by 1330 hours. The FMO/IC said these actions continued through the early to midafternoon.

The NPS fire resources were divided into two divisions covering a "Mynatt Park Division" and a "Twin Creeks Division." As firefighters began to secure the Twin Creeks structures, they recalled the arrival of additional engines, hand crews, and overhead from an interagency response. All of these assets were working together to protect Mynatt Park and preparing to defend the areas along Cherokee Orchard Road.

The FMO/IC continued to describe the actions taken as a unified command structure. He said that the Gatlinburg Fire Department remained committed to defending all structures in cooperation with the fire assets (NPS/Tennessee Division of Forestry) working on the wildfire issues. However, the fire chief of the Gatlinburg Fire Department and the fire chief of the Pigeon Forge Fire Department recall the organization as being "independent efforts" rather than a "unified command."

[4] By this stage, the Chimney Tops 2 Fire had been converted to a Type 3 complexity fire even though no complexity analysis was done to determine this, or the need for the Type 2 incident management team that the park had ordered. The Type 1 team was the closest team available. The FMO, who had been the Type 4 IC, continued as the Type 3 IC at this point. The park was working under an "all-hazard" organization within the boundaries of the park.

During the FMO/IC interview, he referred to a giant map on the Little River Ranger Station wall for reference in describing actions taken that afternoon.

According to the FMO/IC, together he and the Gatlinburg Fire Department captain continued for *"about a four-hour"* timeframe evaluating threats/issues and assigning/reassigning fire assets to protect life and property at the Mynatt Park subdivision area.

Knowing that additional firefighting resources were arriving and waiting for him at NPS headquarters, the FMO/IC returned to park headquarters at approximately 1500 hours. The Gatlinburg Fire Department captain remained on scene working with NPS fire resources under the wildland fire module lead's supervision, as well as with the Tennessee Division of Forestry resources.

When the FMO/IC arrived at park headquarters, he briefed and provided radio communications for the additional fire resources who had assembled there. After being briefed, these firefighters were dispatched to assist the other city, state, and NPS resources at Mynatt Park within the city limits of Gatlinburg. The FMO/IC later confirmed that the entire operation to protect Mynatt Park occurred from approximately 1330 to 1730 hours on November 28.

Fire Suppression Resources Continue to Protect Chimneys Picnic Area

The FMO/IC stated that during this time, the other fire suppression resources (one NPS Type 6 engine, one BIA Type 6 engine with crew, and four other firefighters off the wildland fire module) were still working at the Chimneys Picnic Area.

These resources were eventually cut off along Newfound Gap Road to the north due to continued fire spread and trees falling onto the highway.

These fire assets were supposed to have responded to Gatlinburg to assist the others. They therefore could not reach park headquarters or Gatlinburg via Newfound Gap Road to the north.

Figure 7 – Photo (looking south) taken on Newfound Gap Road approximately two miles south of park headquarters on November 28 at 1657 hours.

The FMO/IC said that these Chimney Tops firefighters and engines were eventually able to leave the area via Newfound Gap Road to the south. They travelled to Cherokee, North Carolina via Newfound Gap. Once reaching Cherokee, the FMO/IC believes they drove through the park and reached Gatlinburg from the north later in the evening[5]. They were not in constant radio communication with other fire resources—including the IC—during this time.

Figure 8 – Great Smoky Mountains National Park wildland fire module conducts burnout operations in the Twin Creeks area off Cherokee Orchard Road to protect park structures on November 28 at 1506 hours.

Fire Now Threatens Park Headquarters, Park Visitor Center, and Various NPS Structures

Sometime after 1700 hours or later, the FMO/IC received information that the wildfire had now pushed west along Newfound Gap Road toward park headquarters inside the park south of Gatlinburg. A decision was made to evacuate park headquarters and prepare the facilities and structures for the fire front.

Crews moved vehicles away from structures, secured the park visitor center and maintenance facilities, and evacuated people from the structures, including park housing. Everyone was evacuated to the north using Newfound Gap Road to Gatlinburg by way of the highway, or by the bypass route around the city.

At approximately 1800 hours, as people were moving out, the FMO/IC heard a call that the fire had crossed Newfound Gap Road north of park headquarters, had also jumped the Little Pigeon River, and was headed toward the Ski Mountain area.

The FMO was still functioning in the role of incident commander at this stage. The incoming Type 1 incident management team would not arrive until the next day. The Type 3 incident management team that was enroute would be cut off by the fire and never make it to Gatlinburg that day.

The FMO/IC called the Gatlinburg Fire Department captain by phone and advised him of the NPS evacuations. He also informed him of the added fire threat—believing fire to be on both sides of Newfound Gap Road and headed toward the Ski Mountain area.

Structures are Burning in Gatlinburg

During this time, the FMO/IC first learned that there were now structures in Gatlinburg that were burning from multiple ignition sources apart from the CT2 fire, as confirmed by 9-1-1 logs.

The FMO/IC recalls that at least three structural engines arrived, plus the NPS Type 6 engine was on hand to help direct protection efforts. All other NPS firefighters and engines, less the one engine at park

[5] After these resources left the Chimneys Picnic Area, they were not in radio communication the entire time with the FMO/IC or other fire resources until they reappeared in Gatlinburg and found NPS resources to tie-in with at that time, several hours later.

headquarters, were “scattered out” or deployed working on fire protection or suppression tasks at Twin Creeks Picnic Pavilion, Airport Road, and Cherokee Orchard.

The Delegation of Authority (see Appendix 1) directed the Review Team to examine and review the Chimney Tops 2 Fire from when it began on November 23 through when the fire left Great Smoky Mountains National Park at approximately 1800 hours on November 28—when multiple wildland fires were burning throughout Gatlinburg as confirmed from 9-1-1 calls reporting fires starting.

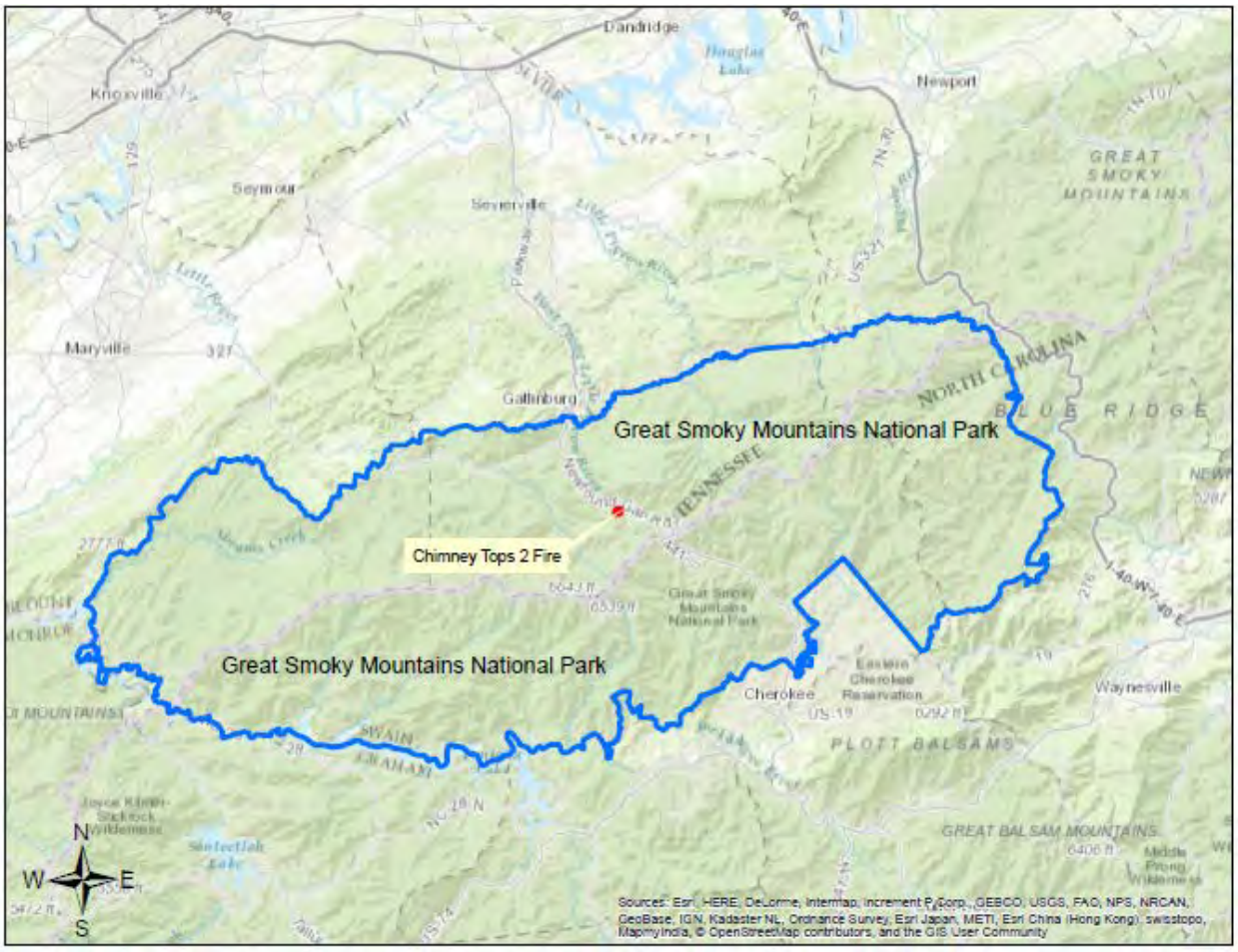


Figure 9 – Area map showing Great Smoky Mountains National Park and the original location of the Chimney Tops 2 Fire.

4. Readiness Evaluation

Special Constraints

While the following "Special Constraints" are not specifically addressed in the Great Smoky Mountains National Park Fire Management Plan, they are listed within the park's Wildland Fire Decision Support System (WFDSS) under "Management Requirements." These "Special Constraints" are:

- No heavy equipment is allowed for fire line construction without prior approval, in writing, by the Superintendent.
- All wildland fire management activities within the boundaries of Great Smoky Mountains National Park will adhere to Minimum Impact Suppression Tactics (MIST).
- All fire management operations will consider Wilderness as a value to be protected during their planning and implementation.
- Avoid adverse impacts to special-status species and their habitat from fire management activities, unless cleared in advance through the appropriate regulatory process.
- Off-road vehicle use is not allowed without prior approval, in writing, by the Superintendent.
- Protect cultural resources, particularly archeological sites that may be damaged by fire line construction and other operational activities.

In September 2016, the park fire management officer (FMO) had discussions with the deputy superintendent about the use of dozers within the park and obtained permission to use them if the need arose. While the park follows the practice of MIST, the direction of the deputy superintendent on the Chimney Tops 2 Fire was full suppression.

Planning Status – Fire Management Plan

The park's fire management plan (FMP) was completed with final approving signature in August 2010. Annual updates had been completed with the exception of 2016. The 2016 annual update paperwork was completed in the fall of 2016, but remained under review by the park superintendent. The fire management plan is consistent with NPS policy. Its programmatic goals are:

1. Protect human life, communities, and resources from the adverse effects of wildfire without compromising safety.
2. Maintain and restore fire-adapted ecosystems using appropriate tools and techniques in a manner that will provide sustainable, ecological and social benefits.
3. Integrate knowledge generated through fire and natural resource research into fire management priorities, decisions and actions.
4. Integrate fire as a natural process into the park's ecosystem to the fullest extent possible.
5. Communicate and coordinate with interagency organizations and other stakeholders to pursue common goals, programs and projects.
6. Build and promote organizational effectiveness by building program capacity, leadership, and effective management practices.

Two Fire Management Units

Great Smoky Mountains National Park is divided into two fire management units (FMU) (see map on next page). FMU 1 is the interface zone. It is generally contiguous with the park boundary and developed areas within the park, representing approximately 17 percent of the park's lands. FMU 1 would be characterized as a "Protection Zone" where all fires are suppressed and resource benefit is not a consideration.

FMU 2 is the "Natural Zone" that comprises 83 percent of the park's lands. Naturally-caused fires in this zone will be evaluated for suitability for using the fire to the benefit of the resource. All human-caused fires will be suppressed in this zone.

The management of unplanned ignitions has two goals: the protection of communities and assets and the conservation of natural resources. In addition, the fire management plan clearly states that the initial action on human-caused wildfires will be with the objective of suppressing the fire at the lowest cost with the fewest negative consequences regarding firefighter and public safety.

Organizational Roles and Responsibilities

The organizational roles and responsibilities of wildland fire in the fire management plan are atypical. The park's chief of resource management and science supervises the fire management officer (FMO). However, the duties of wildland fire response falls under the chief of visitor and resource protection. The dual supervision of fire management activities may result in a lack of clarity in certain situations such as extended fire events and escaped prescribed burns.

Under the park's organizational chart, the chief of resource management and science directly supervises the FMO. In this role, the chief of resource management and science directs the staff functions of fire management through the FMO. In addition, this position also serves as the chair of the Fire Management Committee and coordinates and oversees all aspects of the park's prescribed fire program.

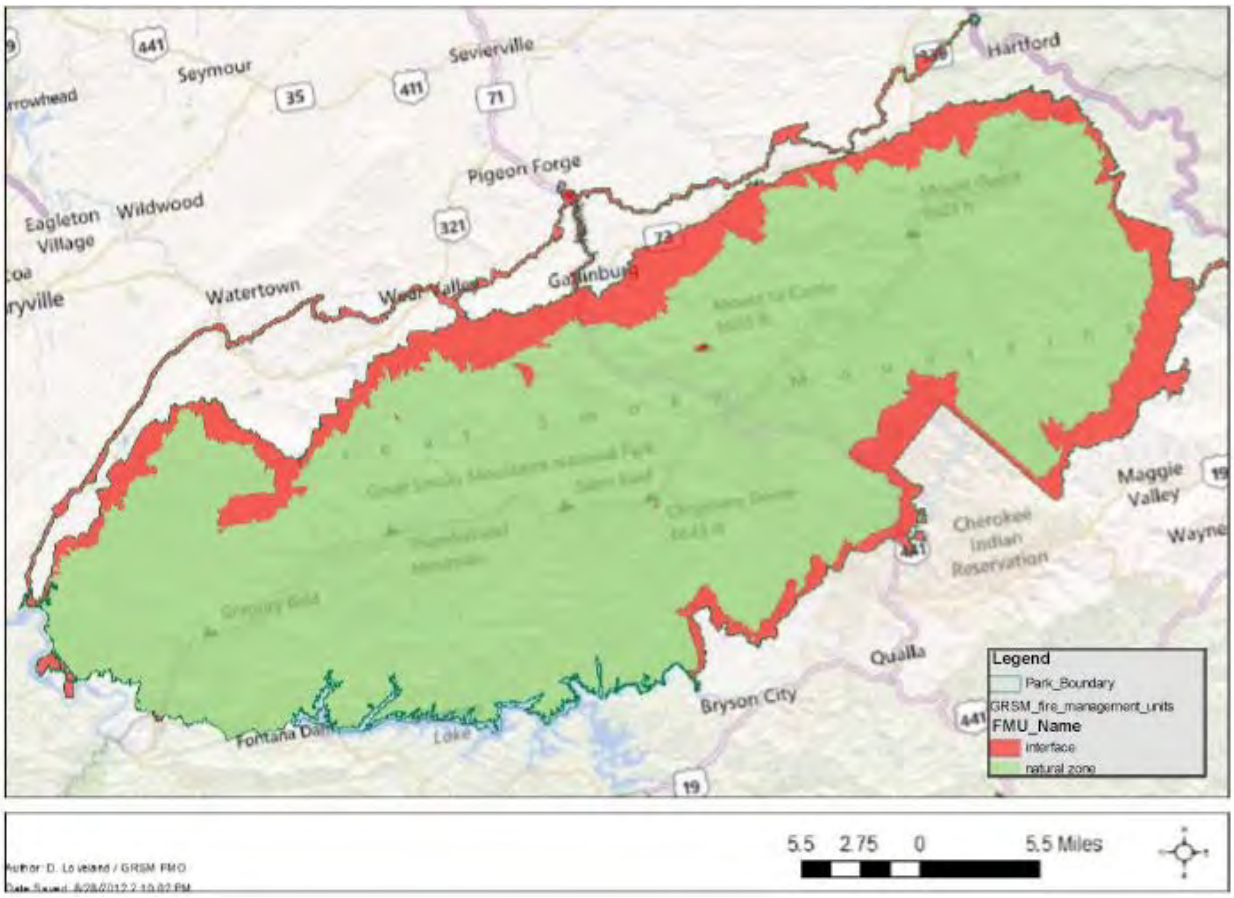
The chief of visitor and resource protection coordinates initial attack to wildland fires with the FMO and ensures that park staff are prepared and qualified to perform wildland fire duties.

The fire management plan identifies that law enforcement is responsible for all initial attack in the park. Currently, one person in park law enforcement has Type 5 Incident Commander (ICT5) qualifications, and no one else in park law enforcement has qualifications above Type 2 Firefighter (FF2). Typically, law enforcement personnel respond to fires by notifying the FMO that a fire exists and then stands by until resources are on scene.

Planning Status – Pre-Planning

Two park boundary assessments were completed in the past 25 years for the purposes of assessing potential numbers of structures at risk from wildland fire in proximity to the park. These assessments were completed by the Student Conservation Association. The first, conducted in 1995, identified 277 structures to be at risk from wildland fire. The second park boundary assessment project was funded in 2004. No property values were identified with these assessments.

Great Smoky Mountains National Park – Fire Management Units



A structure assessment was conducted in 2005 in the following areas: Hidden Hill/Greenbrier Cluster, Roaring Fork Glades Cluster, Ski Mountain Cluster, and Gatlinburg Cluster. These reports provided recommendations and addressed: escape routes, narrow roads, defensible space, removal of dead leaves and debris from roofs and gutters, and the replacement of wood shingles with fire resistant roof covering. There were no property values or total number of properties given in this assessment. The review team determined that the Gatlinburg Fire Department was not aware of these reports.

Preparedness Plan

The park has a Wildland Fire Preparedness Plan, which is to be updated annually with the reviewing of the fire management plan. However, the Wildland Fire Preparedness Plan's content is outdated as described below.

The plan specifies that the chief of visitor and resource protection position is responsible for providing the initial response to wildfires within the park. It further states that the park's district rangers will ensure a qualified Type 5 Incident Commander (ICT5)[6] or higher is available for initial attack. At the time of the Chimney Tops 2 Fire, one person in park law enforcement had Type 5 Incident Commander (ICT5) qualifications.

Furthermore, the ranger workload/span of control prohibits the maintenance or acquisition of fire qualifications necessary to run initial attack. Since the approval of the fire management plan, dramatically increased law enforcement ranger workloads related to declining staff numbers and record visitation, have eroded the capacity to maintain or acquire ICT5-level fire qualifications. Moreover, this hinders law enforcement's ability to respond collaterally as part of an initial attack group.

Preparedness Review

In July 2016, the park's fire management officer conducted a "Preparedness Review." This review included the completion of the following checklists:

- Agency Administrator. (The Agency Administrator did not participate with the FMO to complete this checklist. The FMO completed it alone without input from the Agency Administrator.)
- Fire Management Administration.
- Cache, Facilities.
- Individual Firefighter.
- Engines.
- Fire Program Management Assistant (FPMA).

The superintendent/deputy superintendent at the time of Chimney Tops 2 Fire had not attended the "*Fire Management Leadership"* course. Both individuals were scheduled to attend the course in the fall of 2016, but the course was cancelled. The required timeframe for both individuals to attend the course is two years from time of appointment; both the superintendent and deputy were within this window.

[6] A Type 5-complexity fire is typically terminated or concluded within a short time once resources arrive on scene. Minimal staffing is required; resources may vary from 2-6 firefighters total. There are minimal effects to the population immediately surrounding the incident. It is the lowest level complexity fire rating in the Incident Command System.

Prevention

The objectives of the park's fire prevention program are to: proactively mitigate damages and losses from unwanted wildfires; reduce human-caused ignitions; reduce suppression costs; mitigate the risks of wildfire to private property and natural and cultural resources; and to protect the lives of firefighters and the public.

This is accomplished by working with cooperating agencies and educating park employees, the public and neighbors, not only in fire prevention but also in the natural role of fire in the Appalachian Mountains. At this time, a formal fire prevention plan has not been developed.

The National Park Service's RM-18, Chapter 6 requires a prevention plan for any park that experiences 25 or more human-caused wildfires per 10-year period. If this standard is met, the park is required to conduct a wildfire prevention analysis and prepare a wildfire prevention plan. The Great Smoky Mountains National Park meets the RM-18 requirement for a wildfire prevention plan.

This hyperlink provides access to the Great Smoky Mountains National Park Fire Management Plan (the fire prevention section is located on pages 54-57):

http://go.nps.gov/GRSM-FMP.

Seasonal Severity

Fire seasonal "severity funding" is defined in the *2016 Interagency Standards for Fire and Fire Aviation Operations* as: "The authorized use of suppression operations funds (normally used exclusively for suppression operations and distinct from preparedness funds) for extraordinary preparedness activities that are required due to:

- FMP [Fire Management Plan], FDOP [Fire Danger Operating Plan], or Annual Operating Plan criteria that indicate the need for additional preparedness/suppression resources. The plan(s) should identify thresholds for severity needs;
- Anticipated fire activity that will exceed the capabilities of local resources;
- Fire seasons that either start earlier or last longer than identified in the Fire Danger Operating Plan;
- An abnormal increase in fire potential or danger not planned for in existing preparedness plans.

On November 4, 2016, a request for seasonal severity funding was sent to the regional fire operations specialist from the Great Smoky Mountains National Park fire management officer.

This request describes and documents the unusual drought, the high local and regional fire occurrence, and the need for bolstering the fire staff to meet the staffing Class 4 of the Step-Up Plan. The amount requested was $74,819. There is no evidence that the park agency administrator reviewed or approved the severity request prior to it going to the regional office.

On November 10, 2016, the regional fire management officer approved the severity request for the full amount. The funds were used to extend the hours of the park fire staff. The additional resources ordered consisted of two firefighters and a Type 6 engine.

The severity request did not identify using funds to bring in additional operational resources, prevention resources, or a duty officer. The intent of additional resources is to provide relief for park resources, which had been working extended hours since early in the fire season. (For severity request documentation, see Appendix 4.)

Fire Complexity Analysis

On Friday November 25, the Fire Management Officer/Incident Commander (FMO/IC) completed one *Wildland Fire Risk and Complexity Analysis* (for Type 5, 4 and 3 incidents). A majority of the items were rated "Moderate" (11 out of 15) for which the "Recommended Organization" is Type 3. In his discretion, the FMO kept the organization at a Type 4 and wrote the following justification:

> "*The fire is small with low potential to make a significant run as it is on top of a mountain and can only back down slope, with lower fire intensity and behavior. Type 4 organization sufficient."*

The organization on the fire remained at the Type 4 level until the morning of Monday, November 28. At 0730 hours on that day, a Type 3 organization was created using the park fire staff; however, no additional supporting complexity analysis was completed.

On November 25, elements in the completed complexity analysis were underrated for the conditions that existed—which reflected the lack of awareness regarding actual conditions on the ground. The complexity analysis-recommended organization was a Type 3. The park FMO justified lowering to a Type 4 organization (see above for his justification statement). Park senior leadership did not participate in this complexity analysis process.

While it is not required to complete a complexity analysis with additional leadership participation, such involvement likely results in a more complete picture of a wildland fire. No new complexity analysis was completed when the decision was made to order a Type 2 incident management team on Monday November 28. (See a full complexity analysis in Appendix 5.)

Delegation of Authority/Agency Administrator Briefing

The Applachian-Piedmont Zone fire management officer (AP Zone FMO)[7] is responsible for fire management activities under the authority conferred and defined by two instruments (described below). The AP Zone FMO is also the FMO for Great Smoky Mountains National Park, which is part of the AP zone.

First Instrument

The first instrument is the 2016-2021 Inter-Park General Agreement between the Applachian-Piedmont Fire Management Zone (AP FMZ) that is duty-stationed at Great Smoky Mountains National Park, and 20 NPS units. Great Smoky Mountains National Park and 19 NPS units, referred to as satellite parks, comprise these 20 NPS units under the AP FMZ. These 20 parks in the AP FMZ are managed by 15 superintendents who, along with the AP Zone FMO, are listed as signatories.

While agreement nomenclature regarding satellite parks, Great Smoky Mountains National Park, and the AP FMZ is inconsistent, the abbreviations legend defines the AP FMZ as including: *"Great Smoky Mountains National Park and the nineteen parks, referred to collectively as the satellite parks, and individually listed as parties to this Agreement".*

The 2016-2021 inter-park agreement was signed by the Great Smoky Mountains National Park superintendent and the AP Zone FMO on June 14, 2016. This agreement has two primary objectives:

[7] The AP Zone FMO is responsible for the fire program at Great Smoky Mountains National Park and is stationed at this park.

1. To establish and define services that the AP FMZ staff will provide to the 19 satellite parks in the AP FMZ; and

2. Clarify fire management activities that are the responsibility of the satellite parks. The statement of services defines that Great Smoky Mountains National Park serves as the hosting duty station, providing office space, administrative support and direct supervision of the AP Zone FMO by the park's chief of resources.

Services the AP Zone FMO will provide to AP FMZ parks include the provision of Type 3, 4, and 5 incident commanders/agency representatives. When Type 1 or Type 2 incident management teams are required, the AP Zone FMO will coordinate with the affected AP FMZ park superintendent in developing an incident-specific Delegation of Authority.

Second Instrument

The second instrument(s) is the annual park-specific Delegation of Authority, in which each park superintendent provides more detailed information, actions and responsibilities of the Zone FMO for an individual park unit of the AP FMZ.

In the case of Great Smoky Mountains National Park there are two iterations of an annual delegation. The first, included in the form of an article in the body of the 2016-2021 Inter-Park agreement, was signed by the Great Smoky Mountains National Park superintendent and the Zone FMO on June 13, 2016. It includes broad categories of responsibilities. This form is available to any of the 15 AP FMZ superintendents.

The second annual delegation, entitled "Great Smoky Mountains National Park – Annual Delegation of Authority for Fire Management" is a separate document, signed by the park's superintendent and Zone FMO on July 6, 2016, and is specfic to Great Smoky Mountains National Park fire management activities and expectations.

The inter-park agreements are part of the review team documentation package. (They cannot be electronically linked to this report.)

Incident Commander Roles

On the Chimney Tops 2 Fire, the park's fire management officer did not follow the direction of the fire management plan to staff with duty officers and additional support functions. The park's leadership did not ensure that the fire management plan was followed.

Per policy, as defined in the *2016 Interagency Standards for Fire and Fire Aviation Operations* (Redbook), a duty officer will not fill any Incident Command System (ICS) functions connected to any incident. On this incident, the park's FMO operated in three roles: as the duty officer, the incident commander, and the fire management officer —contrary to 2016 Redbook policies.

Step-Up Plan

The Step-Up Plan is best described as a wildland fire preparedness plan, which specifies when fire danger increases. (See Appendix 3 for a detailed Step-Up Plan description.) The park identifies additional measures and staffing needs that must be taken to provide appropriate response to wildland fires. The park's Step-Up Plan was compared to actions taken on the Chimney Tops 2 Fire from November 23 through November 28. The following is a breakdown from the actions taken to meet the provisions in the plan. The review team questioned whether the Step-Up Plan on Staffing Class 4 (SC4) and Staffing Class (SC5) were adequate for the fire potential that exists within the park.

November 23rd forecast indices for Cherokee RAWS (Remote Automated Weather Station) was Burning Index (BI) 46; Staffing Class 5; and Indian Grave RAWS indices were BI 36 and Staffing Class 4.

1. Management actions were not in place: Duty officer and daily incident planning meeting were not implemented.
2. Support functions were not fully initiated. The plan calls for establishing expanded dispatch, expanding logistical support and determining availability/status of collateral duty and AD employees. The park did not fully meet the plan, however all logistical support was met for the firefighters by on-duty park staff. The park utilized expanded dispatch in the Tennessee Interagency Coordination Center (TICC).
3. Daily coordination of available resources with other agencies was not conducted with the Tennessee and North Carolina Divisions of Forestry, Cherokee Bureau of Indian Affairs (BIA), and Cherokee National Forest.

November 24th forecast indices for Cherokee RAWS was BI 44, Staffing Class 5; and Indian Grave RAWS indices were BI 60, Staffing Class 5.

1. Management actions were not in place: Duty officer and daily incident planning meeting were not implemented.
2. Support functions were not fully initiated. The plan calls for establishing expanded dispatch, expanding logistical support and determining availability/status of collateral duty and AD employees. The park did not fully meet the plan, however all logistical support was met for the firefighters by on-duty park staff. The park utilized expanded dispatch in TICC.
3. Daily coordination of available resources with other agencies was not conducted with the Tennessee and North Carolina Divisions of Forestry, Cherokee Bureau of Indian Affairs (BIA), and Cherokee National Forest.

November 25th forecast indices for Cherokee RAWS was BI 32, Staffing Class 4; and Indian Grave RAWS indices were BI 5, Staffing Class 1.

1. The trace amount of rain the day before had reduced the BI thus reducing the Staffing Class to a 1 for Indian Grave RAWS. The BI did not reflect the fire danger that existed in the area.
2. Management actions were not in place: Duty officer and daily incident planning meeting were not implemented.
3. Support functions were not fully initiated. The plan calls for establishing expanded dispatch, expanding logistical support and determining availability/status of collateral duty and AD employees. The park did not fully meet the plan, however all logistical support was met for the firefighters by on-duty park staff. The park utilized expanded dispatch in TICC.
4. Daily coordination of available resources with other agencies was not conducted with the Tennessee and North Carolina Divisions of Forestry, Cherokee Bureau of Indian Affairs (BIA), and Cherokee National Forest.

November 26th forecast indices for Cherokee RAWS was BI 25, Staffing Class 3; and Indian Grave RAWS indices were BI 19, Staffing Class 3.

1. Management actions were not in place: Duty officer and daily incident planning meeting were not implemented.
2. Support functions were not fully initiated. The plan calls for establishing expanded dispatch, expanding logistical support and determining availability/status of collateral duty and AD employees. The park did not fully meet the plan, however all logistical support was met for the firefighters by on-duty park staff. The park utilized expanded dispatch in TICC.
3. Daily coordination of available resources with other agencies was not conducted with the Tennessee and North Carolina Divisions of Forestry, Cherokee Bureau of Indian Affairs (BIA), and Cherokee National Forest.

November 27th forecast indices for Cherokee RAWS was BI 40, Staffing Class 5; and Indian Grave RAWS indices were BI 38, Staffing Class 4.

1. Management actions were not in place: Duty officer and daily incident planning meeting were not implemented.
2. Support functions were not fully initiated. The plan calls for establishing expanded dispatch, expanding logistical support and determining availability/status of collateral duty and AD employees. The park did not fully meet the plan, however all logistical support was met for the firefighters by on-duty park staff. The park utilized expanded dispatch in TICC.
3. Daily coordination of available resources with other agencies was not conducted with the Tennessee and North Carolina Divisions of Forestry, Cherokee Bureau of Indian Affairs (BIA), and Cherokee National Forest.

November 28th forecast indices for Cherokee RAWS was BI 38, Staffing Class 4; and Indian Grave RAWS indices are not available.

1. Management actions were not in place: Duty officer and daily incident planning meeting were not implemented.
2. Support functions were not fully initiated. The plan calls for establishing expanded dispatch, expanding logistical support and determining availability/status of collateral duty and AD employees. The park did not fully meet the plan, however all logistical support was met for the firefighters by on-duty park staff. The park utilized expanded dispatch in TICC.
3. Daily coordination of available resources with other agencies was not conducted with the Tennessee and North Carolina Divisions of Forestry, Cherokee Bureau of Indian Affairs (BIA), and Cherokee National Forest.

Agreements

A Memorandum of Understanding (MOU) exists between the Great Smoky Mountains National Park and the Gatlinburg Fire Department. This MOU establishes the terms and conditions under which mutual assistance will be provided.

The MOU provides the Great Smoky Mountains National Park's fire management staff to assist the Gatlinburg Fire Department in fire suppression operations outside the park. It states that the Gatlinburg Fire

Department will provide structural fire suppression for the structures located inside the park within the Gatlinburg fire response area of the park. Under the terms of this MOU, when requested, the Gatlinburg Fire Department will also assist with fire suppression inside the park.

Other Great Smoky Mountains National Park MOUs have been established with the following agencies and fire departments: North Carolina Division of Forest Resources, U.S. Fish and Wildlife Service, Tennessee Department of Agriculture - Division of Forestry, Bureau of Land Management, U.S. Department of Agriculture, Wears Valley Volunteer Fire Department, Grassy Fork Volunteer Fire Department, Pittman Center Volunteer Fire Department, Pigeon Forge Fire Department, Stecoah Volunteer Fire Department, Bryson City Volunteer Fire Department, Blount County Fire Department, Townsend Area Volunteer Fire Department, and West Swain Volunteer Fire Department.

From the perspective of the Gatlinburg fire chief, the MOU covers the required legal issues; however, they do not address the cost associated with providing service within the park, which represents several hundred calls for services every year.

Great Smoky Mountains National Park provides wildland training when requested and if fire staff from the park is available. From the NPS perspective, training is offered frequently. However, from the Gatlinburg Fire Department's perspective, this training is offered when the NPS is able and less frequent.

Interagency Coordination

Great Smoky Mountains National Park has agreements with the City of Gatlinburg but the two agreements had never been tested to the degree that the Chimney Tops 2 Fire required.

The City of Gatlinburg additionally has the ability to activate a statewide mutual aid response in response to an incident through Tennessee Emergency Management. This occurred during the Chimney Tops 2 Fire on November 28. This allowed for response from cities, counties, and the state resources to be mobilized and support protection efforts in Gatlinburg once the fire left the park and merged with other fires.

However, the interagency coordination aspect of these MOUs has some deficiencies that come from a lack of experience with events such as the magnitude of the Chimney Tops 2 Fire. Never before in park history had the park leadership or the park fire management officer experienced a fire that required such efforts.

This lack of previous experience with such an unusual event left both parties to the agreement with differing perceptions on how well this coordination worked on this incident. For instance, the Great Smoky Mountains National Park felt that a unified command was implemented once all of the key players met at Mynatt Park around noon on November 28. However, the city's perspective was this meeting was not an attempt to unify command. The city's take away was *"the fire is coming out of the park and this is where they think it will hit first."*

There was coordination between the departments following discovery of the Twin Creeks fire. Beginning at approximately 1200 hours, park and city officials met at Mynatt Park to establish command for both organizations. Command was co-located at the Gatlinburg's Incident Command Post. The movement of structural fire units under Gatlinburg's control, as well as the state and federal wildland units controlled by the NPS, was being coordinated together by the FMO/IC and Gatlinburg Fire captain who remained physically together most of the afternoon.

In addition, communication on this incident proved problematic with the interagency coordination because Gatlinburg Fire Department operates on a UHF radio system and the Great Smoky Mountains National Park

operates on a VHF system. Neither the Gatlinburg Fire Department nor the Great Smoky Mountains National Park fire staff have the ability to operate on the other's radio system.

Some National Park Service law enforcement officer vehicles have the ability to operate on the local UHF system.

The cellular telephone system also went down during this incident. The Gatlinburg Fire Department lost their VOIP phone system (transmitting calls over an IP or internet connection) as a result of the fire.

Personal communication was also problematic on this incident. Though the park issued daily information releases regarding the fire, the city did not feel they had any direct advance communication from the National Park Service regarding this fire, what it was doing or what actions were being taken—including on the morning of November 28 when the park realized that the fire had moved across Newfound Gap Road. Attempts to notify the city beyond press releases were made by the superintendent at 1016 hours and the FMO/IC at 1038 hours. Just prior to discovery that the fire had moved several miles towards Gatlinburg, the superintendent and chief ranger met with officials at Gatlinburg Fire headquarters.

5. Management Evaluation

Personnel Qualifications and 2016 Redbook Position Requirements

The Great Smoky Mountains National Park fire management officer (FMO) is a qualified Type 3 Incident Commander (IC).

When the Chimney Tops 2 Fire transitioned from a Type 4 incident to a Type 3 incident on November 28, the FMO maintained command from Incident Commander Type 4 to Incident Commander Type 3.

The park's wildland fire module lead, who ultimately was assigned as operations chief when the fire transitioned to a Type 3 incident, is a qualified division supervisor, which qualifies him to be in this position.

The review team did not find any violations of ICS qualifications during the fire.

The *2016 Interagency Standards for Fire and Aviation Operations* (Redbook) policy requires that a duty officer and an incident commander do not hold concurrent positions. A duty officer cannot hold an ICS position and an Incident Commander cannot hold concurrent management duties such as FMO. On this incident, the FMO at Great Smoky Mountains National Park was operating in three roles as the duty officer, incident commander, and fire management officer, which is contrary to 2016 Redbook policies.

Wildland Fire Decision Support System (WFDSS)

The Wildland Fire Decision Support System (WFDSS) is a web-based decision support system that provides a single dynamic documentation system for use beginning at the time of the fire's discovery and concluding when the fire is declared out.

WFDSS allows the agency administrator to: describe and analyze the fire situation, develop incident objectives and requirements, develop a course of action, evaluate relative risk, complete an organization assessment, document the rationale, and publish a Decision.

A Published Decision documents:

- Incident management strategies, which follow policy and approved land/resource management plans.
- Estimated costs for the duration of the incident.
- All affected jurisdictions that participated in the decision process and concurred with the strategies selected.
- That agency administrator(s) has reviewed and approved the decision and the framework for the actions to be performed under the Delegation of Authority, which authorizes an incident commander to operate on a specific unit(s).

All fires will have a Published Decision within WFDSS when they:

- Escape initial attack; or
- Exceed initial response; or
- Include objectives with both protection and resource benefit elements consistent with land management planning documents.

The park superintendent and the fire management officer, per the 2016 Redbook policy, are required to ensure the development of Published Decisions within WFDSS with local unit staff specialists for all fires that exceed initial attack or are being managed for multiple objectives—within the objectives and requirements contained in the park's fire management plan.

In the Great Smoky Mountains National Park Fire Management Plan (FMP) direction is given that WFDSS, or equivalent, will be used on each wildland fire to document the decision-making process and outline the strategy and tactics employed. The level of decision support documentation will depend on the fire response level.

Additionally, in the Great Smoky Mountains National Park FMP, direction is given that after the fire's size-up and planned strategy and tactics are determined by the Incident Commander, that information will be relayed to the fire management officer (FMO) or fire duty officer (FDO) who will initiate the WFDSS documentation process and notify the Fire Management Committee. The Fire Management Committee shall review the WFDSS documents for recommendation to the agency administrator (park superintendent or acting) for approval.

In the park's FMP, "extended attack" occurs when objectives have not been met in the case of initial fire response. Extended attack action requires a structured decision process (WFDSS) to guide the ongoing effectiveness and reevaluation of suppression strategies.

If park staff is managing a fire, the incident commander, with assistance from the FMO and/or the FDO, will perform and document this periodic assessment.

Situations that could require selection of a new strategy through the WFDSS analysis include but are not limited to:

- Exceeding periodic assessment criteria (i.e. trigger points, air quality);
- Unacceptable risk to firefighter safety, natural or cultural resources, improvements;
- Fire leaving or threatening to leave the Maximum Manageable Area boundary or park boundary;
- Fire exceeds prescribed fire plan;
- Increasing demand on local and/or national fire management situation;
- Agency administrator prerogative.

The following direction appears in the National Park Service Reference Manual 18:

"Parks will use the current decision support process (e.g. Wildland Fire Decision Support System, WFDSS) to guide and document wildfire management decisions. The process will provide situational assessment, analyze hazards and risk, define implementation actions, and document decisions and rationale for those decisions.

When a wildfire is burning on National Park Service lands and adjoining jurisdictions, a single interagency decision support document should be prepared with input from all jurisdictional agencies.

Approval of the decision to manage a wildfire and the resulting course of actions to be taken to achieve management goals is the responsibility of the park superintendent and will be published in a decision support document. Approval of each successive decision is based on current approval

requirement guidelines and thresholds as defined in the 2016 Interagency Standards for Fire and Fire Aviation Operations."

On the Chimney Tops 2 Fire, WFDSS was utilized to update acreage beginning on November 25 at 0758 hours through November 28 at 0550 hours. A Relative Risk Assessment was completed on November 28 at 1717 hours. The first Published Decision by park staff (deputy park superintendent) was on December 5 at 1825 hours.

The park leadership was unaware of 2016 Redbook requirements that WFDSS be applied to all fires within park boundaries. The deputy superintendent stated that WFDSS was only used when a Type 1 incident management team was brought in. No one in the agency administrator role has training in WFDSS.

Although WFDSS was never utilized for decision support, there were two four-day Near Term Fire Behavior (NTFB) runs done by a geospatial analyst (GSAN) on Saturday November 26. No analyses were made on November 27. One of the two NTFB runs was shared with the park fire management officer/incident commander (FMO/IC) who stated that he was able to view the product on the morning of November 27. When asked what he thought of the model and what his intentions were with this information, he stated: *"I did not place a lot of weight on the information. I was still convinced that we could find places to go direct on the fire as it backed down the mountain and that was the strategy for the day."* When asked when this information was shared about the Near Term Fire Behavior run with the deputy park superintendent, the FMO/IC stated: *"Much later, maybe the 29th or 30th. I can't remember the exact date/time."*

Public Information

[The information in this "Public Information" section was provided by press releases given to the review team as well as through interviews with the park's public affairs personnel. All press releases (hard copies) are in review team's "Documentation Folder" and are available upon request from the park.]

Prior to the Chimney Tops 2 Fire

On November 1, 2016 the Great Smoky Mountains National Park issued a press release restricting campfires inside the park, citing drought conditions. On November 13, 2016, Chimney Top 1 Fire was reported and successful suppression efforts contained the fire at approximately ¼ acre. This resulted in area closures and a reminder of campfire restrictions. On November 14, 2016, a press release described the Chimney Top 1 Fire to be smoldering in duff with minimal fire behavior. This press release further informed that suppression efforts were continuing and relayed optimistic predictions for full containment—it also reemphasized the trail closures.

On November 15, 2016, a press release banning all uses of fire in the park was issued citing continued drought conditions. On November 16, 2016, trail closures were lifted from the area near the Chimney Top 1 Fire after the fire was contained.

During the Chimney Tops 2 Fire

On November 23, 2016 the Chimney Tops 2 Fire press release was issued describing the fire as approximately 1.5 acres with slow rates of spread, smoldering in a location approximately ¼ mile from the Chimney Top 1 Fire, and located in extremely remote, steep and inaccessible terrain. The press release further informed that area trail closures were implemented. It also revealed that light rain was received in the fire area, but cautioned that drought conditions still exist in the park. The press release also informed that the ban on all fires still existed within the park.

On November 25, 2016 a press release described the fire at approximately three acres and slow moving, saying it was a backing fire in heath balds fuels in extremely steep, rugged terrain. This press release also informed that fire suppression crews were establishing containment lines utilizing trails, drainages and hand built lines; and trail closures and campfire bans remain in effect.

On November 27, 2016, a public information officer was assigned to the Chimney Tops 2 Fire, providing visitor information along the Newfound Gap Road vista points. No press releases were issued during this time period.

On November 28, 2016 at approximately 1000 hours, a press release was issued describing how the Chimney Tops 2 Fire had grown to approximately 500 acres due to terrain, drought, and winds in excess of 20 mph. This press release also informed that spot fires in the Chimneys Picnic Area and Bullhead Ridge area had been detected with suppression efforts at the picnic area. Additional trail and road closures were identified. This press release also informed that additional fire suppression resources were being ordered due to fire size and predicted winds later in the day.

From approximately 1100 hours to 1540 hours on November 28, 2016, the park issued two additional press releases and conducted one press interview at park headquarters, providing updates to fire progressions, air quality advisories, and the areas affected by the fire. At approximately 1130 hours on this day, the air quality advisory press release advised that the fire posed no immediate threat to structures in Le Conte Lodge or any areas outside of park boundaries, including Gatlinburg, the Pittman Center, or the Cosby facilities. This information was based on frequent updates from fire suppression efforts relayed to the public information staff.

At approximately 1540 hours on November 28, the City of Gatlinburg along with the park issued a unified press release identifying a spot fire in the Twin Creeks area, located inside the park that was being suppressed by an interagency response.

This unified press release further informed that the new spot fire posed a threat to the Mynatt Park neighborhood and the Gatlinburg Fire Department was making preparations to protect this neighborhood; the Gatlinburg Police were going door-to-door requesting voluntary evacuations; and an evacuation shelter was identified at the Gatlinburg Community Center.

This press release also warned of more fire growth in the park over the next eight hours with a potential for spot fires to form outside the fire area. According to this press release, the Gatlinburg Fire Department would continue monitoring and the Tennessee Division of Forestry had staged equipment in the Mynatt Park community. The press release also informed that an air quality advisory had been issued and fire and law enforcement agencies would be monitoring the situation. A press briefing was announced for 1600 hours at the Gatlinburg Fire Department.

Shortly after the 1600 hours briefing, high winds disrupted power in Gatlinburg and the surrounding area, preventing the dissemination of published press releases. No additional press releases were issued until 0610 hours on November 29, 2016.

Live interviews with information officers and city and park officials that provided news updates were periodically shared throughout the night as reporters and news media followed city and park information officers around town.

The Chimney Tops 2 Fire crossed the park boundary near the Mynatt Park neighborhood at approximately 1800 hours on November 28, 2016.

Resource Objectives were Clear – Did Not Support Incident Decision-Making

In the Great Smoky Mountains National Park Fire Management Plan (FMP), the park's strategy is to protect and preserve the natural and cultural resources of the park. The FMP further states: *"Since the establishment of the park in 1934, the practice has been to extinguish all fires. This has resulted in biological changes different from those that would have resulted from the presence of natural fire. This practice has been recognized by the National Park Service as a problem since completion of the Leopold Report in 1963."*

The FMP provides direction that by implementation, those actions support the park's General Management Plan and Resource Management Plan objectives by specifying an array of fire management strategies designed to help to reestablish fire regimes to the extent possible while providing for the prevention of undesirable effects on people and resources from wildfire.

Additional direction in the park's fire management plan describes those actions that will be taken in meeting the fire management goals for the park, including the requirement as stated in Director's Order 18 (DO18), that: *"As an important part of fulfilling its mission, the National Park Service manages wildland fire to protect the public; park communities and infrastructure; conserve natural resources and cultural resources; and maintain and restore natural ecosystems and processes. The risks and expenses associated with planning and implementing fire management activities require exceptional skill and attention to detail. The highest priority under all circumstances is firefighter and public safety. All plans, project implementation, and responses to wildland fire must demonstrate this commitment."*

Two Fire Management Zones

The park is divided into two Fire Management Zones: FMU 1 is the interface zone and is generally contiguous with the park boundary and Foothills Parkway. Developed areas within the park are also included in this FMU. FMU 2 is the natural zone. This FMU makes up the preponderance of the park (83 percent). Within FMU 2, naturally occurring wildfires will generally be allowed to play their role in the ecosystem.

The Chimney Tops 2 fire originated in FMU 2 on November 23, 2016. The response was guided by the following applicable strategic objectives:

- The initial action to all human-caused fires will be to suppress the fire at the lowest cost with fewest negative consequences with respect to firefighter and public safety.
- Every wildfire will be assessed following a decision support process that examines the full range of responses. Wildland fire response strategies and tactics will consider firefighter and public safety, fire cause, current and predicted weather, current and potential fire behavior and effects, values to be protected, resource availability, cumulative effects of fire and cost effectiveness. Documentation of the decision process will be accomplished using the WFDSS program.

Specific applicable management objectives as outlined in the FMP were:

- All wildfires are managed with the strategic fire response as directed by the FMP and analysis of the specific situation with the goal of using available resources to manage the fire for the most effective, most efficient and safest means available.
- All wildfire operations are conducted so that no lost-time injuries occur to firefighters or the public.

Specific applicable management considerations as outlined in the FMP that were used:

- Firefighter and public safety is the first priority in all fire management activities.
- Minimum Impact Suppression Tactics (MIST) will be employed.
- Park neighbors, park visitors and local residents will be notified of all unplanned fire management activities that have the potential to impact them.
- All personnel involved in fire management operations will receive a safety briefing describing known hazards and mitigating actions, current fire season conditions and current and predicted fire weather and behavior.
- Only properly trained and qualified personnel will carry out fire management operations. Fully qualified personnel must supervise trainees.

Predicted control problems: Suppression efforts undertaken within FMU 2 will typically focus on confinement tactics using natural barriers. Whenever possible, fires within FMU 2 will be managed for the benefit of the resource.

On November 28, 2016 and before the Chimney Tops 2 fire approached the communities surrounding the park, FMU 2 guidance applied.

FMU 1 was established to address the FMP's objective to protect human life, property and sensitive natural and cultural resources within and adjacent to park boundaries. FMU 1 represents approximately 17 percent of the area administered by the park. FMU 1 is contiguous with the park boundary and developed areas. FMU1 is comprised of developed park infrastructure, historical, cultural and sensitive natural resources.

Specific applicable management objectives:

- The management objective during initial attack on all wildfires regardless of cause in FMU 1 will be to suppress the fire at the lowest cost with the fewest consequences with respect to firefighter and public safety.
- A strategic fire response with supporting decision documentation (WFDSS) will be initiated on each wildfire occurrence. Strategic fire response will consider firefighter and public health and safety, fire cause, current and predicted fire weather, current and potential fire behavior and effects, values to be protected, resource availability, cumulative effects of fire and cost effectiveness.

The applicable measureable objectives and management considerations for FMU 1 are the same as FMU 2.

Chimney Tops 2 Fire had Two Phases

The Chimney Tops 2 Fire can accurately be described in two phases. Phase One, from discovery on November 23 until mid-day on November 27, the resource objectives generally supported incident decision-making and subsequent strategy and tactics. WFDSS and documentation of decisions on strategy and tactics, and the full utilization of the decision support services products were not utilized.

Phase Two of the Chimney Tops 2 Fire began at mid-day on November 27 and continued through November 28 when—due to extreme fire behavior, exacerbated by drought conditions and extreme winds—the fire left the park. Once again, WFDSS and documentation of strategy and tactics, and the full utilization of the decision support services products were not utilized.

Resource objectives and decision-making were met partially during Phase One. None were met in Phase Two, which included FMU 1 and FMU 2. The resource objectives were clear, but subsequent incident decision-making did not produce the desired outcomes.

6. Fire Weather

[For a more detailed discussion of fire weather/behavior, see Appendix 6.]

At the time of the Chimney Tops 2 Fire's start on November 23, the risk of wildland fire was significant in eastern Tennessee. Deepening drought had been expanding throughout the state since the summer. The Remote Automated Weather System (RAWS) stations in Great Smoky Mountains National Park had measured below average rainfall, and the frequency of rainfall events was below average as well. Fire danger indices that are calculated from RAWS weather observations, such as the Keetch-Byram Drought Index (KBDI) and the Energy Release Component (ERC), were at record levels.

The impact of the drought was substantial. The drought resulted in lower moisture contents of not only dead fuels such as leaves, sticks, logs, and duff, but live vegetation as well. In drought-free years, duff, large logs, and live vegetation such as understory shrubs are much less flammable. The addition of these fuels to a wildland fire increases its intensity and makes it more difficult to control.

In addition to the drought-stricken fuels, the normal autumn leaf fall was underway in the widespread deciduous forest. With below average rainfall amount and frequency, this litter layer—normally somewhat compacted by moisture—remained uncompressed and subject to movement by winds.

The fall fire season is also commonly characterized by the passage of cold fronts that are accompanied by low relative humidity and preceded by high winds. The combination of low relative humidity, strong winds, and hardwood leaf litter increases the likelihood of fires becoming larger and more difficult to control. In addition to cold fronts, extreme wind events called "mountain waves" frequently occur from November through March in the western foothills of the southern Appalachian Mountains. Mountain waves can be anticipated to occur 2-4 times per year.

Why did this happen…

"Sensemaking is the process through which people work to understand issues or events that are novel, ambiguous, confusing, or in some way violate expectations."

Marlys Christianson Rotman School of Management

"How an agency responds to an accident [incident] is enormously important. Leaders' responses will either vector the agency toward a Learning Culture or away from it. If the organization assumes the accident [incident] happened because someone failed to do something right, the natural response is to determine (in dazzling hindsight) what rules or protocols were broken. We can then identify (or blame) the rule breaker and return the system to safety. All that's needed are better rules or better compliance. End of story – until the next accident [incident]. History has shown us that this approach is an ineffective method for improving our safety record."

USDA Forest Service Facilitated Learning Analysis Guide (a process utilized by the NPS and other agencies as a mechanism of reviewing an incident or event)

7. Sensemaking

[For further understanding of the process of sensemaking and how it applied to the series of events that unfolded during the Chimney Tops 2 Fire, see the expert scientific review in Appendix 7.]

The review team hopes that lessons learned from this review and report will be used to lessen the chances of an event like this occurring in the future.

The wildland fire community uses sensemaking to explore and provoke new models in the future. In other words, looking at why something made sense. Was it the training provided in the line of work? Leadership messaging? Culture? What has happened along the course of time to this point that made the frame look right?

Using what was learned from the process of sensemaking, individuals and agencies strive to change the frame, to adjust what is needed so that chances of these events happening again are reduced. The process creates a new frame for what "right" looks like and how people act within that frame.

Organizations such as NPS use the process of sensemaking to understand why decisions are made and how events unfold without adding in "outcome bias." Outcome bias is when people tend to evaluate a decision or action based on the outcome rather than on what conditions influenced the decision or action. This often leads to judgment of actions and decisions as good or bad, right or wrong etc.

Sensemaking is a presentation of facts and understanding without outcome bias influencing the process.

Sensemaking has been used to examine the connections between people, places, and events (both those in the present and those that led up to the moment) and is an active, unbiased construction of the most plausible explanation. It is the process of looking at what looked right at that moment and why.

No one wakes up in the morning, goes to work and says: *"I think I will intentionally have a bad outcome today."* Thus, by looking at the processes that made each decision look "right" in the framed moment and developing an understanding of what led to that moment, necessary change can be identified and implemented.

A "frame" is a perspective, a point of view that uses a non-biased way of considering a situation. The review team looked at the conditions that existed at the time, the decisions that were made, and what that framework (how it made sense at the time, what made those

decisions look right) was that existed for the park and its fire staff. The review team hopes that lessons learned from this review and report will be used to lessen the chances of an event like this occurring in the future.

The idea behind capturing the sensemaking in terms of conditions and decisions is that people make a decision based on the conditions at that moment in time. The conditions could be fuels, weather, their own past experiences, leadership messaging, or any other factor that lends itself to making sense at the moment in an effort to have the best possible outcome.

When the outcome that resulted was never intended, by evaluating and understanding what went into the decision-making to evaluate the current conditions, the wildland fire community can strive to make system changes where necessary and possible.

The review team assessed the conditions and decisions on the Chimney Tops 2 Fire in the manner discussed above and considered the actions taken on this wildland fire and the decisions that were made. In doing so, the review team accessed:

- Pre-Planning (preparedness and prevention prior to November 23, 2016).
- Initial attack operations on day one (November 23).
- Suppression strategy and tactics taken from November 24-28.

Condition 1: Where the Wildland Fire Started

The Chimney Tops 2 Fire started in terrain that was extremely steep with thick vegetation, dangerous footing, and access to the location that included the need to scramble along a cliff band.

Decision:
Even though the fire management officer /incident commander (FMO/IC) and one other firefighter hiked into the area to attempt initial attack and assess the fire, no suppression action was taken on November 23.

Framework:

- The FMO/IC hiked out to the fire that night and attempted initial attack and size up of the fire's location, fire behavior, and fuels. The FMO/IC hiked to the fire's location, scrambling along a cliff band and attempted action by putting in fire line, but realized that the situation was extremely dangerous. It was difficult enough during the day to access the fire in full light. The FMO/IC realized that in the dark he was in a very dangerous position.
- The review team hiked to the Chimney Tops and saw these conditions existed. Footing was dangerous in the daylight and any attempt in darkness was both unsafe and futile.

Figure 10 – View of Chimney Tops 1 (south peak) and Chimney Tops 2 (north peak).

- Although fire behavior was minimal, there were no obvious escape routes or safety zones.
- The decision to disengage followed risk protocols engrained in the wildland fire culture. The risks far outweighed the benefits that first night. The risk of injury or worse to a firefighter was extremely high while the probability of success in containing the fire was impossible with the resource staffing. At the point of ignition, the slopes were extremely steep and near vertical and it was dark when the FMO/IC arrived on scene.
- Values at risk from the perspective of distance, weather, and burning conditions were nonexistent at the time. The only value at risk was to the firefighters. That first night—based on fuels, weather, topography and fire activity—the fire did not present a risk to other values. This decision was consistent with the Great Smoky Mountains National Park Fire Management Plan.
- On wildland fires, environmental conditions are constantly changing. Consequently, there will be changing probabilities of success. Firefighters must weigh the risk, the known significant changes, and values at risk. Values at risk begins with firefighter safety and then considers resource and property values. The probability of success should drive a fire manager's decisions. For that first night, given the high degree of danger to the lives of firefighters and the low risk, based on the current fire behavior, the decision to not engage made sense.

Figure 11 – This is the sign located at the legal access end of the trail at the base of CT1.

From here, hikers proceed at their own risk up a sheer slate and granite trail that has worn smooth due to the thousands of visitors who have scaled this peak over the years.

At the top of CT1, there is no further trail access on to CT2, not even a primitive trail such as the one that leads up to CT1.

Condition 2: Wildland Fire Activity and Location from November 24-26

From November 24-26, the fire remained in the proximity of Chimney Tops in the same steep terrain, thick vegetation, poor footing and access to the fire that included rock and cliff scrambling. Fire activity had remained minimal with moderate downslope spread.

Decisions:

Decisions were made to not attempt direct attack on the fire on Thursday (11/24) to Friday (11/25) or on Saturday (11/26). Crews spent those days, as described in the narrative, scouting for potential line placement for indirect attack and determining a geographic "box" in which they desired to keep the fire within. However, through their scouting, they discovered that the southwest portion of the box would be very difficult or even impossible to build containment lines with the resources they had on hand. Scouting operations continued in an effort to identify lines that could be implemented.

Framework:

- The FMO/IC plus one firefighter hiked to the fire on Thursday while three others remained on the trail and chose not to risk going up Chimney Tops 1 (CT1), the south peak, let alone proceeding farther onto Chimney Tops 2 (CT2), the north peak. The three others felt the footing was too dangerous and the fire was inaccessible and therefore chose to turn down the assignment. This practice is supported in the wildland fire community. Page 19 of the Incident Response Pocket Guide (2014) instructs firefighters how to properly refuse risk.
- The FMO/IC and firefighter hiked to the fire and removed/lowered their packs over a cliff to access the fire. After assessment of the fire's movement and spread potential, it was determined that the

fire was still backing slowly downhill, but because of terrain and cliffs, direct attack was not possible at the current location or with the available resources.

- Though the fire behavior was minimal, there were no obvious escape routes or safety zones.
- Previous wildland fires at this elevation established an expectation and played a role in this decision. In the recorded history of the park there had been no large wildland fires of significance in terms of extreme rapid rates of spread. The largest wildland fire in the park history was the 2001 Sharp Fire, which was in excess of 7,300 acres and documented in the Incident Management Situation Report on November 22, 2001. The Sharp Fire took 12 days to reach 7,300 acres. Fire behavior on that fire remained low to moderate over its duration. However, the Sharp Fire did not occur during a long-term drought like Chimney Tops 2 Fire. It is important to note the difference in fuel conditions at the time of these two wildland fires. Low fire behavior and small wildland fires were the norm for Great Smoky Mountains National Park. No park personnel had the experience or "memory slides" to be able to consider a large-scale event. The FMO/IC and the park management had never experienced a wildland fire of this magnitude in this park. Consequently, the expectations that the Chimney Tops 2 Fire would hold within the proposed geographic box were based on what was known or within a historical framework.
- The FMO/IC, in drawing the geographic box, believed that the drainages contained enough moisture and would hold the fire, based on previous wildland fires during the 2016 fire season, and the park's fire history. That said, the crews scouting the drainages reported that *"moss on the rocks in those drainages was so dry it turned to dust upon contact,"* which indicates that there was little to no water and quite possibly the drainages would never hold fire. There is a history of park personnel believing that *"blue lines on a map will always hold"*—meaning drainages would stop the fire's spread. When interviewing long-term park staff and past park FMOs, all stated this to be a fact based on experience with wildland fire in this park.
- Fuels and fire behavior advisories at the time warned that direct attack was not likely to be successful, thus indirect attack must be considered. This was the strategy the park attempted to implement. From a wildland firefighter safety perspective, this was the correct approach and is consistent with the park's fire management plan.
- Based on the fuels and fire behavior advisories, as well as other activity in the area, a conversation with the regional fire management officer and park fire management officer two weeks prior indicated the need to be prepared for a large wildland fire event. The park FMO/IC did not perceive a risk of that occurring in the park due to the weather information available at the time of the Chimney Tops 2 Fire outbreak. Furthermore, the wind event had not been predicted in the fire's first two days, no values were imminently at risk, and the fire was doing what was expected, backing slowly downhill.
- The need to change strategy or tactics or order more resources during this time was not anticipated by the FMO/IC based on historical perspective and past fire behavior. The fire behavior was as anticipated and as expected by the FMO/IC on Thursday (11/24) and Friday (11/25). The Standard Firefighting Orders for wildland firefighters state: *"To base all actions off current and expected*

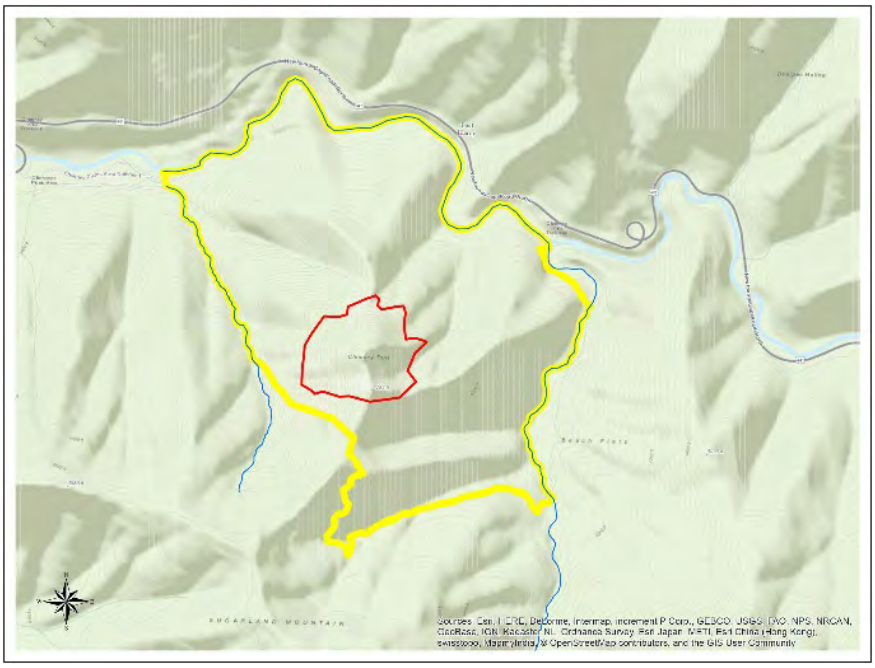


Figure 12 – The proposed containment "box" is indicated by the yellow line.

The location of the Chimney Tops 2 Fire as of November 27, 2016 is shown in red.

behavior of the fire." As a result, the current and expected fire behavior dictated the strategy and tactics taken by FMO/IC on Thursday and Friday.

- It is possible to spend an entire career without experiencing large-scale events and be successful at wildland firefighting. This creates a scale of complexity to which one is accustomed. Without exposure and experience to events outside of past experiences, there is little knowledge or experience available for a person to draw on for making decisions and anticipating outcomes.

Condition 3: Availability of Aviation Assets

Aviation assets were listed as available from the beginning of the fire (per the daily Southern Area Incident Management Briefing, which can be found in Appendix 8.)

Decision:

Aviation assets (rotor and fixed-wing) were listed as available from the beginning of the fire. Representatives of the Multi-Agency Coordinating Group (MAC) told the review team that aviation priorities outside of U.S. Forest Service and private lands were being fully supported because those were rare events, but no air support was ordered until Sunday November 27.

Framework:

- The FMO/IC did not believe that it made sense to order aviation support due to the fuels and topography making these resources ineffective, in his opinion. As described by the FMO/IC, the fuels were heath shrub land, with more of the shrub land component, consisting of deep duff and shrubs varying in height. Furthermore, the FMO/IC believed helicopter bucket work would not provide for an outcome of success as the terrain was too steep and the water would just run off. Based on this, dropping water on the fire was not a viable option in his mind. Mixes of direct and indirect strategies were still the primary suppression focus.
- Windows of opportunity to use aviation prior to Sunday November 27 existed, except for on Friday November 25, and Saturday morning November 26, when aircraft were described as unable to fly

due to weather conditions. Heavy duff, a thick shrub component, steep slopes, past wildland fire history, no immediate threat to values at risk, and an ultimate plan of an indirect strategy using drainages and natural barriers to hold the fire were all factors which contributed to the decision not to utilize aircraft.

Figure 13 – Helicopter working the Chimney Tops 2 Fire at 1440 hours on November 27, 2016.

Condition 4: Other Wildland Fire Activity in the Area, Current Park Burn Ban, and Fuels Advisories

Multiple wildland fires were in progress in all areas surrounding the park. Since June 2016, fuels advisories had been predicting significant fire danger with regular warnings and updates.

Decision:
Information and awareness of the fire activity around the park did not seem to influence decisions on staffing or the strategy of Chimney Tops 2 Fire. The Preparedness Plan and Step-Up Plan were not implemented per the park's fire management plan. The park had implemented a temporary burn ban on campfires in the backcountry, effective immediately, on November 1, and all fires on November 15. This ban was due to extremely dry weather/fuel conditions and the amount of fresh leaf litter on the ground, and the fact that the potential for escaped fires to occur in the backcountry had dramatically increased.

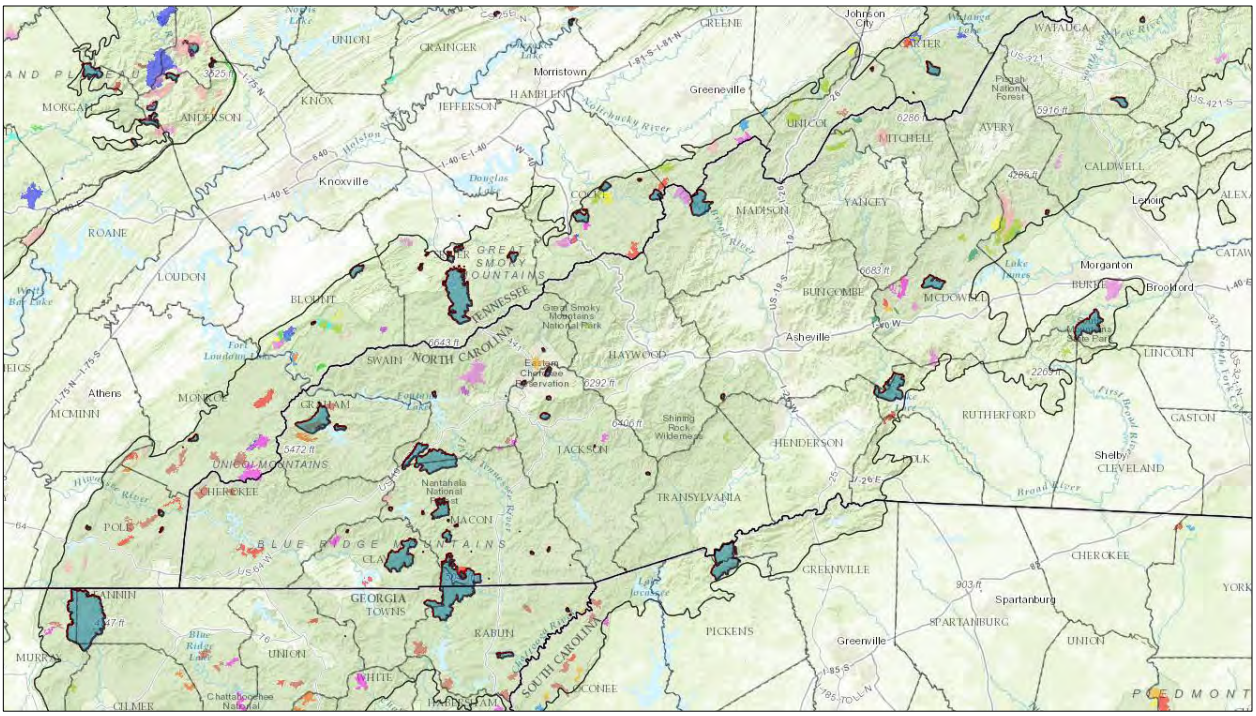


Figure 14 – The fires of 2016 occurring in the area surrounding Great Smoky Mountains National Park. Fires shown in blue were burning at the same time when the Chimney Tops 2 Fire started. Fires indicated in other colors are historical past fires.

Framework:

- Based on seasonality (the time of year), expected fire behavior, and success at "catching" all previous wildland fires that season, steered the FMO/IC from a sense of urgency. This resulted in a lack of requests for more resources and help, even with the wildland fire activity occurring around the park.
- The park did not conduct any fuel moisture monitoring to have a baseline for recognizing the changing condition of wildland fuels. Observations were made and historical references used, but no fuel monitoring was conducted to provide a known comparison to normal conditions vs. the conditions that currently existed on the ground. The lack of this level of data reduces a manager's understanding of current conditions and may not allow a full picture when determining strategies and possible outcomes.
- The Chimney Tops 2 Fire occurred late in the fire season, November, after an already long and busy fire season. Crews had been responding steadily to fires since July and had been successful with similar strategies and tactics. Furthermore, there had been little relief due to a lack of extra resources and multiple vacancies within the park fire crew. Fatigue of the fire crew and staff, after a full and active fire season, matched with the success of using the same strategies and tactics that had worked historically, conspired to enable a loss of a full global and regional perspective. There was a failure to recognize that the conditions and activity occurring outside of the park were actually applicable within the park.

Condition 5: Complexity Analysis

On Friday, November 25 the FMO/IC completed a complexity analysis, which rated the fire at a Type 3 complexity incident with a written justification to maintain the fire as a Type 4 incident. This is acceptable within the complexity analysis form guidance.

Decision:
The IC justified downsizing the complexity to Type 4 by stating: "*Fire is small with low potential to make a significant run as it is on top of a mountain and can only back down slope, lower fire intensity and behavior. Type 4 organization sufficient."* The complexity analysis rating was lowered without any discussion with upper level leadership, thus no "outside" or upper level check and balance occurred—which is not required. The complexity analysis form only requires the signature of the preparer. Typically, this is completed by the incident commander.

Framework:

- At the time of the complexity analysis, the fire had remained stable and was reflected in the justification. The fire was backing downhill with low intensities and behavior. The complexity analysis process facilitates an informed decision through a series of questions and allows for a deviation from the complexity output with a justification box.
- Based on fire seasonality, elevation location, past wildland fire park history and available resource staffing, this complexity made sense to the FMO/IC.

Condition 6: Utilization of the Wildland Fire Decision Support System (WFDSS)

Per RM-18 and Great Smoky Mountains National Park Fire Management Plan, parks will use the current decision support process (e.g. WFDSS) to guide and document wildfire management decisions. The process will provide situational assessment, analyze hazard and risk, define implementation actions and document decisions and rational for those decisions. Approval of the decision to manage a wildfire and the resulting course of actions to be taken to achieve management goals is the responsibility of the park superintendent and will be published in a decision support document. Refer to Chapter 3 of the *2016 Interagency Standards for Fire and Fire Aviation Operations* (Redbook).

Decision:
The first WFDSS decision was not published until December 5. This tool was not used by anyone to document any decisions prior to this date. WFDSS is required for all fires that go into extended attack[8] in the NPS, and is optional for initial attack. The Great Smoky Mountains National Park Fire Management Plan states that the FMO is required to ensure documents and reports are completed, including revision or preparation frequency, and only requires WFDSS preparation or revision updates as needed, including periodic review.

On November 26, a Near Term Fire Behavior projection was requested by the FMO and initiated in the training side of WFDSS by a Geospatial Analyst working at Asheville, North Carolina as part of a working group of the Southeast Regional Fire Behavior/Predictive Services group. This analysis was not calibrated, nor completed in the production side of WFDSS due to confusion on the official name of the fire. There was never any feedback to the geospatial analyst as to the usefulness of the analysis and the FMO/IC was not

[8] As defined by the fire management plan as "extended attack occurs when objectives have not been met in the case of initial fire response."

able to view the information until the morning of November 27 due to working in the field all day on the previous day.

Framework:

- There was not a clear understanding of the requirement for WFDSS from the FMO/IC or park leadership. There was a statement made by the deputy superintendent that it was only required when an incident management team Type 1 (IMT) was ordered.
- The FMO/IC was filling several roles on the incident in the park, leaving little time to concentrate on WFDSS, spending nearly all of the time developing the plan and implementing both direct and indirect strategies to suppress the fire.
- The fire was not active until Sunday, the 27th and the FMO/IC and park leadership felt the plans and strategies were going to be successful.

Condition 7: Multiple Roles and Collateral Duties

The FMO was also acting in the roles of IC and duty officer for the duration of the Chimney Tops 2 Fire, until the Type 1 incident management team assumed command on November 29. Additionally, the FMO was still responsible for 19 other parks under the Zone FMO concept during this time period.

Decision:
The FMO decided to function (and continued) as ICT4 and then ICT3 with no duty officer, and while maintaining FMO duties, which is counter to NPS and Redbook policy.

Framework:

- Many of the park fire staff employees had been granted "annual leave" (vacation) for the Thanksgiving Holiday weekend, prior to the Chimney Tops 2 Fire starting and based on past park wildland fire history. Based on the observed activity of this fire, the FMO/IC and park leadership did not feel an immediate need to cancel this annual leave status and recall employees.
- The park has a historical culture within its fire program of being reluctant to accept outside support. This has been reinforced by past successes with this culture. The FMO/IC believed that giving employees annual leave was the correct thing to do and did not have a sense of urgency from the Chimney Tops 2 Fire due to the low fire behavior. Thus, the FMO/IC believed the collateral duties scenario would be successful. Based on low wildland fire frequency/intensity/growth in the past, this practice had always worked before.
- The FMO/IC had been in this position for approximately eight months and lacked experience in being an FMO. The FMO has many years of experience as a wildland firefighter, including his previous job as the North Zone assistant fire management officer for the Cherokee National Forest. The NPS does not have a formal mentoring program to help transition wildland firefighters to FMO positions. The FMO possesses all required training and qualifications to be an FMO, however little guidance or mentorship was provided to help manage the increasing level of complexities of being an FMO. These complexities include, but are not limited to, managing multiple park fire programs across the Zone, managing multiple fire programs with a declining workforce, and the park's visitor growth.
- Park leadership did not question the FMO/IC for having collateral duties.

- The supervisor of the FMO/IC did not question the multiple roles being filled by the FMO or provide oversight to make sure the work/rest guidelines, or other policies were followed. In the NPS, often the FMO's supervisor does not have expertise in wildland fire management policy or guidance to oversee the finer details of the program. The NPS regional office, which does have that expertise, does not have line authority for FMOs. Regional offices provide guidance and advice and at times will work with agency administrators and supervisors when needed, though in this case, the regional office did not question the multiple roles.

Condition 8: Park Leadership Role and Program Oversight

Decision:
Park leadership was clear that Chimney Tops 2 Fire was a full suppression fire, was aware of—and supported—the strategy and tactics being implemented. Park senior leadership deferred to the expertise of the FMO/IC.

Framework:

- The strategy and tactics developed and implemented by the FMO/IC made sense to the chief ranger and deputy superintendent. Both the chief ranger and deputy superintendent are long-term Great Smoky Mountains National Park employees and had similar experience with wildland fires and wildland fire growth in the park. They therefore deferred to the FMO/IC's expertise. At one point, the deputy superintendent stated, via text, to the chief ranger and the FMO/IC that he *"would like to set up a call to better understand the strategy and be able to fully articulate the rationale just in case it was to blow-up at some point."* In talking with him during his interview, it was determined that the deputy superintendent was referencing the possibilities of fire behavior along the lines of the 2001 Sharp Fire, which grew to 7,380 acres over a 12-day period.
- Because the park staff did not understand the policies or program value of using WFDSS tools, they did not connect the concern about "a possible blow-up" to the need for engaging WFDSS.
- Neither the deputy superintendent, chief ranger nor superintendent has taken the Fire Management Leadership course, which is a required course for the superintendent, per NPS Chapter 2 in the Redbook. There is no recommended standard for the deputy superintendent and chief ranger (who may be acting agency administrator). Fire Management Leadership provides a framework by presenting policy, obligations, and consequences, which are relevant to agency administrator duties. As a result, it appears each deferred to the expertise of the FMO/IC and did not ask "big picture" questions (e.g. "what if?" questions, or contingency plans, etc.). There is no documentation of alternate plans in the event that conditions change and/or if the plan based on the "box" fails. Failure to verify strategy and tactics was based on previous fire history in the park. The proposed actions by the FMO/IC were consistent with previous success.

Decision:
A lack of engagement in fire program oversight and deference to expertise in the fire program by park leadership exists at Great Smoky Mountains National Park.

Framework:

- The organization and chain of command within the park fire program leads to oversight confusion for such things as: ensuring proper work rest; days off requirements; collateral duties being filled by the FMO; filling key positions; and lack of review of documents such as the severity packet, fire management plan requirements, dispatch and fire coordination, the Weather Information

Management System (WIMS), the National Fire Danger Rating System (NFDRS), and WFDSS requirements, etc.

- ❖ This past practice had always worked in the past and continued throughout Chimney Tops 2 Fire.
- ❖ The chief ranger is responsible for initial attack responsibilities, while the chief of resource management and science is responsible for prescribed fire activities and supervision of the FMO.

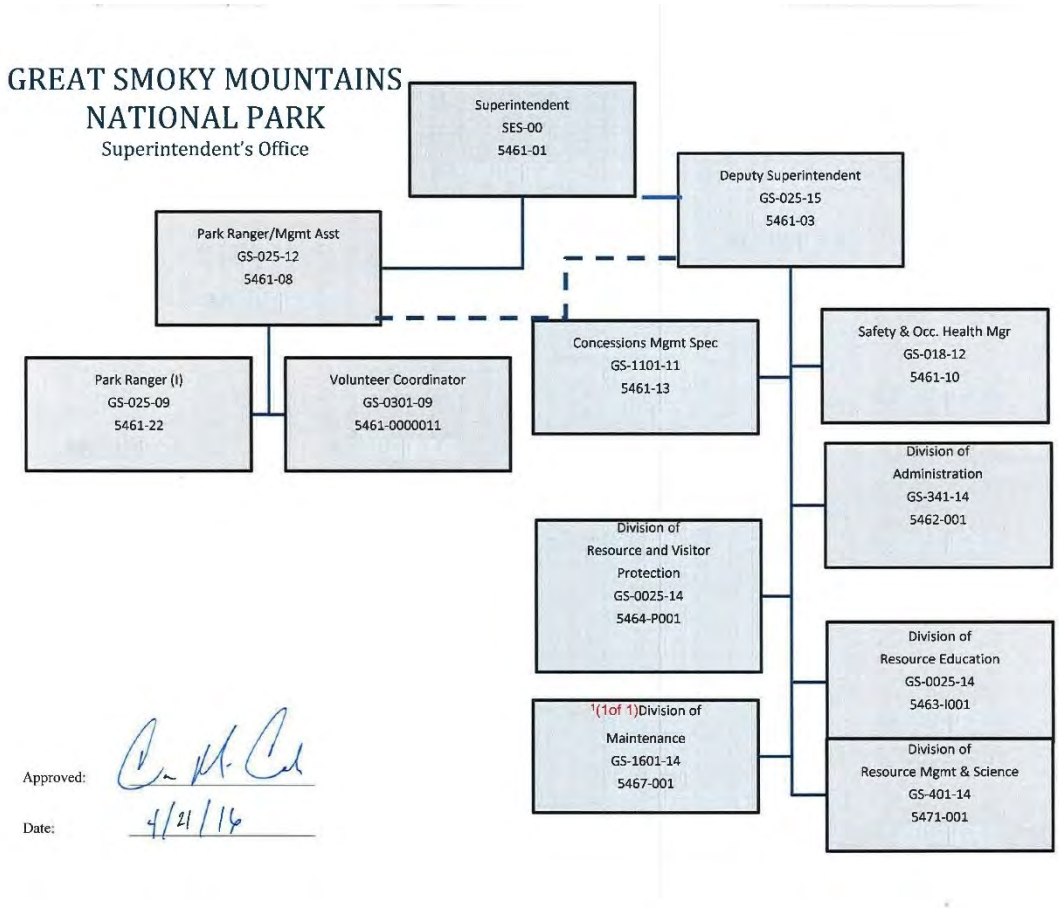


Figure 15 – Great Smoky Mountains National Park organizational chart. The chief ranger is responsible for initial attack activities, while the chief of resource management and science is responsible for prescribed fire activities and supervision of the fire management officer.

Condition 9: Fire Weather and Wind Forecasts

The wind event was predicted in advance of the fire-spread event on Monday November 28. The first forecast was issued through a Fire Weather Planning Forecast on November 25 at 0306 hours. A Hazardous Weather Outlook followed this at 0337 hours that same day. The most extreme winds predicted at this time were 15-25 mph from the Fire Weather Planning Forecast. Early on November 26 at 0311 hours, the Fire Weather Planning Forecast predicted winds up to 35 mph with winds by the night of November 28 possible at 35-50 mph and gusting to 60 mph. Rain was also predicted in all forecasts.

Decision:
The Hazardous Weather Outlook from November 26 as well as the Fire Weather Planning Forecast issued that same morning were discussed. No change in strategy or tactics occurred.

Framework:

- With the activity of the Chimney Tops 2 Fire to this point and its location on the landscape, the FMO/IC and park staff had a general sense that the benefit of the rain in the forecast was going to be helpful. This seemed to override concerns of the wind forecast.
- The FMO/IC and park leadership had never experienced an extreme wind event during the existing drought condition at the time, with the Chimney Tops 2 Fire present in the park.
- There were several comments and texts hoping that the rain would materialize. There was an anticipation that the incoming rains would be a "season ending event," which, by definition, means a weather pattern that changes conditions and brings the local fire season to an end.

Condition 10: Wildland Fire Preparedness

Decision:
The park did not submit a severity packet throughout the majority of the wildland fire season even with persistent drought conditions, until November 2016. The packet did not identify using any additional resources or staffing a duty officer position. The submitted request simply asked for money to extend hours of the current staff. The request was sent directly from the FMO to the regional office. There is no evidence of agency administrator involvement or approval.

There was little alignment of the severity request with the step-up plan in the fire management plan regarding the ordering of additional resources and key positions. Most of the park staff had requested vacation for the Thanksgiving Holiday and vacation requests were not cancelled. One Type 6 engine and two additional firefighters were the only resources brought in using severity funding.

Preparedness efforts were not communicated and coordinated between the park and interagency partners as per the park's fire management plan requirements.

Framework:

- Due to the magnitude of the park's visitation, daily operations take precedence over wildland fire operations—including preparedness and severity packets—and are the focus of park leadership. Statements of park leadership/staff and the organizational chart reflect this operational norm.
- The experience level of the FMO and park leadership was not sufficient to know and understand the NPS policies, requirements, and standards.
- There is a culture and history within Great Smoky Mountains National Park that created an isolated wildland fire program and did not engage external stakeholders to the desirable degree for the conditions that existed with Chimney Tops 2 Fire.

8. Review Team Findings and Recommendations

This chapter is divided into three sections. **Section A** focuses on the findings and recommendations that would likely have **not** led to a different outcome on the Chimney Tops 2 Fire. **Section B** addresses recommendations on any planning, operational or managerial issues which can be addressed locally, regionally, and/or nationally to reduce the chance of a similar incident in the future that, if implemented, **would** likely result in a different outcome on a future Chimney Tops 2 type complexity fire. **Section C – Additional Review Team Discoveries** outlines additional issues/discoveries identified by the review team that **should be** addressed within Great Smoky Mountains National Park, the National Park Service, and with external stakeholders.

Section A

This section discusses the findings and recommendations made by the review team that **would likely have not led** to a different outcome on the Chimney Tops 2 Fire. Even so, these findings should be addressed within the Great Smoky Mountains National Park, the National Park Service, and with external stakeholders.

Finding 1

Some of the goals and objectives in the current Great Smoky Mountains National Park Fire Management Plan were not achievable based on the outcomes of the Chimney Tops 2 Fire.

Examples:

The highest priority under all circumstances is firefighter and public safety. All plans, project implementation and responses to wildland fire must demonstrate this commitment.

Ensure that firefighter and public safety is the first priority in every fire management action.

Protect human life, communities, and resources from the adverse effects of wildfire without compromising safety.

The management objective during initial action on all wildfires regardless of cause in Fire Management Unit 1 will be to suppress the fire at the lowest cost with the fewest negative consequences with respect to firefighter and public safety.

All wildland fire operations are conducted so that no lost time injuries occur to firefighters or the public.

The initial action to all human-caused wildfires in Fire Management Unit 2 will be to suppress the fire at the lowest cost with the fewest negative consequences with respect to firefighter and public safety.

Recommendation:

Revise the park's fire management plan to reflect achievable goals, objectives, and outcomes for types of wildland fire like Chimney Tops 2 and revise the plan to reflect more aggressive strategies and tactics during extreme fire weather conditions.

Finding 2

The park's Step-Up Plan was partially met, the personnel necessary to meet the Step-Up Plan were not ordered or on duty.

Finding 3

The severity request from the park was for additional hours for existing personnel and did not include a request for funding sufficient for additional resources necessary to provide adequate staffing for the fire danger conditions that existed.

Recommendation:

The NPS Southeast Regional Office must ensure that the elements—defined annually by the NPS National Office and required for severity plan requests—are sufficiently addressed in each severity request from a park. These elements must be related back to the park's current fire management plan and not be broad and undefined. Additionally, all regionally approved severity requests are required to be uploaded to the NPS National Office severity Google Drive folder.

Finding 4

Radio communication capacity is an issue externally and internally. As the Chimney Tops 2 Fire approached the boundary of the park, interoperability issues existed during the fire with external first responders. At the time of this report, this remains an unresolved issue for boundary wildland fires.

The Great Smoky Mountains National Park operates a digital VHF multi-site linked repeater system with a capacity of one repeated channel. Repeater towers are linked and lend themselves to heavy amounts of radio traffic, which law enforcement tends to dominate. The park's fire staff only has access to VHF radios, which creates concerns for firefighter safety. Externally, the park fire staff has no ability to communicate with their partners, specifically the fire departments in the communities adjacent to the park.

Additionally, there is no ability to communicate directly with the Tennessee Interagency Coordination Center or with the North Carolina Interagency Coordination Center via radio. Therefore, all orders and communication must occur via phone, yet there is little to no cell coverage within the park.

Recommendation:

Expand communications capacity to allow interoperability with responders outside the federal system.

Finding 5

The chain of command and two-prong management of the wildland fire program is problematic and leads to a lack of policy oversight (e.g. work rest guidelines, duty officer/IC simultaneous roles of FMO). Additionally, roles and responsibilities in initial and extended attack are unclear.

Recommendation:

The wildland fire program and FMO should be supervised through a chain of command where a single supervisor is committed to providing program leadership and guidance. This must be inclusive of all aspects of the wildland fire program.

Finding 6

While on-site weather observations for relative humidity were taken and shared between firefighters on the Chimney Tops 2 Fire, no on-site observations were utilized to create Spot Weather Forecasts. Utilizing near-site RAWS technology produced these spot forecasts.

Finding 7

No Red Flag Warnings or advisories were issued during the Chimney Tops 2 Fire.

Recommendation:

Evaluate current Red Flag Warning and advisory criteria to reflect conditions experienced during the fire season in 2016.

Finding 8

On November 25, the fire management officer/incident commander (FMO/IC) changed the complexity analysis for the fire from a complexity Level 3 to a complexity Level 4. While allowed by policy, this unilateral action is symptomatic of the park's history of excessively informal strategy development and tactical decision-making during the management of wildland fire events. Furthermore, the park on Monday morning, November 28, ordered a Type 2 incident management team without completing a complexity analysis.

Recommendation:

The NPS commit to a change in policy that would require a higher-level review by leadership for reduction of complexity from Level 3 to Level 4.

Finding 9

During the fire, the FMO was simultaneously serving as the duty officer and incident commander, which is contrary to NPS policy.

Section B

The review team was also tasked with making recommendations on any planning, operational or managerial issues which can be addressed locally, regionally, and/or nationally to reduce the chance of a similar incident in the future and if implemented, **would likely** result in a different outcome on a future Chimney Tops 2 type complexity fire.

The review team identified three key recommendations:

Recommendation One

The Chimney Tops 2 Fire review exposed situational preparedness weaknesses at Great Smoky Mountains National Park as well as with its adjacent stakeholders.

A universal statement from responders was: *"I've never seen anything like this, and I never even imagined this could happen."*

Unless Great Smoky Mountains National Park and the National Park Service is fundamentally willing to accept and lead social and cultural change to address the future of wildland fire at the park and surrounding landscapes, history will be repeated. This condition is the "new normal" for the park and adjacent stakeholders.

Recommendation:

Circumstances are likely to align again in the future to create the conditions that will allow for a large-scale wildfire that runs into the urban interface. The park superintendent at Great Smoky Mountains National Park should lead a change with all cooperators and partners around the park in both states

to recognize where things did not go well on the Chimney Tops 2 Fire and effect change to enhance the likelihood of success in the future.

The National Park Service leadership should also embrace and institute change to create wildland fire management organizations that have the capacity and resilience to meet the realities of this "new normal."

Recommendation Two

Fire management and fire program management have increasing complexities and responsibilities. To help prepare fire management officers and agency administrators address the changing fire environment will require programs that develop stronger leaders who are able to address the increasing demands of a wildland fire program.

The National Park Service does not have a mentor or leadership development program for fire management officers or agency administrators. Current and new fire management officers and agency administrators are faced with managerial and leadership challenges where they have little to no experience. The required Fire Management Leadership and Fire Program Management (M-581) courses provide an introduction to managing a wildland fire program for agency administrators and fire management officers.

Recommendation

Institute a formal fire management officer mentoring and/or development program.

Institute a formal agency administrator development/mentoring program for managing wildland fire.

Recommendation Three

The review team found inconsistencies between the fire management program in Great Smoky Mountains National Park and other national parks. Based on these inconsistencies, a wildland fire program review is warranted at the park and regional levels.

Section C – Additional Review Team Discoveries

The following are additional issues/discoveries identified by the review team that should be addressed within Great Smoky Mountains National Park, the National Park Service, and with external stakeholders.

1. Resource Ordering

The park's fire management plan requires all orders for resources to be placed with the Tennessee Interagency Coordination Center, even though the park is located in Tennessee *and* North Carolina. North Carolina should be considered as part of the park's plan for ordering resources, particularly if a wildland fire occurs on the North Carolina side and must be supported with additional resources.

2. Dispatch

Dispatch's primary mission is to support law enforcement. Therefore, wildland fire is not able to utilize Dispatch to the fullest extent for communicating on fires—or to update Dispatch on the status of fires. On prescribed burns, local park tactical channels are utilized but do not communicate with Dispatch regarding significant operations. Law enforcement contacts Dispatch if a wildland fire occurs and the FMO is contacted via phone. Subsequently, resource orders are placed via phone to the Tennessee Interagency Coordination Center.

3. Lines of Authority

The various lines of authority from the superintendent to the FMO are not identified in the *2016 Interagency Standards for Fire and Fire Aviation Operations* (Redbook). It would be of value to acknowledge that these supervisory roles may vary from park to park. Chief rangers, chief of resources, the deputy supervise FMOs at different parks, or some FMOs report directly to the superintendent.

The 2016 Redbook and RM-18 should reflect the position requirements for deputy superintendent and for the FMO's supervisor. (RM-18 represents the most detailed and comprehensive guidance on implementing service-wide wildland fire management policy for the National Park Service.)

Great Smoky Mountains National Park's deputy superintendent and chief of resource and science directly provide oversight and supervise the park's fire program. The 2016 Redbook does not identify that a deputy superintendent—or anyone overseeing a fire program such as a chief of resources who supervises the FMO—is required or recommended to take the Fire Management Leadership course. This course is only required for superintendents within two years from the time of their appointment.

4. Weather Forecasting

From November 23 to November 28, 2016, the Morristown Office of the National Weather Service issued 11 Zone Forecasts, 16 Fire Weather Planning Forecasts, 12 Hazardous Weather Outlooks, 6 Area Forecast Discussions, 5 Special Weather Statements for 2 High Wind Watches, 2 High Wind Warnings, and 1 forecast for Enhanced Fire Danger, in addition to the 6 Spot Weather Forecasts requested by the Chimney Tops 2 Fire FMO/IC.

The first forecast for elevated wind speed on Monday November 28 was issued through a Fire Weather Planning Forecast on Friday November 25 at 0306, followed by a Hazardous Weather Outlook at 0337. The Fire Weather Planning Forecast forecasted Monday as "breezy" with "south winds 15 to 25 mph." The Hazardous Weather Outlook stated: "Strong southerly winds will develop Monday night…" The Fire Weather Planning Forecast called for a "chance of showers" Monday night while the Hazardous Weather Outlook expected "much needed showers" Monday night through Wednesday with possible rainfall amounts of 1-2 inches.

Early on Saturday November 26 at 0311, the Fire Weather Planning Forecast described Monday as breezy and Monday night as windy, with winds to 35 mph. It forecasted "showers likely" Monday night. The Hazardous Weather Outlook at 0321 stated that strong southerly winds will develop Monday night, very windy conditions possible, winds 35-50 mph with gusts over 60 mph possible.

The Hazardous Weather Outlook emphasized the high winds but also called for rainfall amounts up to 3 inches over southeast Tennessee. Later on Saturday morning, 3 Zone Forecasts were issued that forecasted Monday as windy and Monday night as cloudy with "rain showers likely" with the chance of rain at 70 percent. On November 26, the Fire Weather Planning Forecast at 1522 forecasted that "on Monday afternoon, increasing southerly winds will occur ahead of the next storm system" and estimated wind speed/gust speed of: 9/29 mph Sunday night, 16/44 mph Monday morning, and 19/52 mph Monday afternoon. In this Fire Weather Planning Forecast, the chance of showers on Monday was 20 percent while Monday night was described as "very windy" with "showers."

The first Spot Weather Forecast for the Chimney 2 Fire (before the name change to Chimney Tops 2 Fire) that covered the significant fire spread of the night of November 27/28 and the day of November 28 was issued at 0729 on November 27. This Spot Weather Forecast began with the High Wind Watch that had been issued earlier that morning and that was in effect from Monday afternoon through

Tuesday morning. Included in the “Discussion” was the expectation of “much needed rainfall on Monday” while the tabular portion of the forecast for Monday called for “a chance of rain showers in the afternoon” with a rainfall amount of 0.01 inches.

No Red Flag Warning was issued for the area during the Chimney Tops 2 Fire.

9. Conclusion

The unprecedented Chimney Tops 2 Fire event exposed several wildland fire situational preparedness and planning weaknesses at the Great Smoky Mountains National Park. Despite these weaknesses, the review team found no evidence of wanton disregard or negligence by anyone at the park.

What was unprecedented was the combination of a severe wind event (a "mountain wave" extreme wind that usually occurs 2-4 times per year from November through March in the western foothills of the southern Appalachian Mountains), coupled with severe drought and a wildland fire on the landscape. This scenario had never been witnessed by anyone at the park.

The park and adjacent wildland fire agencies have been successful in limiting the presence and impact of unwanted fire for decades. However, today, a variety of emerging trends increasingly places responders, the public, and other values to be protected at risk. Changes in wildland fuels resulting from past land management practices, climatic change, and decades of fire suppression have all conspired to create a fire exclusion conundrum that can no longer be ignored.

Combined with these factors, expansion of the wildland-urban interface (WUI), which has largely been unaccompanied by parallel increases in local community resiliency, is also creating new risks. Fire suppression in conjunction with a limited prescribed fire program only exacerbates the problem and limits fire managers' best tools to combat fire-related smoke and air quality issues. These issues are expected to become more acute as climatic change exposes new areas—particularly those with high concentrations of organic biomass—to wildland fire.

During the review team's interviews, a universal statement from responders was: *"I've never seen anything like this, and I never even imagined this could happen."* The review team agrees that these circumstances present during the Chimney Tops 2 Fire will likely be the "new normal" for the park. To be sure, these same conditions are likely to align again in the future to allow for a large-scale wildfire that leaves the park and burns into the urban-interface. The findings and recommendations in this review report are intended to help the park be prepared for such a scenario.

Park leadership and adjacent stakeholders must challenge long-held assumptions and practices in the wildland fire management community and produce a multidimensional planning framework to enable fire leaders' evaluation of strategies and programmatic investments against plausible future wildland fire environments, or the "new normal."

10. Appendices

Appendix One

Delegation of Authority for the Chimney Tops 2 Fire Review

United States Department of the Interior

NATIONAL PARK SERVICE
Fire Management Program Center
3833 S. Development Avenue
Boise, Idaho 83705

ELECTRONIC COPY ONLY – NO HARD COPY TO FOLLOW

February 5, 2017

Memorandum

To: Joe Stutler, Chimney Tops 2 Fire Review Team Leader

From: Chief, Division of Fire and Aviation

Subject: Delegation of Authority, Chimney Tops 2 Fire Review

In accordance with National Park Service (NPS) Reference Manual 18, Wildland Fire Management, (RM-18) and the 2017 Interagency Standards for Fire and Fire Aviation Operations, I am delegating authority to you to conduct a review of the Chimney Tops 2 Fire, which started in Great Smoky Mountains National Park on November 23, 2016. The purpose of this review is not punitive. The intent of this review is to identify the facts leading up to and during the incident as well as making recommendations on any planning, operational, or managerial issues which can be addressed locally, regionally, and/or nationally to reduce the chances of a similar incident in the future.

Your responsibilities include the following:

1. Organizing, managing, and conducting the review in accordance with RM-18 and the 2017 Interagency Standards for Fire and Fire Aviation Operations.
2. Providing for in-briefings and out-briefings with affected personnel and agency officials including the Great Smoky Mountains National Park superintendent.
3. Maintaining liaison with the Park, local and state cooperators, NPS Investigative Services Branch, NPS assigned criminal investigators, and regional office representatives.
4. Approving requests and allocating funding for resources to assist with the review.
5. Requesting technical, logistical, or other support, as required to conduct the review.
6. Providing briefings to myself and others.
7. Preparing and submitting a final report following the applicable portions of the format found in RM-18, Chapter 17 (see attached RM-18 Chapter 17 3.5 *National Level Reviews* and Exhibits 1 and 2*).*

The Chimney Tops 2 Fire experienced exponential growth on November 28 and spread into the City of Gatlinburg, where it merged with multiple independent ignitions caused from downed powerlines on that same date, collectively referred to as the Sevier County Fires. As it relates to response, the scope of your

review will be defined by Federal wildland fire actions taken from the time of ignition of the Chimney Tops 2 fire on November 23 until the fire spread out of the park on the evening of November 28.

I understand that interviews and analysis may take several weeks to complete given the demands of the recovery operations as well as personal schedules. Please provide me an initial briefing following your initial assessment and a draft review 45 days after interviews are completed. We will conduct regular phone updates during the initial stages of your deployment and then schedule them as appropriate once your work is well under way.

Your review will fit within a larger framework of your federal, and other state and local review(s) surrounding the larger response and evacuation effort called the Sevier County Fires After Action Review (AAR). Anticipate that a member of your team may be called upon to participate in discussions as part of the larger AAR. I expect you to coordinate with myself and the park on this effort.

Your team members should charge their travel, salary (if not preparedness funded), and any related costs to the Chimney Tops 2 Fire account.

Your initial point of contact in the Great Smoky Mountains will be Deputy Superintendent Clayton Jordan.

You may contact Dan Buckley, Chief, Branch of Wildland Fire, or Chad Fisher, Wildland Fire Operations Program Leader, with questions or for support.

Cc: Barclay Trimble, Deputy Regional Director, Southeast Region
David Horne, Regional Chief Ranger, Southeast Region
Shawn Nagle, Fire Management Officer, Southeast Region
Cassius Cash, Superintendent, Great Smoky Mountains National Park
Clayton Jordan, Deputy Superintendent, Great Smoky Mountains National Park
Dan Buckley, Chief, Branch of Wildland Fire
Chad Fisher, Wildland Fire Operations Program Leader
Cindy Rose, Administrative Assistant, Fire and Aviation Management Division
NPS Memorandums

Appendix Two

Timeline

The following page provides an abbreviated chronology that highlights critical moments and decisions that occurred from Wednesday, November 23 through Monday, November 28 on the Chimney Tops 2 Fire.

November 23, 2016 (Wednesday)

- At approximately 1719 hours, fire is detected on Chimney Tops.
- FMO hikes into the fire as incident commander (IC), taking along one other firefighter, and determines that it is unsafe to take action at this time.

November 24, 2016 (Thanksgiving Holiday)

- A "box" is identified for holding the fire to approximately 400 acres. It is planned but not yet implemented.
- Fire smolders, no crews directly attack the fire. Fire grows to approximately 2 acres.

November 25, 2016 (Friday)

- Fire is still smoldering, has only grown slightly. Cloud cover is present most of the day around the area of the fire, making air attack out of the question.
- Crews scout for ways to implement the "box" but with no action taken.
- Public Information releases update about trail closures and smoke.

November 26, 2016 (Saturday)

- Fire weather forecast calls for 40+ mph winds on Monday with rain. Warning comes in at 0300 hours.
- Fire gets more active, no crews directly attack fire. Fire grows to approximately 8 acres.

November 27, 2016 (Sunday)

- Fire increases in activity. Air resources are ordered. Helicopters make drops that afternoon. At 1430 hours, an infrared MMA (Multi-Mission Aircraft) flight is conducted which shows the fire to be 35 acres.
- Crews monitor fire behavior and direct air operations. Some fireline construction is done on the proposed box.

November 28, 2018 (Monday)

- By 0730 hours, fire has spotted across Newfound Gap Road in the park and grown to approximately 200 acres (accounts of size vary from 200-500 acres).
- Type 2 incident management team is ordered by the park.
- At 1135 hours, the fire spots to the Twin Creeks area.
- At 1152 hours, Gatlinburg Fire Department activates a county-wide Wildland Task Force.
- At 1200 hours, the voluntary evacuation of Mynatt Park, a park and subdivision within the City of Gatlinburg, is implemented.
- At 1430 hours, the Gatlinburg fire chief activates a state-wide mutual aid call.
- At 1745 hours, a brush fire is reported inside the City of Gatlinburg.
- At approximately 1800 hours, fire is observed leaving Great Smoky Mountains National Park at Park Vista.

Appendix Three

The Step-Up Plan and Predicted Fire Danger Staffing

The Step-Up Plan is best described as a wildland fire preparedness plan, which specifies when fire danger increases how the Great Smoky Mountains National Park identifies additional measures and staffing needs that must be taken to provide appropriate response to wildland fires.

The park's Step-Up Plan was compared to actions taken on the Chimney Tops 2 Fire from November 23 through November 28.

Table 1 – Step-Up Plan Staffing Level

Staffing Class Step-Up Plan					
BI FM "E"* **Mid-Oct – Early May**	0 - 7	8 - 15	16 - 30	31 - 37	38 +
BI FM "R"** **Early May – Mid-Oct**	0 - 3	4 - 7	8 - 14	15 - 17	18 +
Staffing Class	**SC 1**	**SC2**	**SC3**	**SC4**	**SC5**
Fire Danger	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Open Preparedness Account for extended staffing and outside resources ordered as required	No	No	No	Contact regional office for preparedness account number.	Request severity funding if prolonged fire danger is anticipated.
Engines (T6: ENGB + FFT2) (T7: FFT1 + FFT2) **Squads** (FFT1/ICT5 + 3 FFT2)	1 T7 within 1 hour	1 T7 within 1 hour	1 T6	1 T6 1 Squad 7 day coverage (*if VH to Extreme fire danger is expected to continue*)	1 T6 1 Squad 7 day coverage
Overhead *** ENGB can also function as ICT5 (if qualified) in SC 1 and SC2 only. At SC3 or above, a separate incident commander is required.**	ICT5 *	ICT5 *	ICT4	ICT4 Designate daily Duty Officer. ICT3 (available within 2 operational periods)	ICT4 Designate daily Duty Officer. ICT3 (*if VH to Extreme fire danger is expected to continue*) Determine need for local T3 team

Staffing Class Step-Up Plan					
BI FM "E"* Mid-Oct – Early May	0 - 7	8 - 15	16 - 30	31 - 37	38 +
BI FM "R"** Early May – Mid-Oct	0 - 3	4 - 7	8 - 14	15 - 17	18 +
Staffing Class	**SC 1**	**SC2**	**SC3**	**SC4**	**SC5**
Fire Danger	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Support Function				Establish logistical support Determine availability/ status of collateral duty and AD employees	Establish expanded dispatch Expand logistical support Determine availability/ status of collateral duty and AD employees
Coordination			Daily verification of available resources with District Rangers	Daily coordination of available resources with division chiefs; TN/NC Division of Forestry, Cherokee BIA and Cherokee NF	Daily coordination of available resources with division chiefs; TN/NC Division of Forestry, Cherokee BIA and Cherokee NF
Management Actions				Duty Officer determines need for extended hours Evaluate need for expanded incident management functions	Duty Officer determines need for extended hours Initiate daily incident planning meeting
Prevention Activities				Superintendent may restrict campfires based on current activities and conditions	
			Increase patrols and visitor contacts in campgrounds, boundary areas and Parkways and other high use areas		

Staffing Class Step-Up Plan					
BI FM "E"* Mid-Oct - Early May	0 - 7	8 - 15	16 - 30	31 - 37	38 +
BI FM "R"** Early May – Mid-Oct	0 - 3	4 - 7	8 - 14	15 - 17	18 +
Staffing Class	**SC 1**	**SC2**	**SC3**	**SC4**	**SC5**
Fire Danger	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Miscellaneous Requirements	Daily Weather entered into WIMS Verify / Relay NFDRS indices Situation Reporting	Daily Weather entered into WIMS Verify / Relay NFDRS indices Situation Reporting	Daily Weather entered into WIMS Verify / Relay NFDRS indices Situation Reporting	Daily Weather entered into WIMS Verify / Relay NFDRS indices Situation Reporting	Daily Weather entered into WIMS Verify / Relay NFDRS indices Situation Reporting

* **BI**=burning index **FM**=fuel model **"E"**= timber

** **BI**=burning index **FM**=fuel model **"R"**= leaf litter

Table 2 – Staffing Comparison: Step-Up Plan vs. Actual Staffing

Date	Type 6 Engine	Squad	ICT4	ICT3	Management Actions	Daily Coordination	Support Functions	Duty Officer Designated Daily
11/23/16	Yes	Yes	Yes	Yes	Partial	No	Partial	No
11/24/16	Yes	No	Yes	Yes	Partial	No	Partial	No
11/25/16	Yes	No	Yes	Yes	Partial	No	Partial	No
11/26/16	Yes	No	Yes	Yes	Partial	No	Partial	No
11/27/16	Yes	No	Yes	Yes	Partial	No	Partial	No
11/28/16	Yes	Yes	Yes	Yes	Partial	No	Partial	No

Type 6 Engine + Firefighter Type 2—per Great Smoky Mountains National (GRSM) Park Fire Management Plan

Type 7 Engine + Firefighter Type 1 + Firefighter Type 2—per Great Smoky Mountains National Park Fire Management Plan

Squad (Required Staffing of 4) (Firefighter Type 1/Incident Commander Type 5 + 3 Firefighter Type 2)

Support Activities (Establish expanded dispatch, Expand logistical support and Determine availability/status of collateral duty and AD employees)

Table 3 – Fuel Model E (Forecast Indicies)

Date	RAWS	Staffing Class	B I	Percentile	E R C	Percentile
11/22/16	Cherokee	5	46	97	44	99.9
	Indian Grave	4	36	94	34	99
11/23/17	Cherokee	5	44	96.5	35	99
	Indian Grave	5	60	100	39	99.9
11/24/17	Cherokee	4	32	86	25	90
	Indian Grave	3	5	36.5	3	35
11/25/17	Cherokee	3	25	76	23	86
	Indian Grave	5	19	60	12	47
11/26/17	Cherokee	4	40	94	27	94
	Indian Grave	4	38	96	24	87
11/27/17	Cherokee	4	38	92	39	99.9
	Indian Grave	**	**	**	**	**
11/28/17	Cherokee	5	64	99.9	35	99
	Indian Grave	**	**	**	**	**

Table 4 – Fuel Model G (Forecast Indicies)

BI, ERC and KBDI leading up to the Event

Date	RAWS	Staffing Class	B I	Percentile	E R C	Percentile
11/22/16	Cherokee	5	48	99	59	100
	Indian Grave	5	44	97.5	63	99.5
11/23/17	Cherokee	5	46	98.5	55	99.9
	Indian Grave	5	61	99.9	67	99.9
11/24/17	Cherokee	4	38	94	48	99.5
	Indian Grave	2	16	50	38	91.5
11/25/17	Cherokee	3	30	82	40	98
	Indian Grave	3	30	81	42	94
11/26/17	Cherokee	5	40	95.5	41	98
	Indian Grave	5	43	97	51	97.5
11/27/17	Cherokee	5	42	96.5	49	99.5
	Indian Grave	**	**	**	**	**
11/28/17	Cherokee	5	73	99.9	49	99.5
	Indian Grave	**	**	**	**	**

** No Forecast Indices on November 27th and 28th on Indian Grave Weather Station.

Table 5 – Cherokee RAWS (Observed Indices)

Fuel Model E				Fuel Model G			
Date	**B I**	**ERC**	**KBDI**	**Date**	**B I**	**ERC**	**KBDI**
11/16/16	39	43	500	11/16/16	39	43	500
11/17/16	41	45	502	11/17/16	41	45	502
11/18/16	48	49	506	11/18/16	48	49	506
11/19/16	40	44	509	11/19/16	40	44	509
11/20/16	54	47	509	11/20/16	54	47	509
11/21/16	53	58	509	11/21/16	53	58	509
11/22/16	47	57	511	11/22/16	47	57	511
11/23/16	56	59	512	11/23/16	56	59	512
11/24/16	0	16	505	11/24/16	0	16	505
11/25/16	31	38	506	11/25/16	31	38	506
11/26/16	46	44	507	11/26/16	46	44	507
11/27/16	46	49	508	11/27/16	46	49	508
11/28/16	39	41	509	11/28/16	39	41	509
11/29/16	0	0	361	11/29/16	0	0	361

Fuel Model E and G comparisons for BI, ERC and KBDI pre-event at Cherokee RAWS.

Table 6 – Indian Grave RAWS (Observed Indices)

Fuel Model E				Fuel Model G			
Date	**B I**	**ERC**	**KBDI**	**Date**	**B I**	**ERC**	**KBDI**
11/16/16	42	36	591	11/16/16	47	62	591
11/17/16	41	38	593	11/17/16	47	66	593
11/18/16	48	42	596	11/18/16	53	70	596
11/19/16	24	22	596	11/19/16	34	53	596
11/20/16	31	34	595	11/20/16	39	59	595
11/21/16	38	42	595	11/21/16	45	65	595
11/22/16	44	41	596	11/22/16	49	67	596
11/23/16	48	42	597	11/23/16	52	70	597
11/24/16	35	24	598	11/24/16	42	54	598
11/25/16	11	7	599	11/25/16	24	40	599
11/26/16	32	27	599	11/26/16	43	51	599
11/27/16	39	38	600	11/27/16	47	59	600
11/28/16	38	30	601	11/28/16	49	57	601
11/29/16	0	0	545	11/29/16	0	0	545

Fuel Model E and G comparison for BI, ERC and KBDI at Indian Grave RAWS.

Table 7

Staffing targets and areas lacking for positions or qualifications in 2010 and 2016

ICS Functional Area	Qualification	2010 Target	Fully Qualified		Current Trainees		Qualified Target vs. 2010	Qualified Target vs. 2016
			GRSM-FMP 2010	2016	GRSM-FMP 2010	2016		
	ICT3	2	0	1	2	1	-2	-1
	ICT4	4	5	5	1	3	+1	+1
	ICT5	6	10	12	1	0	+4	+6
	SOFR	1	0	0	1	1	-1	-1
	RXB1	1	0	0	0	0	-1	-1
	RXB2	3	2	2	0	0	-1	-1
	PIOF	1	0	1	3	1	-1	0
Operations	DIVS	1	0	2	0	1	-1	+1
	TFLD	3	3	3	1	0	0	0
	FIRB	3	4	4	2	6	+1	+1
	ENGB	4	6	10	2	5	+2	+6
	CRWB	2	4	3	1	3	+2	+1
	FALC	1	0	4	1	5	-1	+3
	FALB	4	7	10	1	2	+3	+6
	FFT1	10	8	14	1	3	-2	+4
	FFT2	20	25	21	10	3	+5	+4
Air Ops.	HMGB	1	0	1	0	0	-1	0
	HECM	4	6	8	3	2	+2	+4
	PLDO	2	2	2	0	0	0	0
Planning	SOPL	1	1	0	0	0	0	-1
	FEMO	4	11	9	1	3	+7	+5
	FOBS	1	1	0	0	1	0	0
	FBAN	1	0	0	0	0	-1	-1
	SITL	1	0	0	0	0	-1	-1
	RESL	1	1	0	1	2	0	-1
	READ	2	4	6	0	0	+2	+4
	GISS	1	0	0	2	1	-1	-1
Finance	PTRC	1	1	0	0	0	0	-1
	POCC	1	0	1	0	0	-1	-1
Logistics	SPUL	1	0	0	0	0	-1	-1

There are five staffing classes that describe escalations in preparedness responses to increased fire danger. Table 1 shows the actions to be taken for each of the five staffing classes in the park.

Appendix Four

Severity Request

Memorandum

To: Willie Adams, Fire Operations Specialist

From: Greg Salansky, Appalachian-Piedmont Fire Management Zone, FMO

Subject: Severity Funding Request – 30 days

Appalachian-Piedmont Fire Management Zone Funding Request, November, 4 2016

The Appalachian-Piedmont fire management zone APFMZ is experiencing increasingly high fire danger especially within the Western part of the zone which includes Great Smoky Mountains National Park GRSM, Chickamauga and Chattanooga National Military Park CHCH, Blue Ridge Parkway BLRI, Kings Mountain National Military Park KIMO. Many other park units are also susceptible to a wildfire event. No significant moisture events are forecasted for the next several weeks. Under current environmental conditions, APFMZ can expect high fire danger which could result in multiple fires. With delayed fire response they could result in large fire development. This could impact public safety, private property, park resources and economic aspects caused by road closures and smoke impacts.

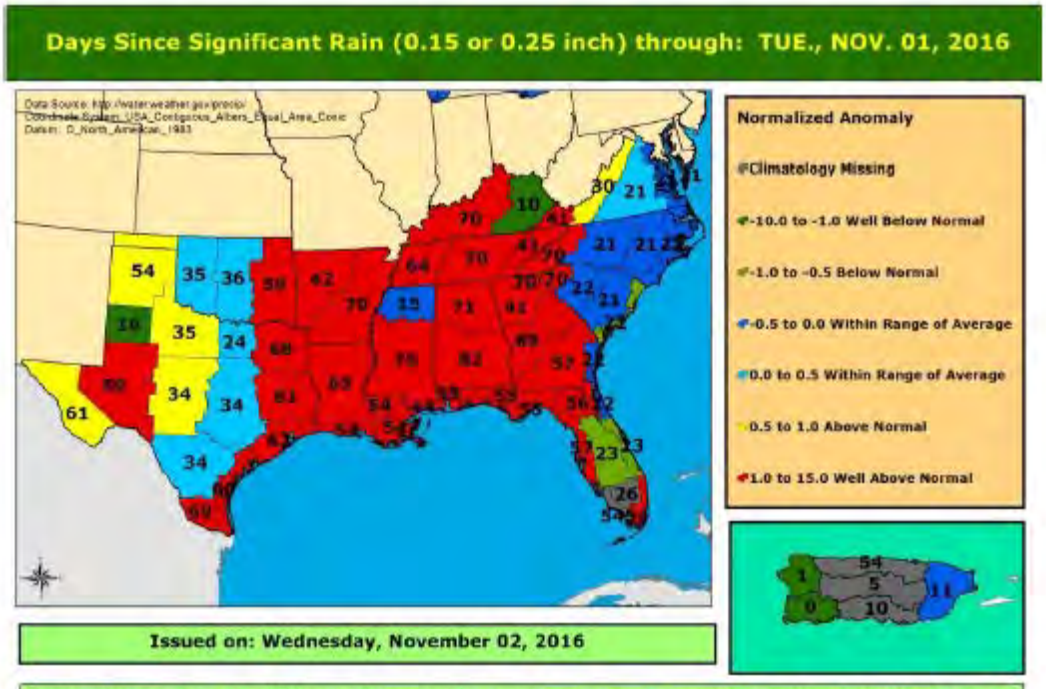
APFMZ has responded to four wildfires during the month of October in GRSM and BLRI. CHCH and BLRI each have had one fire suppressed by local VFD. In November BLRI had three sets on the West end of the Parkway. CHCH picked up a 15 acre fire and GRSM responded to a 0.1 acre fire that started right off the boundary. State and National Forest lands that surround GRSM have been active in fire response as well. NC forest service has two active large fires and the Cherokee National Forest currently has three active large fires. Local cooperators which many of the APFMZ rely on for assistance in fire suppression are busy as well which could hinder their ability to assist the park units of needed.

The continuing severe drought conditions across the area coupled with the fresh fuel load of newly fallen leaves will increase the probability for fires. Many of the federal lands have initiated back country burn bans to help reduce the possibility of ignition. The APFMZ is requesting funding for a 30 day period from November 4 – December 4, 2016. If conditions improve during this timeframe, severity expenditures will be terminated.

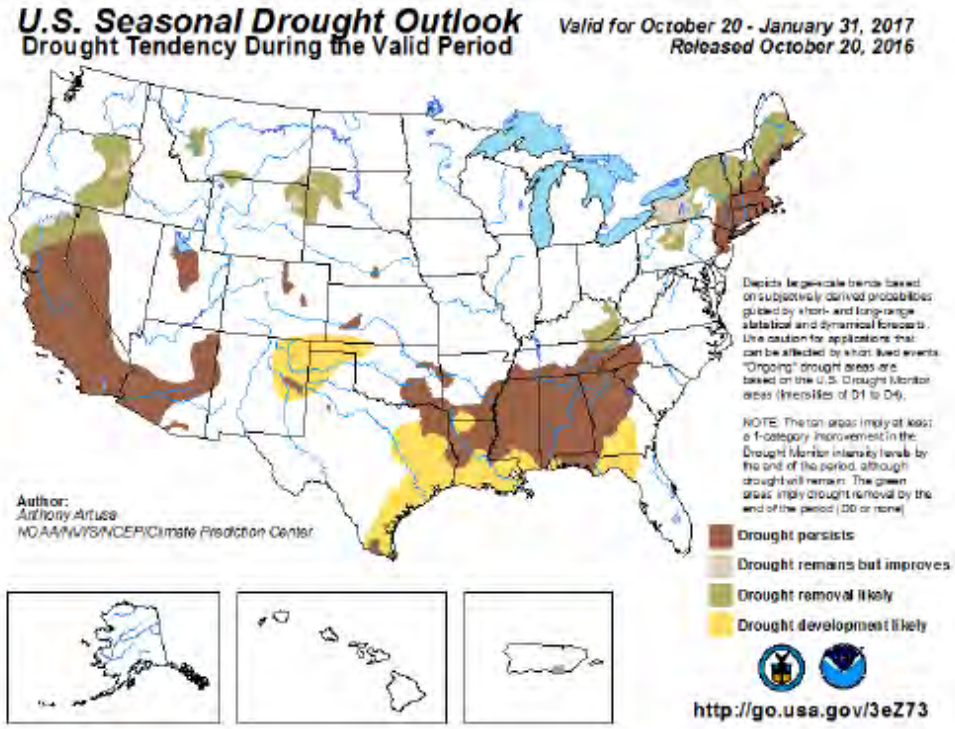
APFMZ will use this request for severity funding to pay for extended staffing hours during weekdays, weekends and holidays when weather parameters indicate periods of increased fire danger and increased staffing to meet equipment and overhead needs that are required. The funding request will also be used to partially pay base eight salaries for fuels funded individuals who hold various qualifications to assist with overhead positions and staff equipment.

Current Environmental Condition Indicators:

Much of the western part of the APFMZ is within the 95-97+ Energy Release component percentile.

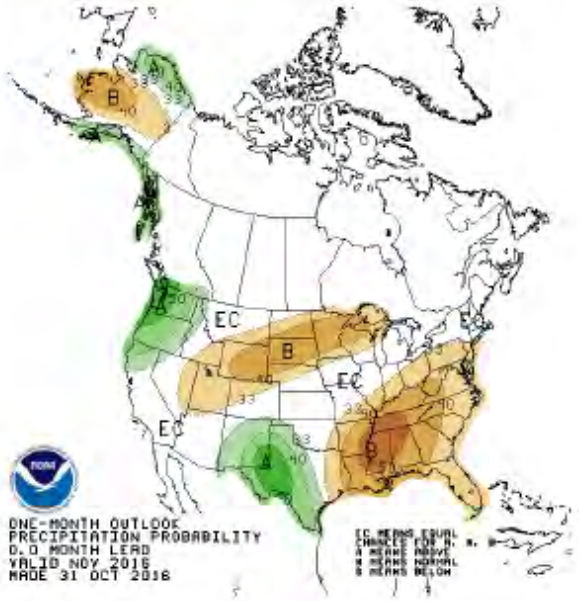


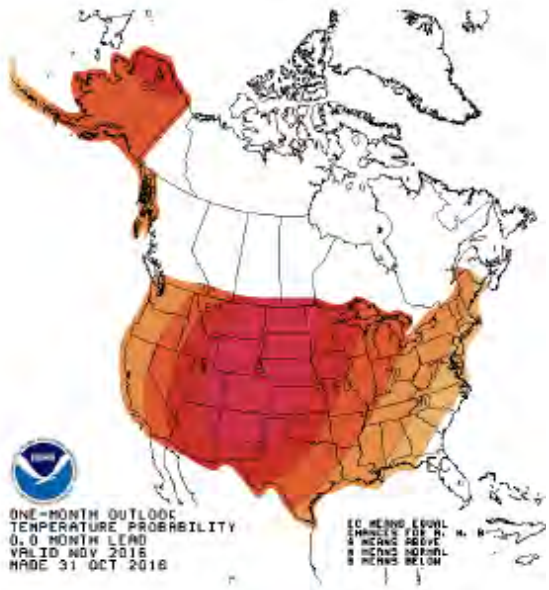
Drought condition will continue through the next several months.

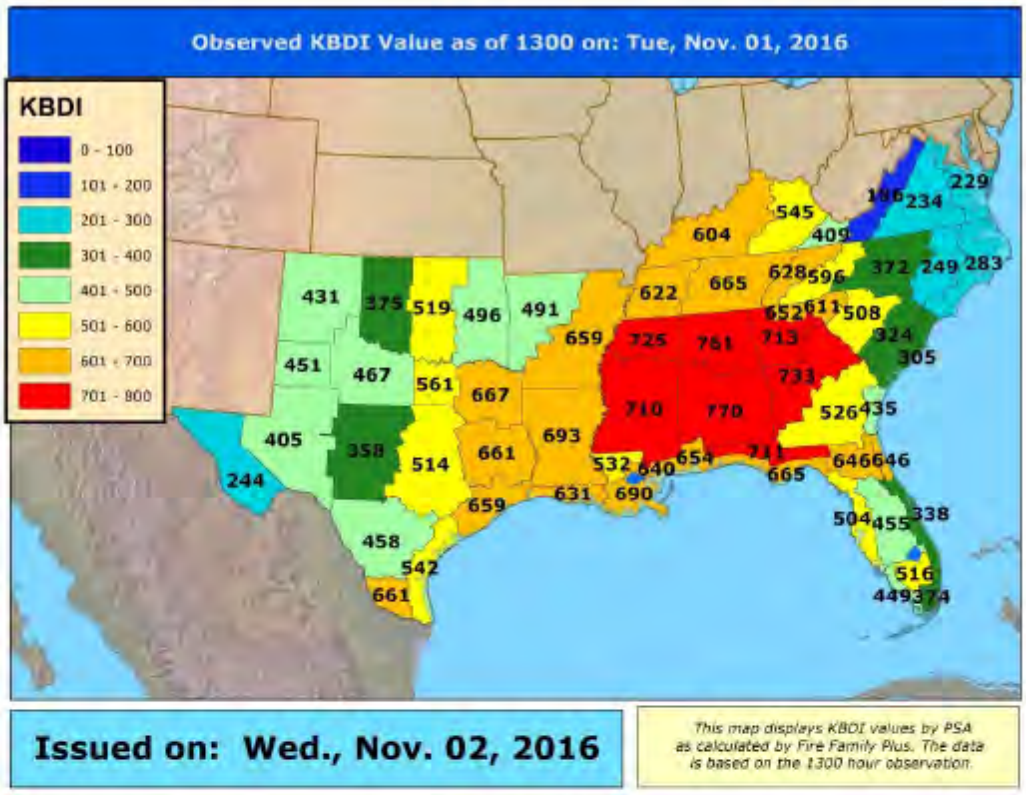


Precipitation and Temperature outlook for November:

The monthly probability maps indicate a significant chance of below normal precipitation.







Request:

The request would provide the resources in the GRSM Step-up plan for Staffing Class 4, Severity. However, the step-up plan is only specific for one park. Since the Appalachian-Piedmont is a zone and covers multiple park units the staffing will be utilized to support any area within the zone where the need arises. A spreadsheet outlining the estimated costs associated with this request is attached. The total cost for this request is $74,819.

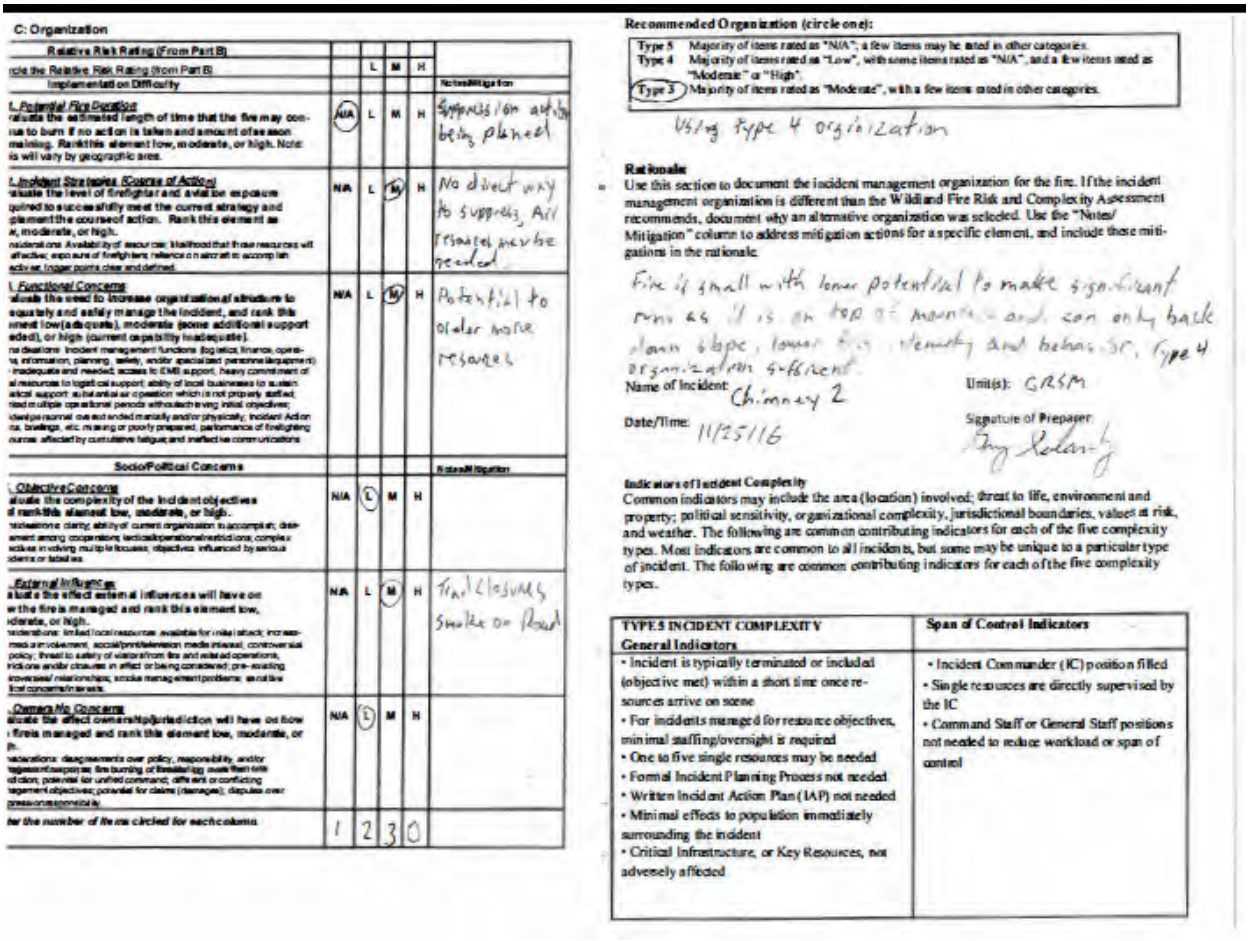
Summary:

The requested resources are critical for protecting various WUI areas both within and outside the park units. The probability of a fire starting in surrounding communities and entering the parks is great. This along with the vastness of the coverage area within the APFMZ will give the zone staff the ability to respond to wildfires with an initial attack capacity. If wildfires escape the initial attack response then it is expected that additional resources will be required to complete suppression. Other resources would include crews, engines and aviation resources such as helicopters and possibility tanker drops which are not figured into this request. It is the desire of the APFMZ staff to manage this severity request in the most cost effective manner.

Please contact Greg Salansky ZFMO, at 865-436-1247 or email Greg_Salansky@nps.gov if you have questions or require further details.

Appendix Five

Complexity Analysis



C: Organization

Relative Risk Rating (From Part B)					
role the Relative Risk Rating (from Part B)		L	M	H	
Implementation Difficulty					Notes/Mitigation
I. Potential Fire Duration alculate the estimated length of time that the fire may con- ue to burn if no action is taken and amount of season maining. Rank this element low, moderate, or high. Note: is will vary by geographic area.	N/A	L	M	H	Suppression action being planned
I. Incident Strategies (Course of Action) alculate the level of firefighter and aviation exposure quired to successfully meet the current strategy and plement the course of action. Rank this element as w, moderate, or high. nsiderations: Availability of resources; likelihood that these resources will effective; exposure of firefighters; reliance on aircraft to accomplish ectives; longer points clear and defined.	N/A	L	M	H	No direct way to suppress. All resources may be needed
I. Functional Concerns alculate the need to increase organization or structure to equately and safely manage the incident, and rank this ment low (adequate), moderate (some additional support eded), or high (current capability inadequate). nsiderations: Incident management functions (logistics, finance, opera- s, information, planning, safety, and/or specialized personnel/equipment) inadequate and needed; access to EMS support; heavy commitment of al resources to logistical support; ability of local businesses to sustain ential support; substantial air operation which is not properly staffed; ted multiple operational periods without achieving initial objectives; dent personnel overused and/or demotivated and/or physically, incident Action ns, briefings, etc. missing or poorly prepared; performance of firefighting ources affected by cumulative fatigue; and ineffective communications.	N/A	L	M	H	Potential to order more resources
Socio/Political Concerns					Notes/Mitigation
Objective Concerns alculate the complexity of the incident objectives d rank this element low, moderate, or high. nsiderations: clarity; ability of current organization to accomplish; dis- ement among cooperators; tactical/operational restrictions; complex- ectives involving multiple focuses; objectives influenced by serious idents or fatalities.	N/A	L	M	H	
External Influences alculate the effect external influences will have on w the fire is managed and rank this element low, derate, or high. nsiderations: limited local resources available for initial attack; increas- media involvement; social/print/television media interest; controversial policy; threat to safety of visitors from fire and related operations; rictions and/or closures in effect or being considered; pre-existing nsive/weak relationships; smoke management problems; sensitive l concerns/issues.	N/A	L	M	H	Trail Closures, Smoke on Road
Ownership Concerns alculate the effect ownership/jurisdiction will have on how fire is managed and rank this element low, moderate, or h. nsiderations: disagreements over policy, responsibility, and/or agement objectives; fire burning or threatening multi-jurisdic- ction; potential for unified command; different or conflicting agement objectives; potential for claims (damages); disputes over pressure responsibility.	N/A	L	M	H	
ter the number of times circled for each column.	1	2	3	0	

Recommended Organization (circle one):

Type 5 Majority of items rated as "N/A"; a few items may be rated in other categories.
Type 4 Majority of items rated as "Low", with some items rated as "N/A", and a few items rated as "Moderate" or "High".
(Type 3) Majority of items rated as "Moderate", with a few items rated in other categories.

Using type 4 organization

Rationale

Use this section to document the incident management organization for the fire. If the incident management organization is different than the Wildland Fire Risk and Complexity Assessment recommends, document why an alternative organization was selected. Use the "Notes/ Mitigation" column to address mitigation actions for a specific element, and include these mitigations in the rationale.

Fire is small with lower potential to make significant runs as it is on top of mountain and can only back down slope, lower fire intensity and behavior, type 4 organization sufficient

Name of Incident: Chimney 2

Unit(s): GRSM

Date/Time: 11/25/16

Signature of Preparer:

Indicators of Incident Complexity

Common indicators may include the area (location) involved; threat to life, environment and property; political sensitivity, organizational complexity, jurisdictional boundaries, values at risk, and weather. The following are common contributing indicators for each of the five complexity types. Most indicators are common to all incidents, but some may be unique to a particular type of incident. The following are common contributing indicators for each of the five complexity types.

TYPE 5 INCIDENT COMPLEXITY General Indicators	Span of Control Indicators
• Incident is typically terminated or included (objective met) within a short time once resources arrive on scene • For incidents managed for resource objectives, minimal staffing/oversight is required • One to five single resources may be needed • Formal Incident Planning Process not needed • Written Incident Action Plan (IAP) not needed • Minimal effects to population immediately surrounding the incident • Critical Infrastructure, or Key Resources, not adversely affected	• Incident Commander (IC) position filled • Single resources are directly supervised by the IC • Command Staff or General Staff positions not needed to reduce workload or span of control

Appendix Six

Fire Weather/Behavior

Pre-Fire Weather Conditions

There are many sources of weather and environmental data in and around Great Smoky Mountains National Park. The following resources all provided data used in this report: Remote Automated Weather Stations (RAWS), Hydrometeorological Automated Data System (HADS), National Park Service Air Quality Monitoring Stations, "Co-Op" Multi-Agency Meteorological Sites, and a National Ecological Observatory Network (NEON) site (Table 1).

Table 1 – Meteorological Stations Surrounding the Chimney Tops 2 Fire

Station Name	Type	Latitude, Longitude	Elevation (feet)	Distance from Fire Origin (miles)	Direction from Fire Origin (azimuth)
Cherokee	RAWS	35.6197, -83.2071	3366	15.25	93
Indian Grave	RAWS	35.6239, -83.8143	2721	19.0	269
Tow String	RAWS	35.5497, -83.2923	2994	11.8	118
Cow Mountain	RAWS	35.4741, -83.3227	2390	13.8	141
Cove Mountain	Air Quality	35.6966, -83.6096	4077	8.7	302
Cades Cove	Air Quality	35.6040, -83.7829	1845	17.3	264
Look Rock	Air Quality	35.6334, -83.9416	2628	26.1	271
Elkmont	Air Quality	35.6645, -83.5903	2760	6.75	290
Noland Divide	Water Quality	35.6560, -83.4765	5650	4.5	179
Newfound Gap	HADS NFGT1	35.6108, -83.4289	5005	3.1	117
NEON	Ecological Monitoring	35.6889, -83.5019	1891	4.25	341

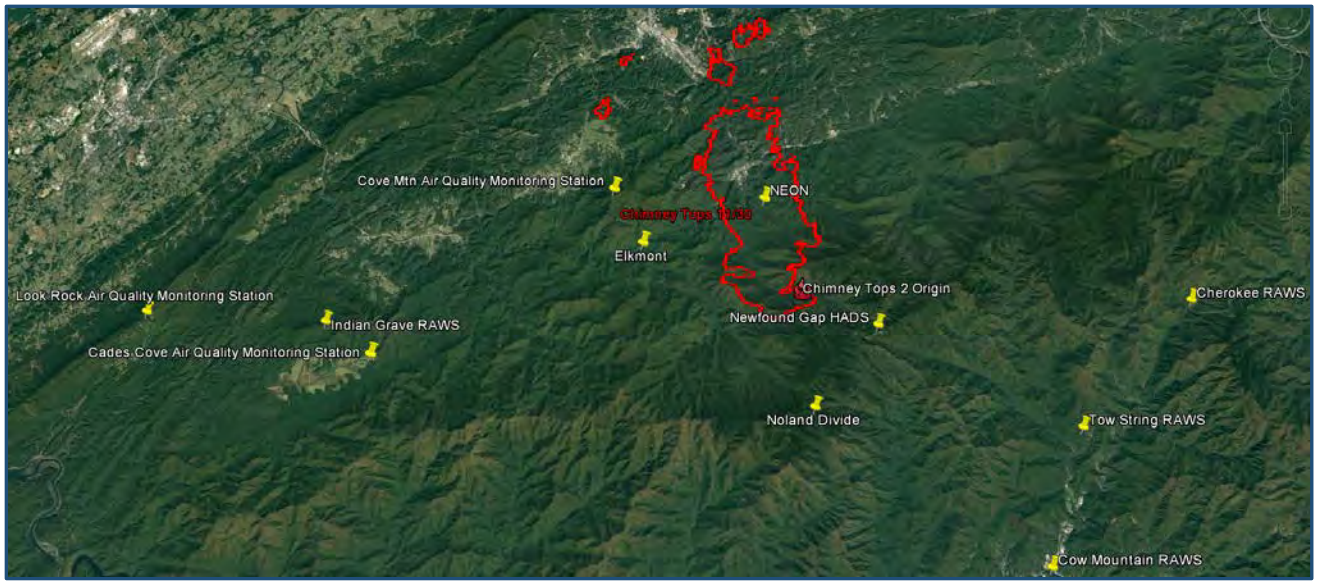


Figure 1 – The location of the RAWS stations used by Great Smoky Mountains National Park.

Drought

The Southern Area Risk Assessment for the fall of 2016 was distributed by the Southern Area Coordination Center Rapid Assessment Team and covered the time period from October 12 to December.

The escalating drought in the Southern Region was described as a serious concern for its potential impact on the fall fire season in terms of increased fire activity. This Risk Assessment noted that the trend of worsening drought conditions over most of the area of the southern Appalachian Mountains began in September 2015.

"Severe Drought" began to appear in late May 2016 in northern Alabama, Georgia, and extreme southern Tennessee. Over the summer months, the area of "Severe Drought" expanded and pockets of "Extreme Drought" began to appear. In late September, as "Extreme Drought" persisted in northeast Alabama and much of northern Georgia, a pocket of "Exceptional Drought" emerged in extreme northern Georgia and in southeast Tennessee, centered there on Hamilton County.

By late November, 60 percent of the state of Tennessee, including Sevier County where the Chimney Tops 2 Fire occurred, was classified as being in "Extreme Drought" or worse (Figure 2).

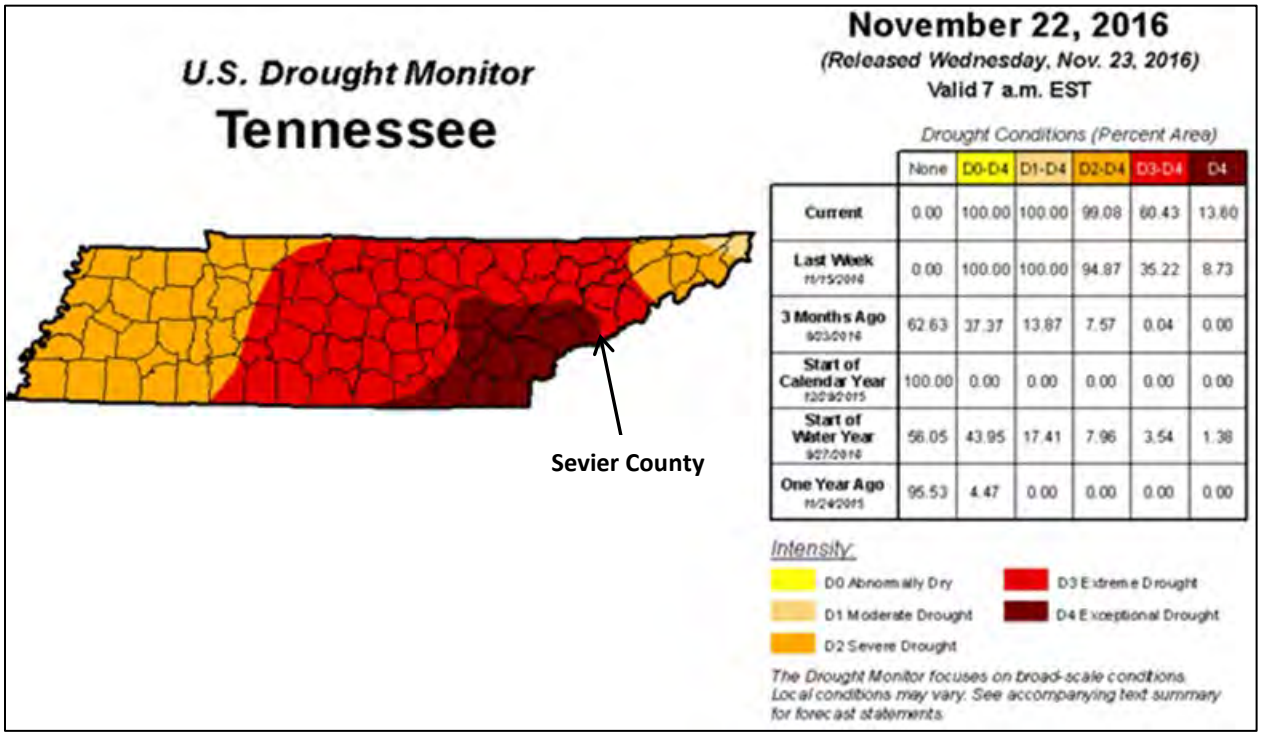


Figure 2 – State of Tennessee Drought Status.

The Keetch-Byram Drought Index (KBDI) was designed specifically for wildland fire potential assessment. It represents the net effect of both evapotranspiration and precipitation in producing cumulative moisture deficiency in duff and soil and is therefore related to the flammability of organic material in the ground. Data from the two Great Smoky Mountains National Park RAWS, Cherokee and Indian Grave, shows that KBDI was at a record-high level from late October until November 29, 2016 (Figure 3).

Temperature and Relative Humidity

Although the period from December 2015 to November 2016 was the record warmest such period for much of eastern Tennessee (Figure. 4), pre-fire RAWS maximum temperatures and minimum relative humidity were not exceptional. Examining the Great Smoky Mountains National Park RAWS historical data, that begins in 1997, reveals that the maximum air temperature did reach record highs on a few days in mid- and late-October and once in mid-November. In addition, both Indian Grave and Cherokee RAWS measured record low relative humidity in the days immediately preceding the Chimney Tops 2 Fire. The 1300 hour observations for Indian Grave RAWS for November 21-23 were 20%, 22%, and 21%, respectively; while Cherokee RAWS 1300 hour observations for November 20-23 were 8%, 9%, 23% and 21%, respectively.

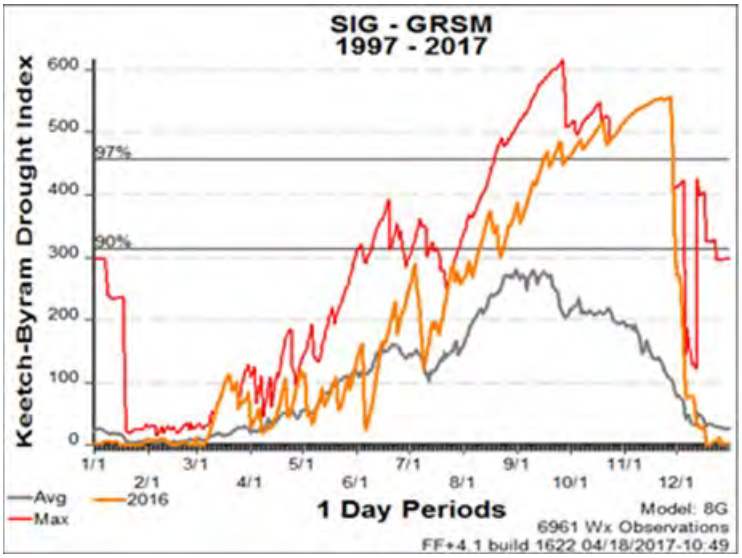


Figure 3 – Average, Maximum, and 2016 KBDI.

Precipitation

Analysis of the two Great Smoky Mountains National Park RAWS determined that both had recorded below average precipitation for the period January 1 to November 23, 2016. For the 20-year dataset from Indian Grave, the 34.0" was 71% of average, while for the 15-year dataset from Cherokee the 36.4" was about 66% of average.

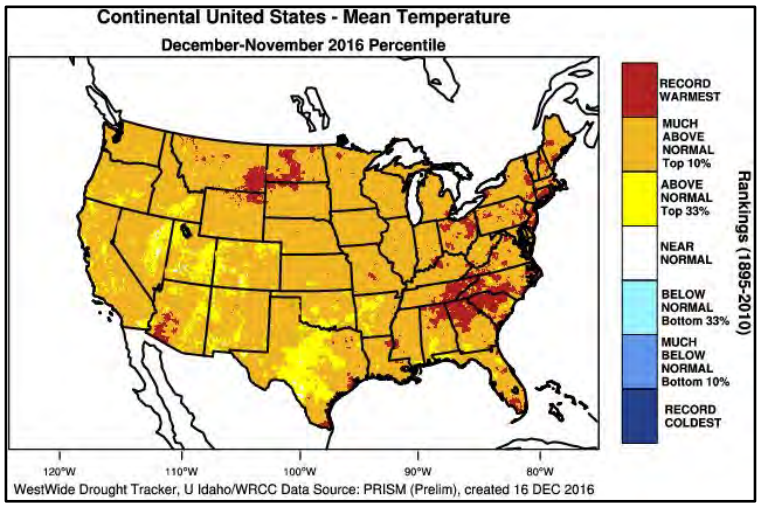


Figure 4 – Average temperature ranking for Dec. 2015-Nov 2016.

The Southern Area Risk Assessment that was distributed on October 11, 2016 noted that the frequency of precipitation events is more important than actual precipitation amounts in determining the type of fall fire season in the Appalachian Mountains. Precipitation frequency of three to five days can essentially prevent a fall fire season whereas frequency beyond seven days can become problematic.

Starting with the most recent rainfall in the area of the fire before the distribution of the Risk Assessment (October 8, 2016), precipitation frequency and amount were examined for two of the closest meteorological stations nearest to the Chimney Tops 2 Fire origin as well as the two Great Smoky

Mountains National Park RAWS. Amounts and frequencies varied, but all four stations had two rainless periods of more than 7 days. All four stations show a 12-day rainless period between October 8 and 21.

Subsequently, the Indian Grave RAWS and Newfound Gap Hydrometeorological Automated Data System (HADS) experienced a two week rainless period between the first and third week of November, while the mid-November rainless gap for Cherokee and Noland Divide was 9 days due to an episode of very light rain on November 9 (Figure 5).

All stations recorded precipitation the first night following discovery of the fire. Overnight on November 23rd-24th, Noland Divide measured 0.37", Newfound Gap 0.03", Cherokee 0.28" and Indian Grave 0.05" of rainfall. In addition, the Incident Commander left a rain gauge overnight near the fire origin that measured approximately 0.01" of rainfall.

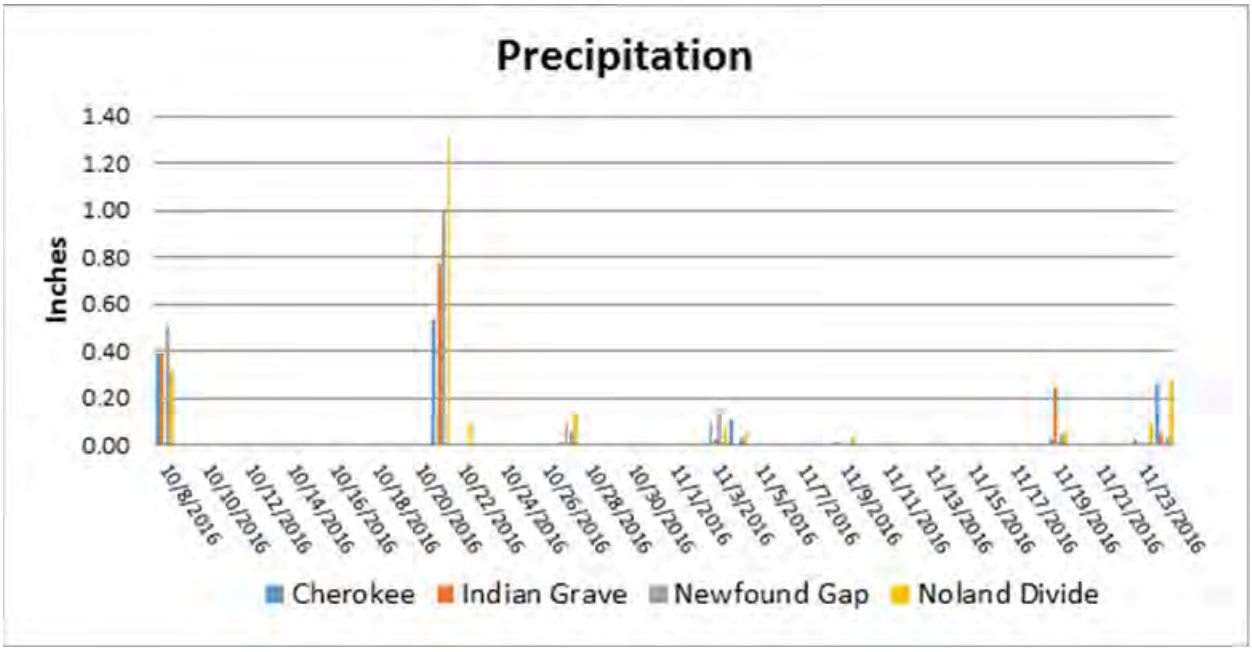


Figure 5 – Precipitation Frequency and Amount.

Fuels and Seasonal Severity

The vegetation in the area of the Chimney Tops 2 Fire is dominated by deciduous forest with pockets of short-needle pine. Conifers are found in greater numbers on exposed or partially exposed ridge tops and upper slopes. The upper slopes of Chimney Tops, where the fire originated, were covered in short- to mid-stature shrubs. Hemlock forest was present, but most of these trees have been killed by the hemlock wooly adelgid, leaving abundant snags on the landscape.

During the early stages of the fire, the area's standing hemlock snags showed much breakage of limbs and tops, but overall probably did not add a significant amount of downed woody debris to the fuel bed when compared to other surface and ground fuels. A larger contribution to the fuels environment by dead hemlocks may have been the absence of their former role in shading the forest floor, resulting in increased warming and drying of surface fuels.

Fuels in the area of the fire consist mostly of hardwood litter accompanied by moderate to deep duff layers. Dense growth of understory shrubs such as rhododendron and mountain laurel are common in both hardwood and conifer stands.

Deciduous leaf fall was underway to various degrees at different locations of the eventual fire footprint, and most locations still had some dried foliage in tree canopies. In normal years, much of the leaf fall is compressed by precipitation and moisture as it lies on the forest floor. At the time of the fire in late November 2016, however, due to the drought and infrequency of rain, much of the hardwood litter could be described as "fluffy"—loose, not compacted, and easily moved by wind.

Extreme drought conditions dry out heavier fuels and duff layers, making them available to burn. Moisture content of live fuels may also be lowered in response to prolonged drought. Leaf litter and other fine fuels respond to diurnal patterns of temperature and relative humidity. Although no local fuel moisture measurements are available for the time period, the local RAWS and National Fire Danger Rating System outputs provide some information on the condition of fuels.

Cherokee is the closest Great Smoky Mountains National Park RAWS to the fire origin and also the RAWS closest in elevation. By mid-October, the calculated 1000-hour fuel moisture was already below normal and continued to decrease to a record minimum value of 15% on November 22.

The Energy Release Component (ERC) is also a calculated index that reflects the contribution of all live and dead fuels to potential fire intensity. The Cherokee ERC rose steadily following the last significant measured rainfall in mid-October, surpassing the 97th percentile of 36 in early November before setting historical highs of 58 in the days immediately before the Chimney Tops 2 Fire (Figure 6).

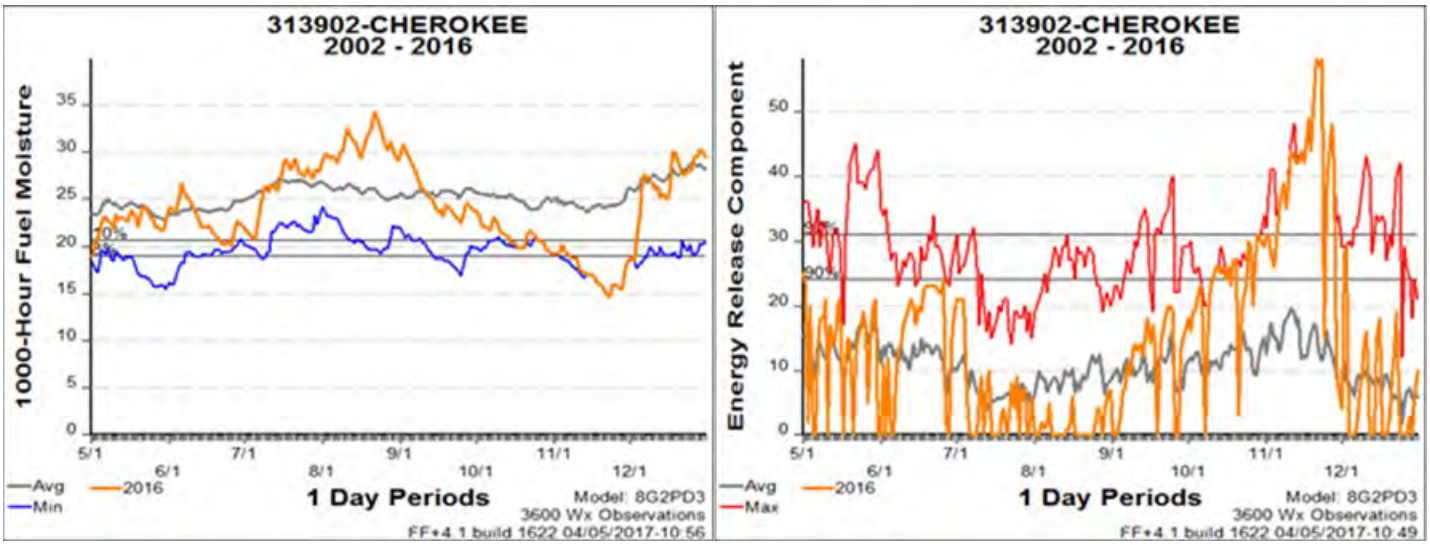


Figure 6 – Cherokee RAWS NFDRS Outputs: 1000-hr Fuel Moisture (left) and ERC (right).

Data on fuel loading in the area of the fire origin is lacking because fuels management activities that would measure it emphasize hazardous fuel reduction in Wildland Urban Interface areas near the edge of the park. The fuel loading in the area of the fire, and throughout the park and the Appalachian Region, is the result of a long and complex fire regime story that most recently reflects the successful exclusion of fire (Lafon et al 2017).

Fire Danger

The Energy Release Component (ERC), KBDI, and 1000-hour fuel moisture are National Fire Danger Rating System (NFDRS) indices that reflect the seasonal severity well because they can reflect worsening trends in drought and fuel bed dryness. They use weather observation from entire 24-hour periods in their calculation. The Great Smoky Mountains National Park Step-Up Plan uses Burning Index (BI) to determine staffing level and is also used on the park's Fire Danger Pocket Cards. (The Fire Danger Pocket Card provides a format for interpreting and communicating key index values provided by the National Fire Danger Rating System. The objective is to lead to greater awareness of fire danger and subsequently increased firefighter safety.) The BI is calculated from a single afternoon observation and during the fire showed greater day-to-day variability than either ERC or KBDI. The BI was higher on the day of the fire discovery (November 23) than on the day of the large spread event (November 28). (See Table 2.)

Table 2 – BI, ERC, and KBDI – November 16-29, 2016

BI, ERC and KBDI leading up to the Event

Cherokee RAWS (Observed Indices)

Fuel Model E

Date	B I	ERC	KBDI
11/16/16	39	32	500
11/17/16	42	35	502
11/18/16	52	38	506
11/19/16	39	29	509
11/20/16	49	45	509
11/21/16	56	48	509
11/22/16	46	40	511
11/23/16	58	40	512
11/24/16	0	0	505
11/25/16	25	23	506
11/26/16	43	35	507
11/27/16	42	38	508
11/28/16	28	20	509
11/29/16	0	0	361

Fuel Model G

Date	B I	ERC	KBDI
11/16/16	39	43	500
11/17/16	41	45	502
11/18/16	48	49	506
11/19/16	40	44	509
11/20/16	54	47	509
11/21/16	53	58	509
11/22/16	47	57	511
11/23/16	56	59	512
11/24/16	0	16	505
11/25/16	31	38	506
11/26/16	46	44	507
11/27/16	46	49	508
11/28/16	39	41	509
11/29/16	0	0	361

Indian Grave RAWS (Observed Indices)

Fuel Model E

Date	B I	ERC	KBDI
11/16/16	42	36	591
11/17/16	41	38	593
11/18/16	48	42	596
11/19/16	24	22	596
11/20/16	31	34	595
11/21/16	38	42	595
11/22/16	44	41	596
11/23/16	48	42	597
11/24/16	35	24	598
11/25/16	11	7	599
11/26/16	32	27	599
11/27/16	39	38	600
11/28/16	38	30	601
11/29/16	0	0	545

Fuel Model G

Date	B I	ERC	KBDI
11/16/16	47	62	591
11/17/16	47	66	593
11/18/16	53	70	596
11/19/16	34	53	596
11/20/16	39	59	595
11/21/16	45	65	595
11/22/16	49	67	596
11/23/16	52	70	597
11/24/16	42	54	598
11/25/16	24	40	599
11/26/16	43	51	599
11/27/16	47	59	600
11/28/16	49	57	601
11/29/16	0	0	545

Topography

The Chimney Tops 2 Fire origin is located very close to and just below the peaks of Chimney Tops Mountain, a double-peaked, exposed bedrock summit with an elevation of 4,724 feet. The sloping terrain surrounding these peaks is extremely steep with multiple forested ridges radiating from the summits on the south, east, north, and northwest. Expressing slope as a percent becomes difficult to interpret in such extreme terrain because as slopes approach vertical, slope percentages approach infinity.

The National Elevation Dataset (NED) produced by the U.S. Geological Survey is the digital elevation model used in the Wildland Fire Decision Support System (WFDSS). Using a 30-meter resolution, much of the area surrounding the fire origin is characterized by slopes in excess of 35 degrees, or 70% slopes, with areas near the fire origin of more than 50 degrees, or up to 128% (Figure 7).

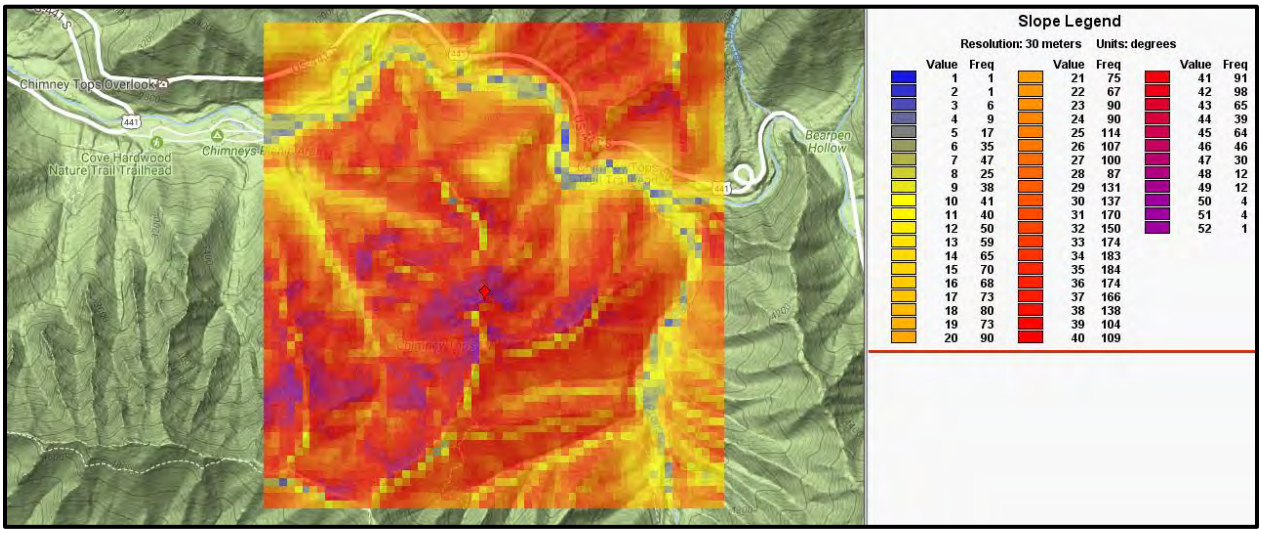


Figure 7 – Topography of fire area near Chimney Tops.

The fire origin and the terrain comprising Sugarland Mountain to the west are the highest elevations where the fire burned, with maximum elevations around 4,700-5,000 feet. Elevation generally decreases from Sugarland Mountain north six miles to around 1,300-1400 feet around Gatlinburg.

References

Lafon, Charles W., Naito, Adam T., Grissino-Mayer, Henri D., Horn, Sally P., and Waldrop, Thomas A. 2017. Fire History of the Appalachian Region: A Review and Synthesis. U.S. Forest Service, Southern Research Station, General Technical Report SRS-219. 108p.

Monitoring

Great Smoky Mountains National Park has not had a fuel moistures monitoring program in place for an extended period of time. During the last year, the park fire staff had not taken fuel sample readings or conducted any type of monitoring of their drought conditions beyond tracking from the RAWS. While the park had a fuels oven purchased, there has been a delay of almost one year installing it.

Spot Weather Forecasts did not have any feedback during the period of the fire. While the park has provided feedback, this is not a consistent practice. While it is not policy to do so, it is in the best interest of maintaining accuracy in weather forecasts for local areas.

Fire Environment

On November 23, three components of the fire environment were favorable for the ignition and spread of the fire on Chimney Tops.

1. Extreme drought conditions had resulted in duff fuels being available to burn whereas in more normal years duff at that altitude is probably fairly moist.
2. The two Great Smoky Mountains National Park RAWS (Cherokee and Indian Grave) and two other nearby meteorological stations measured fairly low relative humidity (RH) during a 30-hour period immediately before the discovery of the fire on November 23 (Figure 3). Low overnight RH is favorable for increased fire activity because fine fuels do not recover fuel moisture to the extent possible with more normal, higher nighttime humidity.
3. The afternoon and evening of November 23 were fairly breezy (Figure 6). Cove Mountain, the location of the Great Smoky Mountains National Park Air Quality Monitoring station, located less than nine miles NW of the fire, recorded ten consecutive hours of sustained, one hour-average wind speed above 20 mph and nine hours with peak wind gusts above 40 mph on November 23rd-24th, generally from the SSW. Enhanced oxygen flow to a small fire burning in duff and litter sheltered by shrubs and terrain would enhance burning conditions compared to similar conditions with little wind.

The evening of November 23, the Incident Commander estimated the fire at 1.5 acres or less and observed a lot of smoke production as the fire slowly established itself in the duff and litter fuels below the northern pinnacle of the summit of Chimney Tops. The next morning it appeared that a small amount of rain had fallen overnight on the fire. The fire was observed to be only marginally larger than the night before, but limited to smoldering and creeping fire behavior with no visible active flame. The estimated fire size for November 24 was 2 acres. Throughout the day, wind speeds at Cove Mountain gradually decreased before picking up slightly overnight.

Friday November 25 was a cloudy day with high minimum relative humidity and light winds. Cherokee RAWS RH percent only dropped into the mid-40s for three hours by late afternoon. The fire again showed minimal fire behavior, creeping, smoldering, and backing downhill. Estimated size at this time was 3 acres.

Area temperatures dropped overnight on November 25th-26th, with the Newfound Gap HADS station recording temperatures in the upper 20°F while the Cherokee RAWS air temperature dropped to the low 30s. Below the Chimney Top summit a cloud layer remained until lifting around midday Saturday November 26. Frost had formed on the vegetation in the fire area.

After the inversion lifted, leaving clear skies in the afternoon, fire behavior picked up slightly in the form of brief and isolated torching of small-stature shrubs. Up to this point the fire had mainly expanded on the north and east of the northernmost of the two Chimney Tops pinnacles.

The afternoon of November 26 saw generally light winds at the nearby weather stations but with more variable directions including SE and E in contrast to the general south-southwest flow of the previous days. The steep, complex terrain around Chimney Tops also undoubtedly influenced diurnal wind

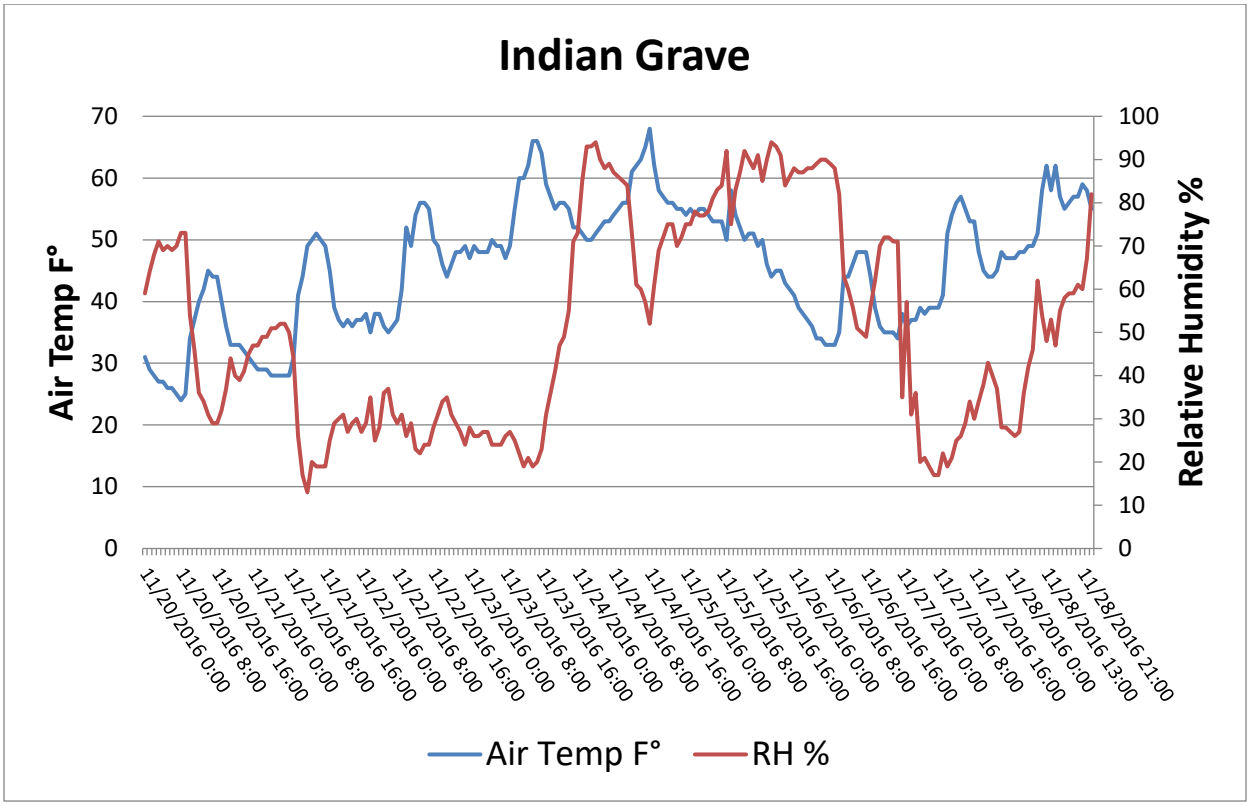
patterns. The afternoon of November 26 also experienced additional expansion of the fire to the west. At this time the estimated fire size was 6-8 acres.

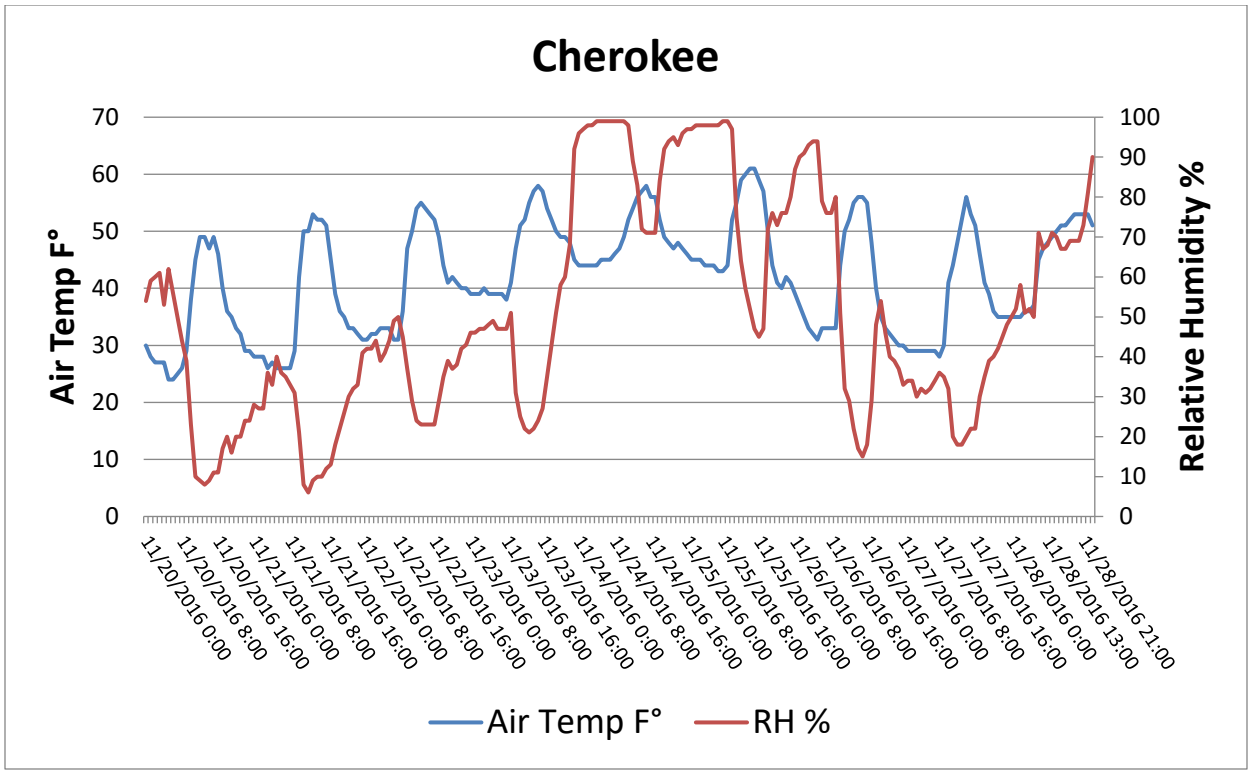
During the course of November 26 relative humidity continued to drop. Overnight on the 26th-27th, relative humidity remained quite low. The minimum RH for November 26 at the Noland Divide weather station was measured at 2350 hours at 14%. The minimum daily RH at the Newfound Gap HADS station was 7%, recorded at 2200 hours and 2315 hours, while the Cove Mountain Air Quality Monitoring Station measured a daily minimum RH of 9% at 2300 hours.

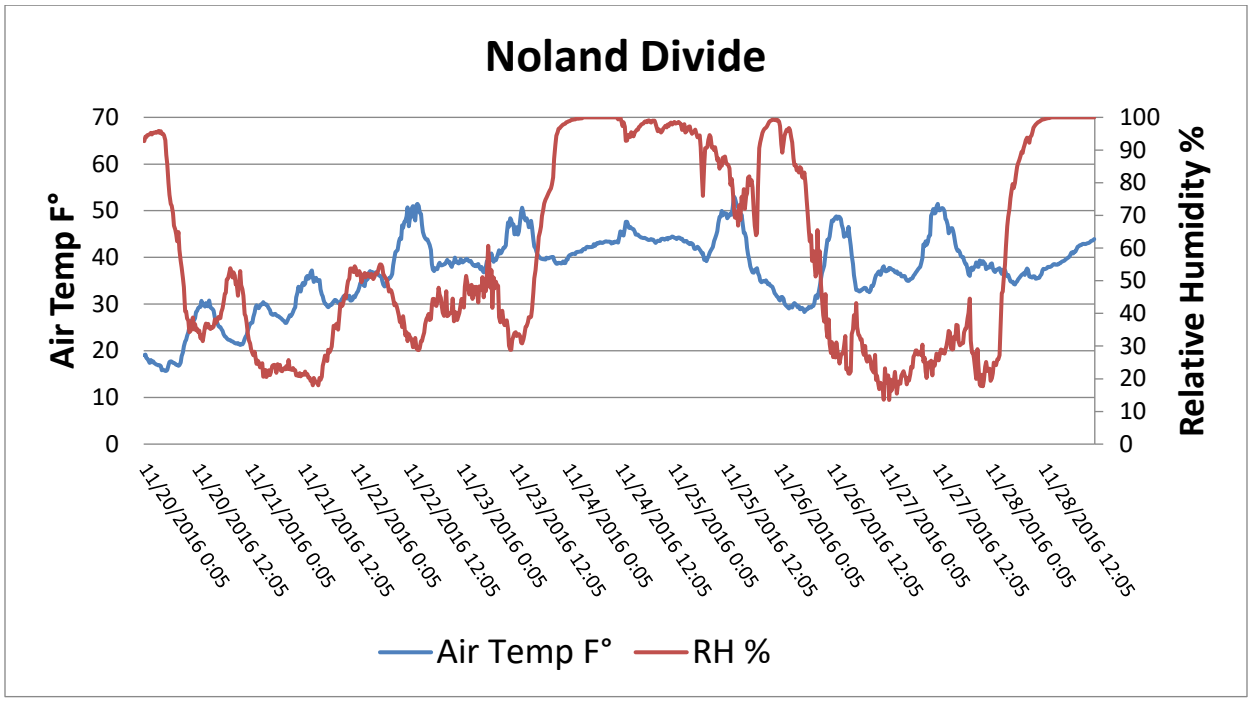
The patterns of relative humidity at the Great Smoky Mountains National Park RAWS were more typical in the way RH dropped in the afternoon of November 26 and then began to increase later in the day, but the RH also dropped overnight. Minimum afternoon RH that was measured around 1500-1600 hours for both Cherokee and Indian Grave (15% and 49%, respectively), rebounded in the late afternoon and early evening, but then began to drop again very late in the day. For instance, Indian Grave RAWS measured RH percent in the low 70s the last few hours of November 26, but the RH dropped to 17% by 0700 the next day. Cherokee RAWS RH reached 54% the early evening of November 26 and dropped into the low-mid 30% range overnight, then reached the November 27 low of 18% at 1200 hours (Figure 2).

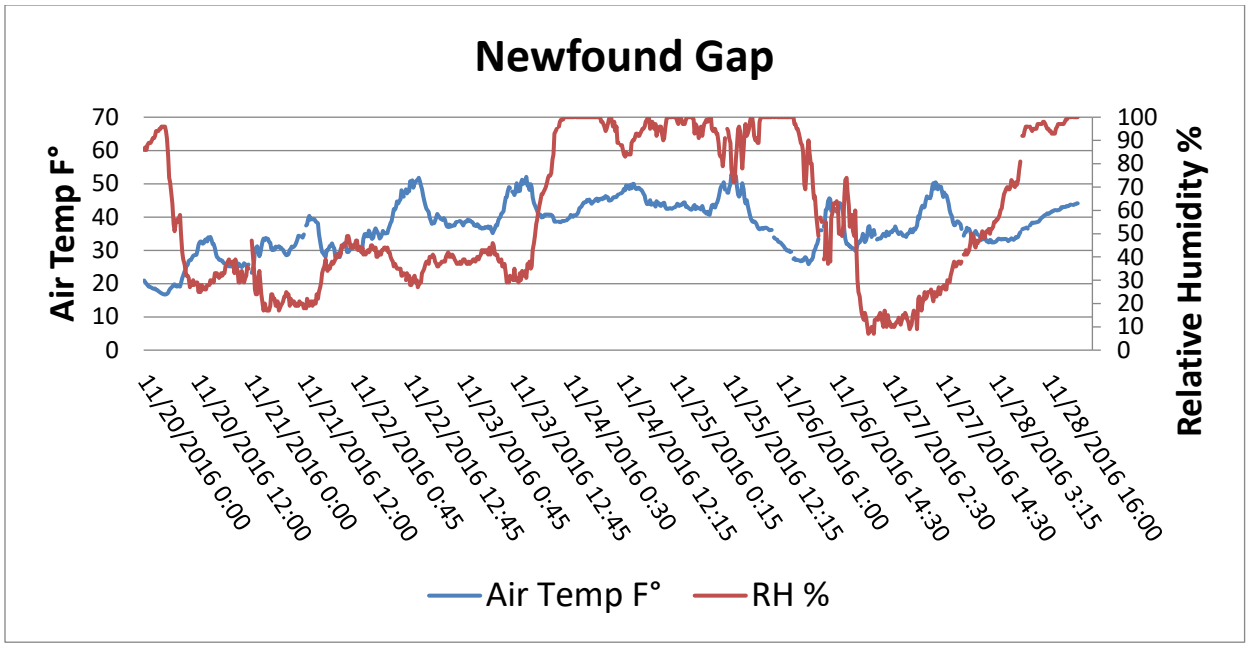
The Tow String RAWS is the closest RAWS to the fire origin, located 12 miles to the southeast. The relative humidity dropped from 96% on the morning of November 26 to 16% in five hours. The RH percent rebounded to the low 30s by that evening, but remained below 35% until almost midnight of November 27 (Figure 2).

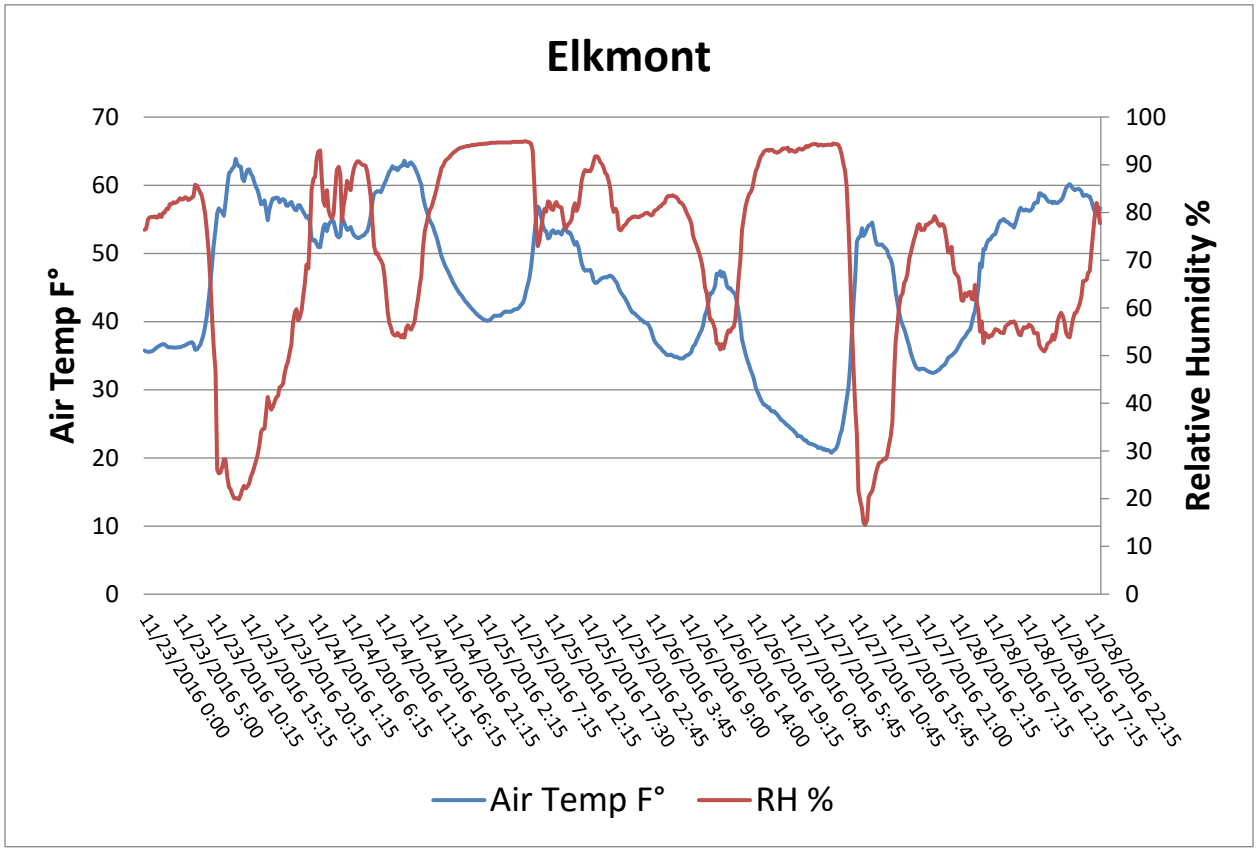
The Cove Mountain Air Quality Monitoring Station is less than 9 miles northwest of the fire origin and about 5 miles west of the City of Gatlinburg. On November 26 the relative humidity dropped from over 90% in the late morning to less than 10% at 2300 hours. Single-digit relative humidity was recorded for 9 consecutive hours overnight on November 26 into November 27 (Figure 8).




Cherokee
Air Temp F°
Relative Humidity %
70
60
50
40
30
20
10
0
100
90
80
70
60
50
40
30
20
10
0
11/20/2016 0:00
11/20/2016 8:00
11/20/2016 16:00
11/21/2016 0:00
11/21/2016 8:00
11/21/2016 16:00
11/22/2016 0:00
11/22/2016 8:00
11/22/2016 16:00
11/23/2016 0:00
11/23/2016 8:00
11/23/2016 16:00
11/24/2016 0:00
11/24/2016 8:00
11/24/2016 16:00
11/25/2016 0:00
11/25/2016 8:00
11/25/2016 16:00
11/26/2016 0:00
11/26/2016 8:00
11/26/2016 16:00
11/27/2016 0:00
11/27/2016 8:00
11/27/2016 16:00
11/28/2016 0:00
11/28/2016 13:00
11/28/2016 21:00
Air Temp F°
RH %


Noland Divide
Air Temp F°
Relative Humidity %
70
60
50
40
30
20
10
0
100
90
80
70
60
50
40
30
20
10
0
11/20/2016 0:05
11/20/2016 12:05
11/21/2016 0:05
11/21/2016 12:05
11/22/2016 0:05
11/22/2016 12:05
11/23/2016 0:05
11/23/2016 12:05
11/24/2016 0:05
11/24/2016 12:05
11/25/2016 0:05
11/25/2016 12:05
11/26/2016 0:05
11/26/2016 12:05
11/27/2016 0:05
11/27/2016 12:05
11/28/2016 0:05
11/28/2016 12:05
Air Temp F°
RH %


Newfound Gap
Air Temp F°
Relative Humidity %
70
60
50
40
30
20
10
0
100
90
80
70
60
50
40
30
20
10
0
11/20/2016 0:00
11/20/2016 12:00
11/21/2016 0:00
11/21/2016 12:00
11/22/2016 0:45
11/22/2016 12:45
11/23/2016 0:45
11/23/2016 12:45
11/24/2016 0:30
11/24/2016 12:15
11/25/2016 0:15
11/25/2016 12:15
11/26/2016 1:00
11/26/2016 14:30
11/27/2016 2:30
11/27/2016 14:30
11/28/2016 3:15
11/28/2016 16:00
Air Temp F°
RH %


Elkmont
Air Temp F°
Relative Humidity %
70
60
50
40
30
20
10
0
100
90
80
70
60
50
40
30
20
10
0
11/23/2016 0:00
11/23/2016 5:00
11/23/2016 10:15
11/23/2016 15:15
11/23/2016 20:15
11/24/2016 1:15
11/24/2016 6:15
11/24/2016 11:15
11/24/2016 16:15
11/24/2016 21:15
11/25/2016 2:15
11/25/2016 7:15
11/25/2016 12:15
11/25/2016 17:30
11/25/2016 22:45
11/26/2016 3:45
11/26/2016 9:00
11/26/2016 14:00
11/26/2016 19:15
11/27/2016 0:45
11/27/2016 5:45
11/27/2016 10:45
11/27/2016 15:45
11/27/2016 21:00
11/28/2016 2:15
11/28/2016 7:15
11/28/2016 12:15
11/28/2016 17:15
11/28/2016 22:15
Air Temp F°
RH %

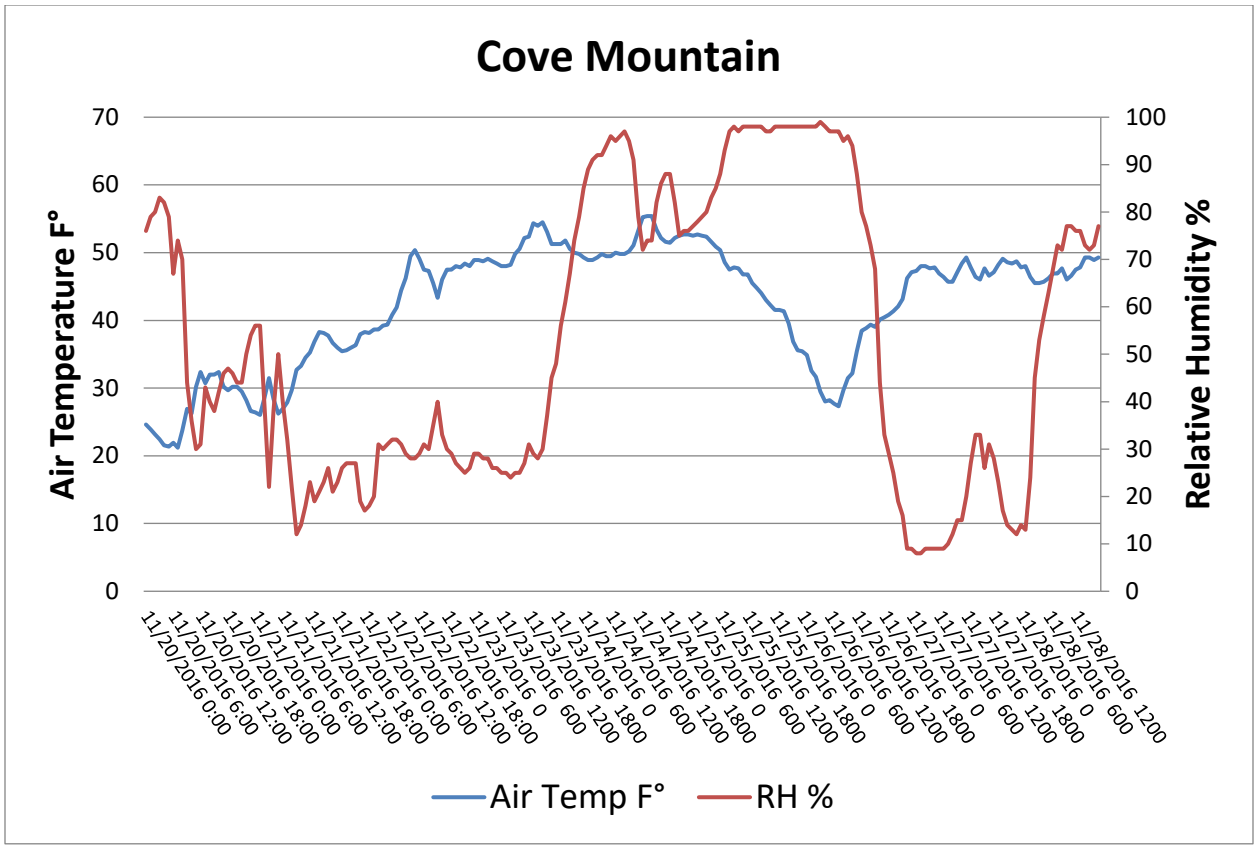


Figure 8 – Air Temperature and Relative Humidity patterns from November 20 to late November 28 for six area meteorological stations. Note the very low overnight relative humidity in the days preceding the fire discovery and between November 26-27.

The low overnight RH recovery on November 26-27 kept fine fuels dry and created a long burn period the following day. On November 27 at 0755 the fire was observed to be actively burning with some torching of shrubs and was estimated at 10 acres. Winds from area weather stations were fairly light and were described as calm at the fire. The fire grew from an estimated 10 acres in the morning to about 35 acres when mapped by a Multi Mission Aircraft (MMA) at around 1549 hours (Figure 9). Fire behavior was described as a backing fire, but rollout of burning debris probably occurred as well on the steep slopes around the pinnacles.

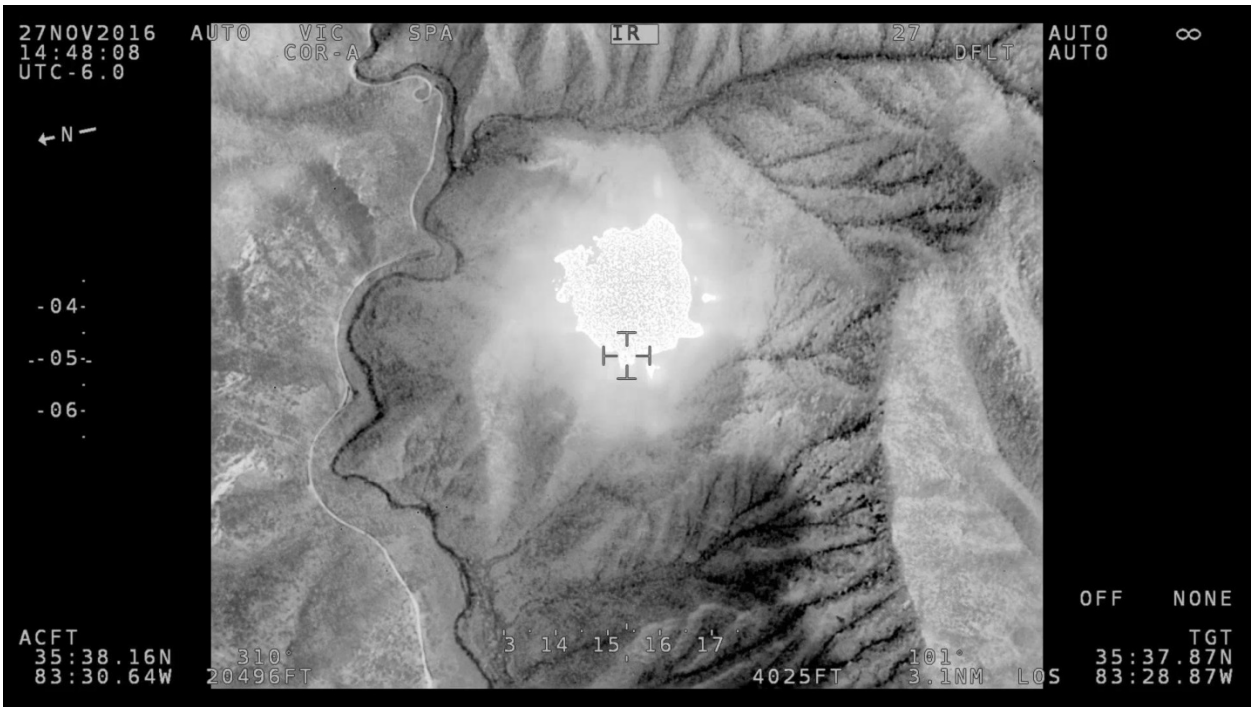


Figure 9 – Infrared image from Multi Mission Aircraft.

For the first time since the fire started, the fire was large enough and fire intensity was high enough on November 27 to be captured by the Visible Infrared Imaging Radiometer Suite (VIIRS) on the Suomi NPP Satellite (Figure 10).

Figure 10 – November 27 satellite image showing VIIRS hotspots.

Helicopter water drops that occurred during the afternoon of November 27 appeared to have cooled down the fire, but enough fire remained on the northwest and west sides of Chimney Tops for the fire to continue spreading to the west overnight. Sometime overnight fire activity increased, probably from a combination of backing, rollout, spotting, reduced relative humidity, and increased winds. On the

morning of November 28, the fire was positioned south of the Chimneys Picnic Area and was estimated at 250-500 acres. At approximately 0700 hours on November 28, a spot fire was also observed north of Highway 441 on a south aspect.

The Cove Mountain Air Quality Monitoring Station measured wind direction that was consistently from the south from 1600 hours on November 27 until 1000 hours on November 28, when the direction shifted to be more southeasterly. Wind direction from area Remote Access Weather Stations (RAWS) was much more variable, probably because terrain and sheltering by vegetation is more of an issue with RAWS, where wind instrumentation is 20 feet above ground level. The instruments at the Cove Mountain Air Quality Monitoring Station are located 98 feet above ground level.

The standard sampling height for fire weather stations is 20 feet. Fire weather and Spot Weather Forecasts use the 20-foot wind speed and direction. For comparison, and for fire behavior modeling, the Cove Mountain Air Quality Monitoring Station wind speeds need to be downscaled to 20-foot wind speeds prior to applying the appropriate wind reduction factor to reduce the wind speed to mid-flame wind speed for fire behavior modeling. A standard logarithmic wind profile was used to reduce the wind speeds recorded at Cove Mountain down to 20-feet above ground level. Thus, the November 28 0700 hours Cove Mountain hourly average 27 mph wind speed and peak 48 mph wind speed would be 17 and 30 mph 20-foot wind speeds respectively.

A fire behavior model was used to examine fire spread late on November 27 and early November 28. WindNinja 3.1 was used to develop gridded winds based on 30 mph 20-foot wind speed and 180 degrees wind direction. The “Conservation of Mass and Momentum solver” of WindNinja was used because it improves flow predictions on the lee side of terrain obstacles compared to the “Conservation of Mass solver” (Wagenbrenner et al 2016).

The Chimney Tops pinnacles and the surrounding complex terrain deflect modeled southerly winds. The gridded winds from WindNinja were used as inputs to the Minimum Travel Time (MTT) module of FlamMap 5.0. Using simulated ignition points around the Multi Mission Aircraft’s mapped perimeter and a 12-hour simulation time, the model shows how the complex terrain may have influenced fire spread to the west, where the fire was positioned south of the Chimney Picnic area in the early morning of November 28 (Figure 11).

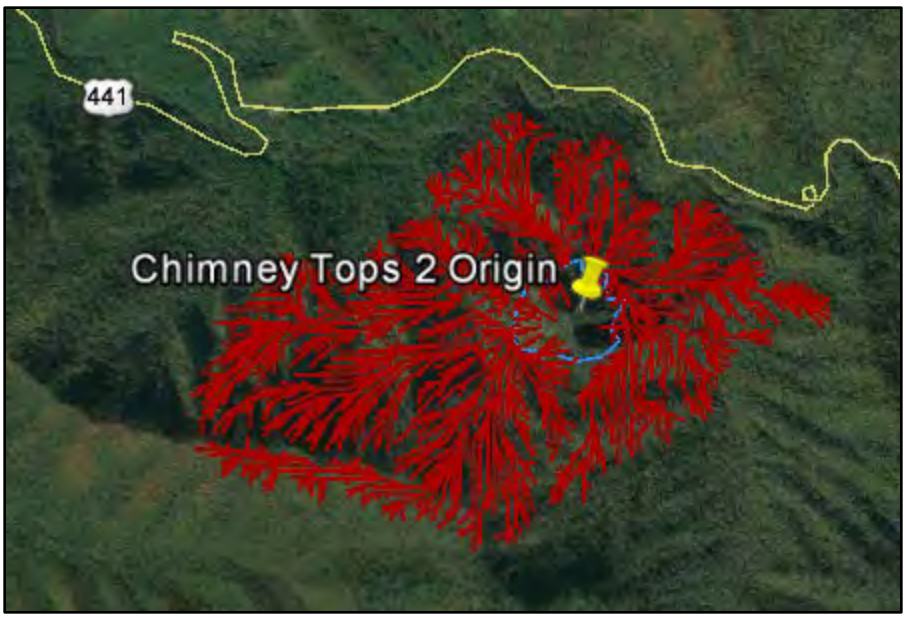


Figure 11 – Fire spread flow paths from the MTT model of FlamMap.

The Cove Mountain Air Quality Monitoring Station had measured 32 consecutive hours with RH below 35%, including 17 hours below 25%. The RH at Cove Mountain only began to rise above 30% at 0300 hours on November 28, but by then winds had begun ramping up.

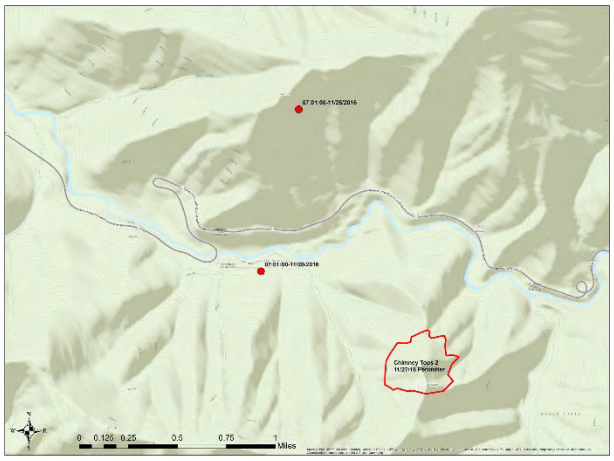


Figure 12 – Red outline at bottom shows the Chimney Tops 2 Fire's perimeter on November 27. Lower red dot indicates the Chimney Picnic Area where the fire had spread by the morning of November 28. Top red dot is a spot fire on Bullhead Ridge that was observed on the morning of November 28.

The spot fire was about 0.5 mile north of Newfound Gap Road and about 0.6 to 0.8 miles from some of the lower ridges of Sugarland Mountain above the West Prong of the Little Pigeon River. Well established by 0800 hours on the November 28, the fire was now aligned with both slope and wind (Figure 12).

As the fire was pushed northward by winds that increased throughout the day, it burned into lower elevations that probably had even drier fuels than those around the fire's origin. In addition, the fire moved into stands of Table Mountain Pine (*Pinus pungens*), a fire-dependent conifer with a mountain laurel (*Kalmia latifolia*) understory that occupies the upper windward (south aspect) slopes of Bullhead Ridge and other prominent ridges that radiate westward from 6,593-foot Mt. LeConte. These pine stands burned intensely and resulted in high-severity fire effects (Figure 13). Windy, dry conditions and high-intensity fire on upper slopes create an ideal fire environment for the production of medium- to long-distance embers that could have ignited multiple additional spot fires downwind to the north.

Winds around the fire area began ramping up late November 27 to different degrees (Figure 14). The RAWS data from the east and southeast (Cherokee and Tow String) showed winds increasing

significantly only on November 28, beginning around noon. Sources of wind data on the west and northwest of the fire (Cades Cove, Indian Grave RAWS, and Cove Mountain) show earlier ramp-up, with significantly increasing wind speeds manifesting early in the morning of November 28—or, in the case of Cove Mountain and Look Rock, late in the day on November 27.

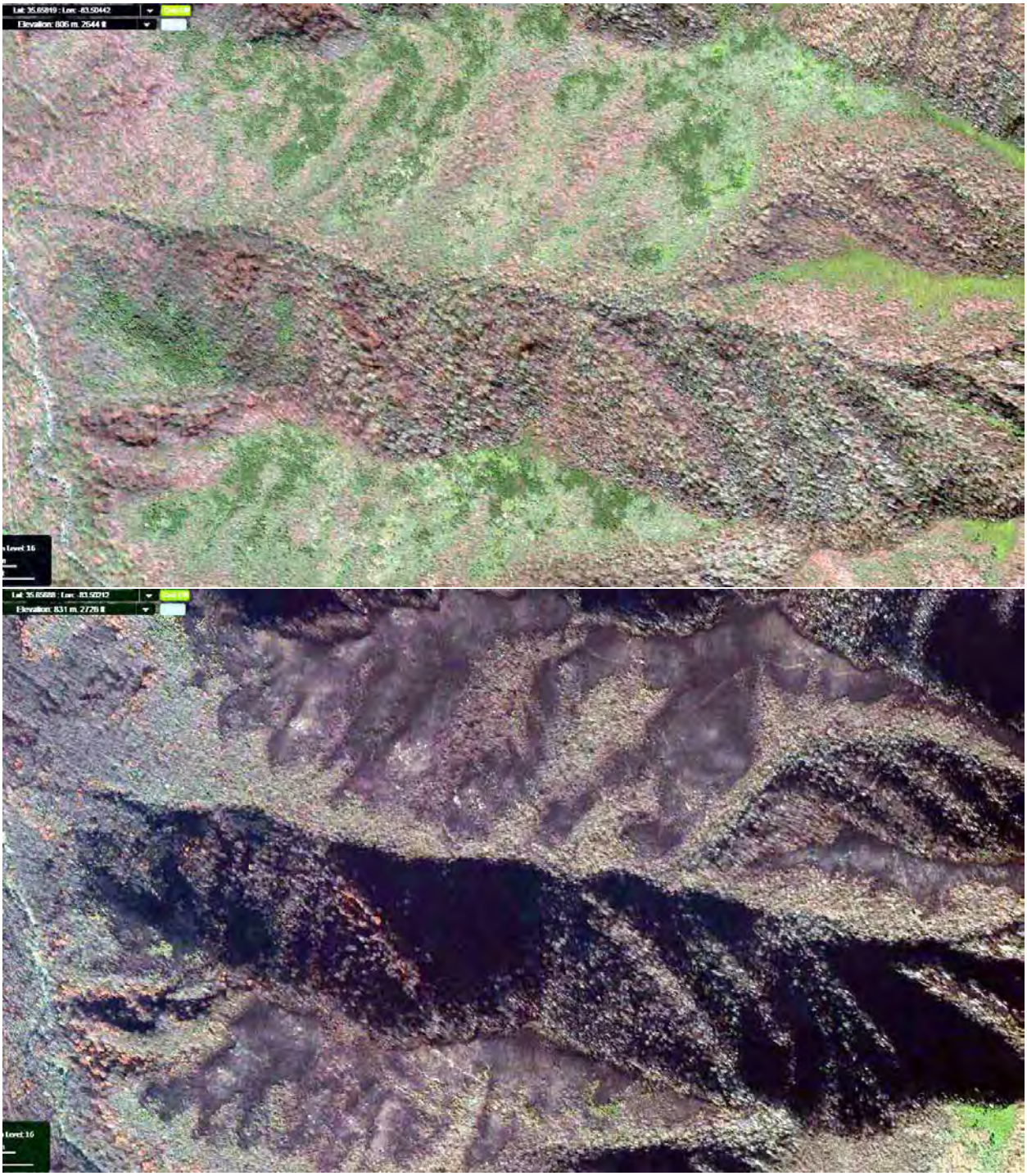
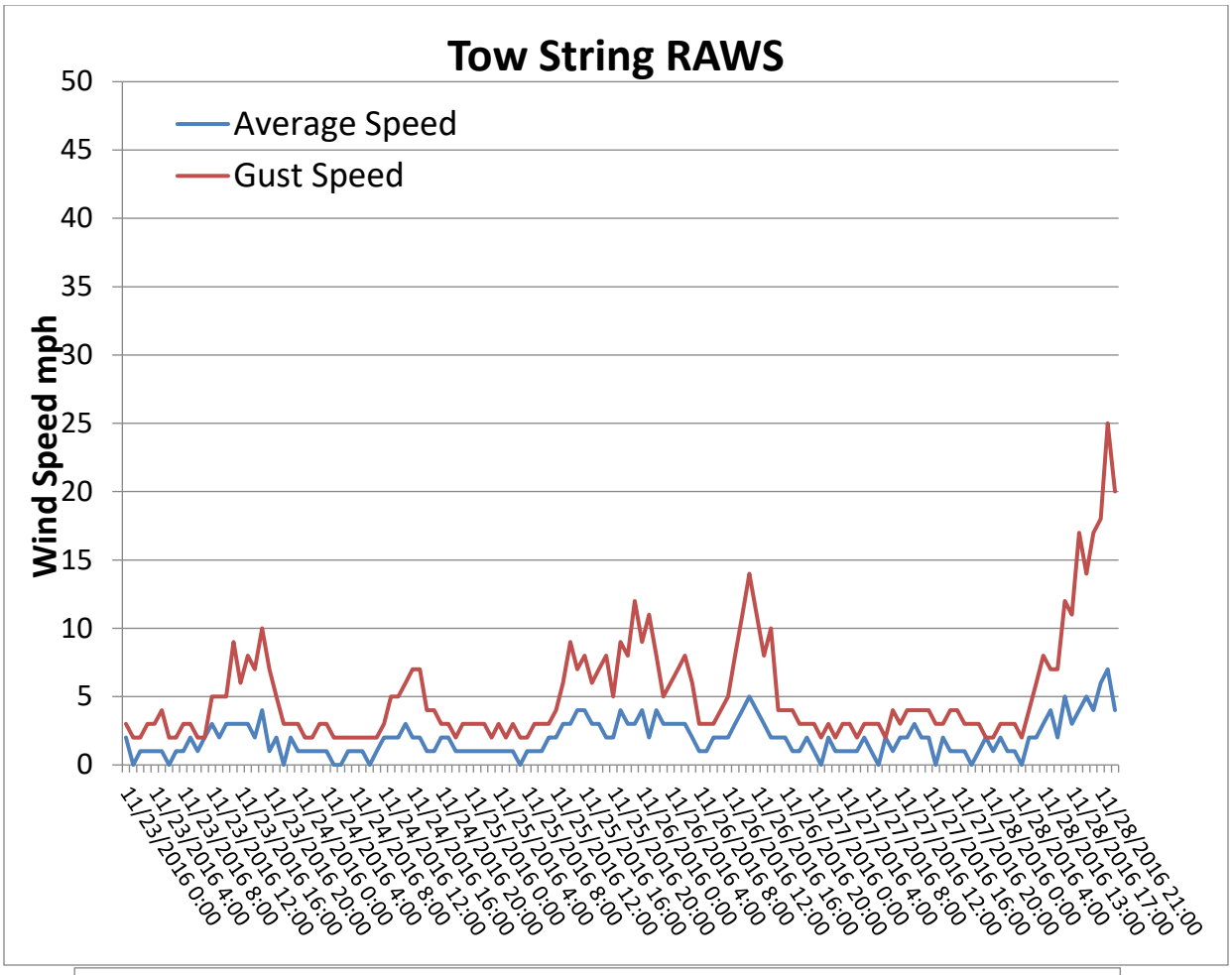
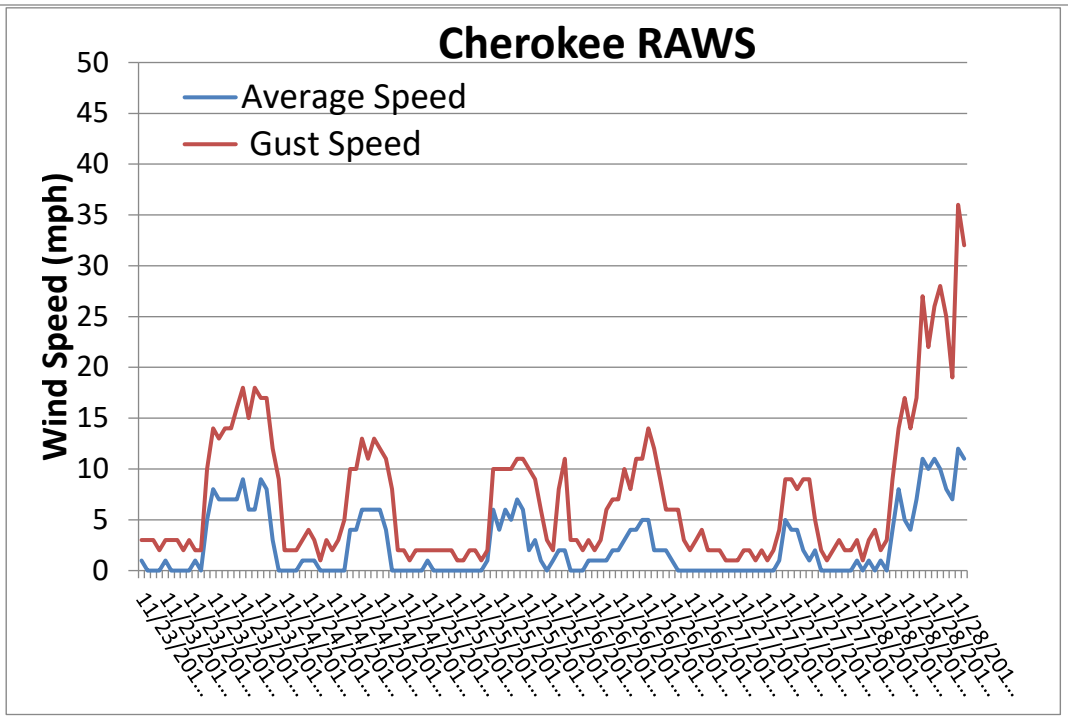
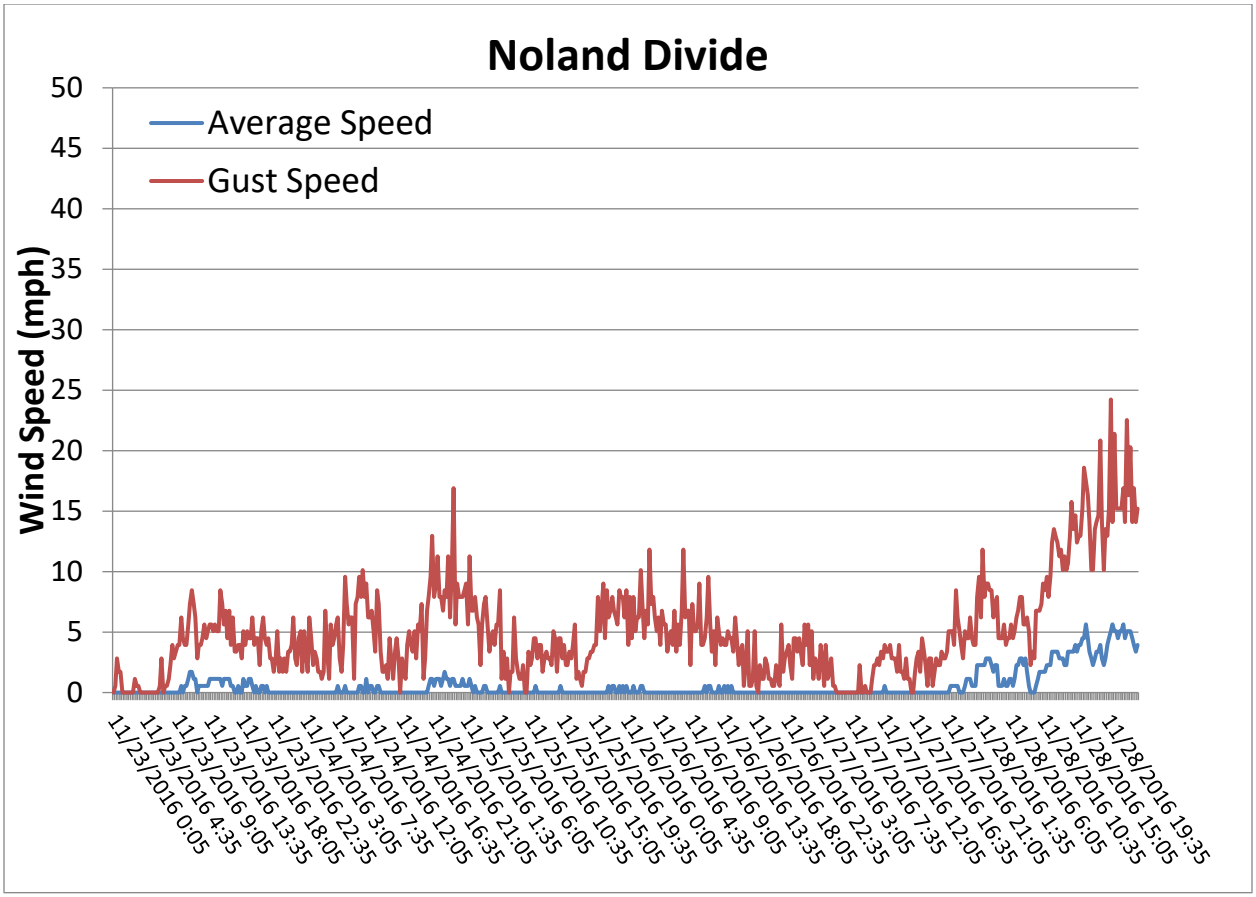
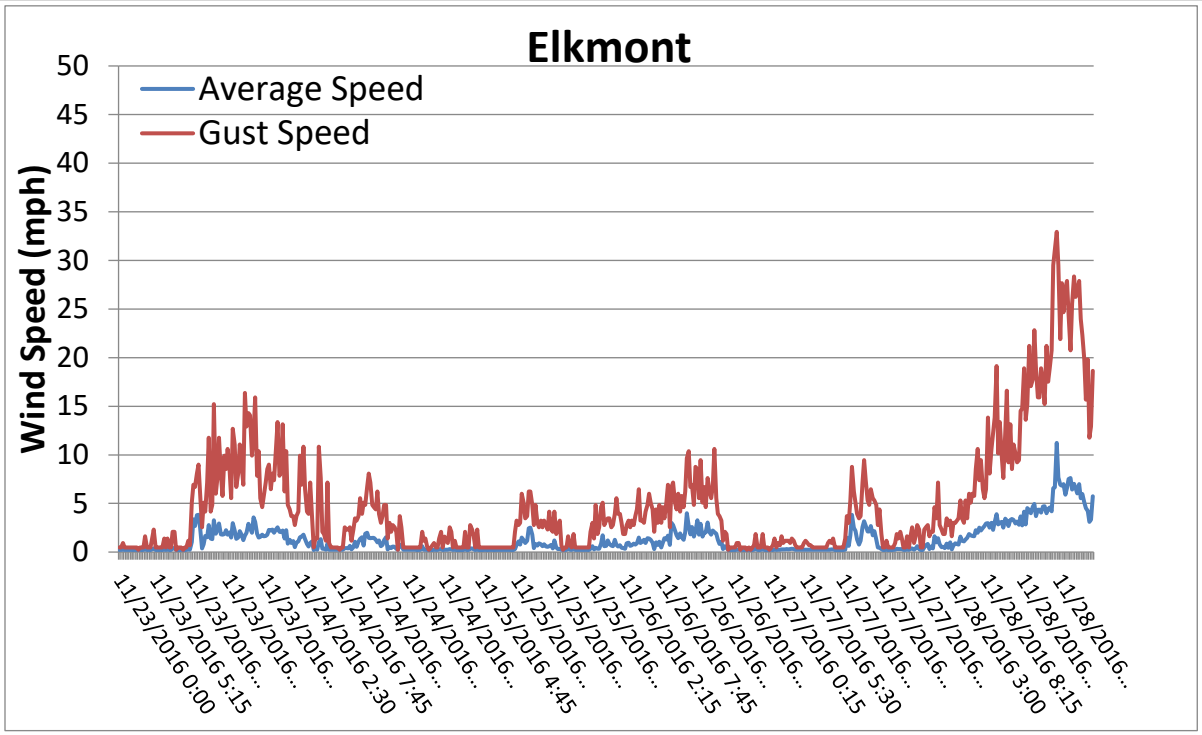


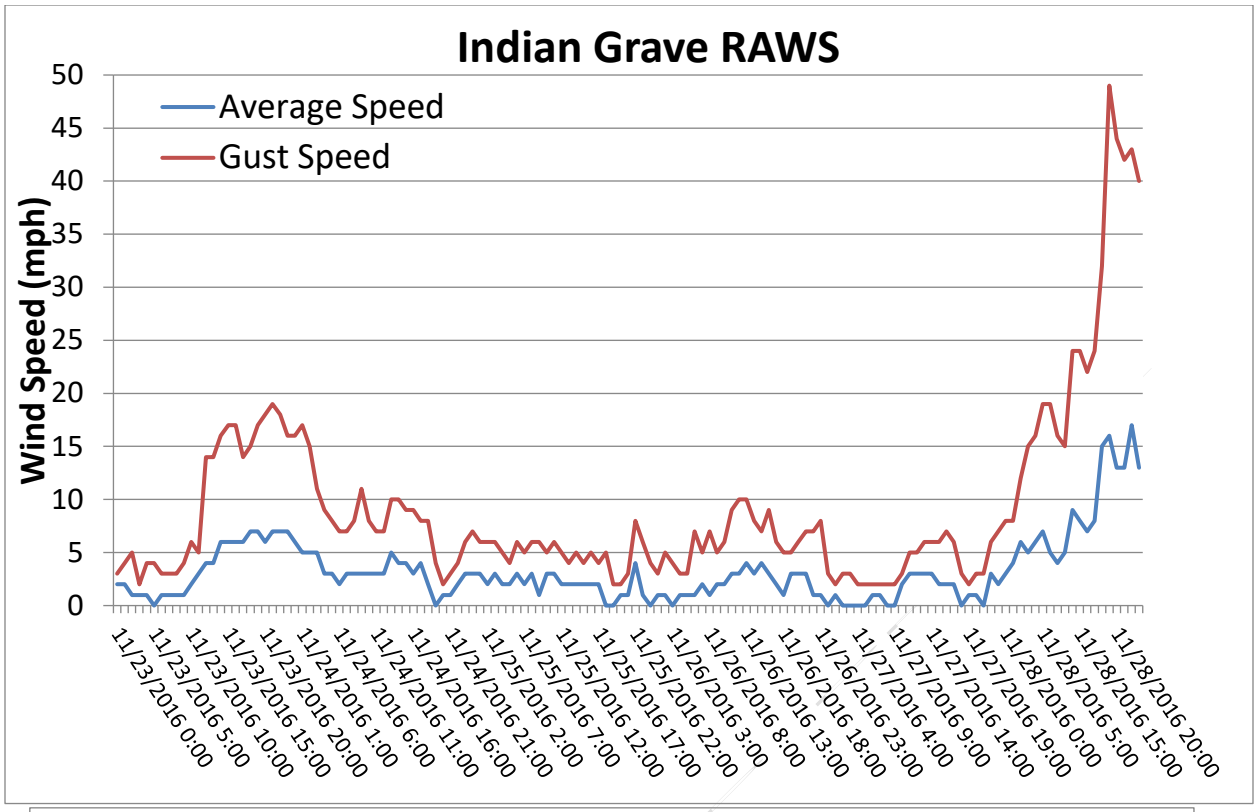
Figure 13 – April 4 (above) and December 1, 2016 (below), satellite imagery showing dark green pine stands on Bullhead Ridge and adjacent terrain that burned as a crown fire, leaving high-severity burn patches (below). Images Copyright 2016 DigitalGlobe Inc.

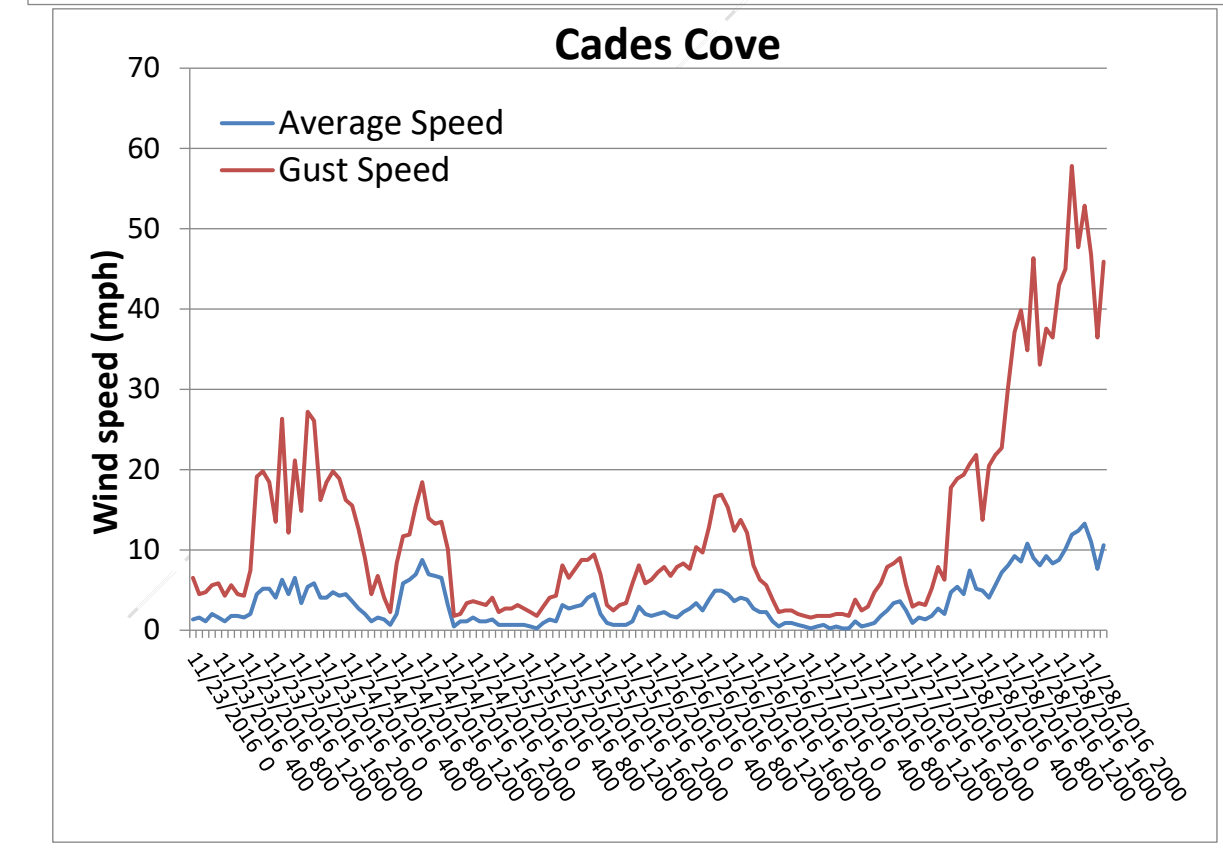

Tow String RAWS
Average Speed
Gust Speed
Wind Speed mph
50
45
40
35
30
25
20
15
10
5
0

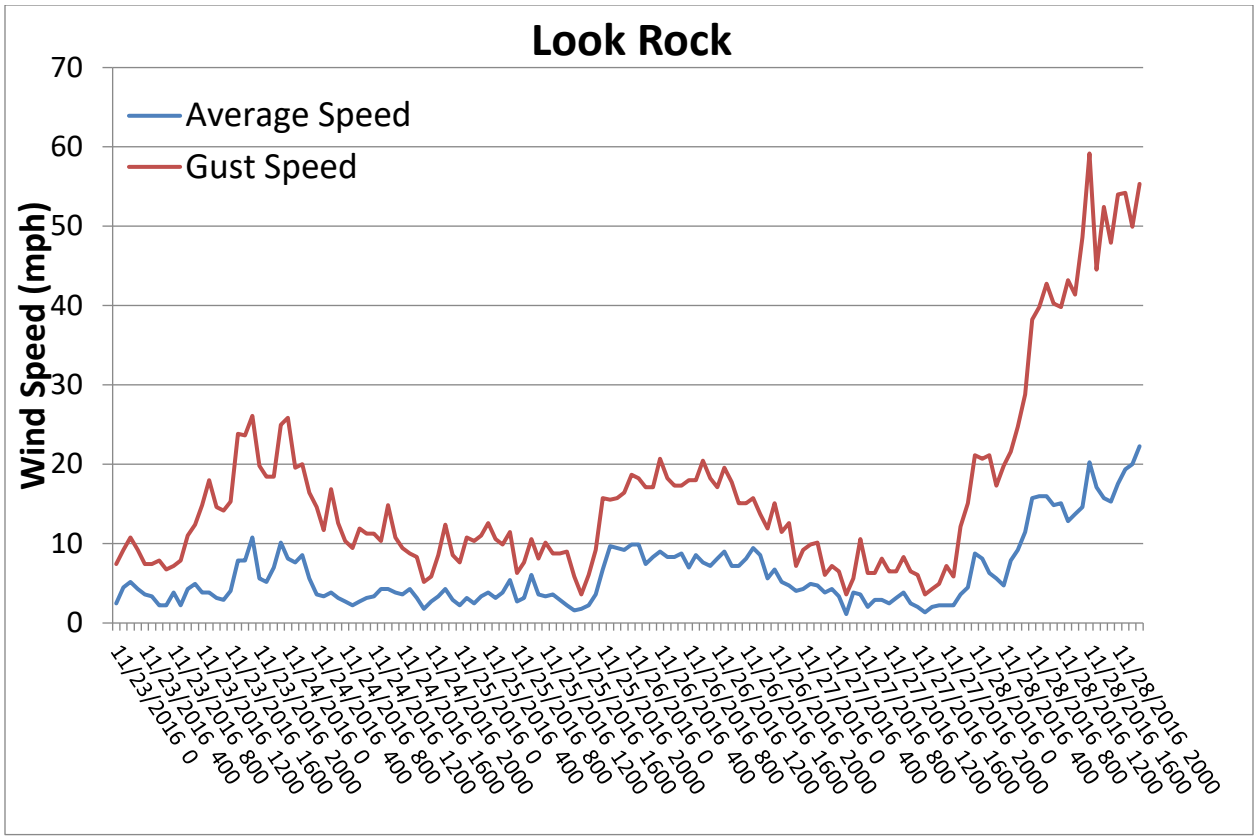

Cherokee RAWS
Average Speed
Gust Speed
Wind Speed (mph)
50
45
40
35
30
25
20
15
10
5
0

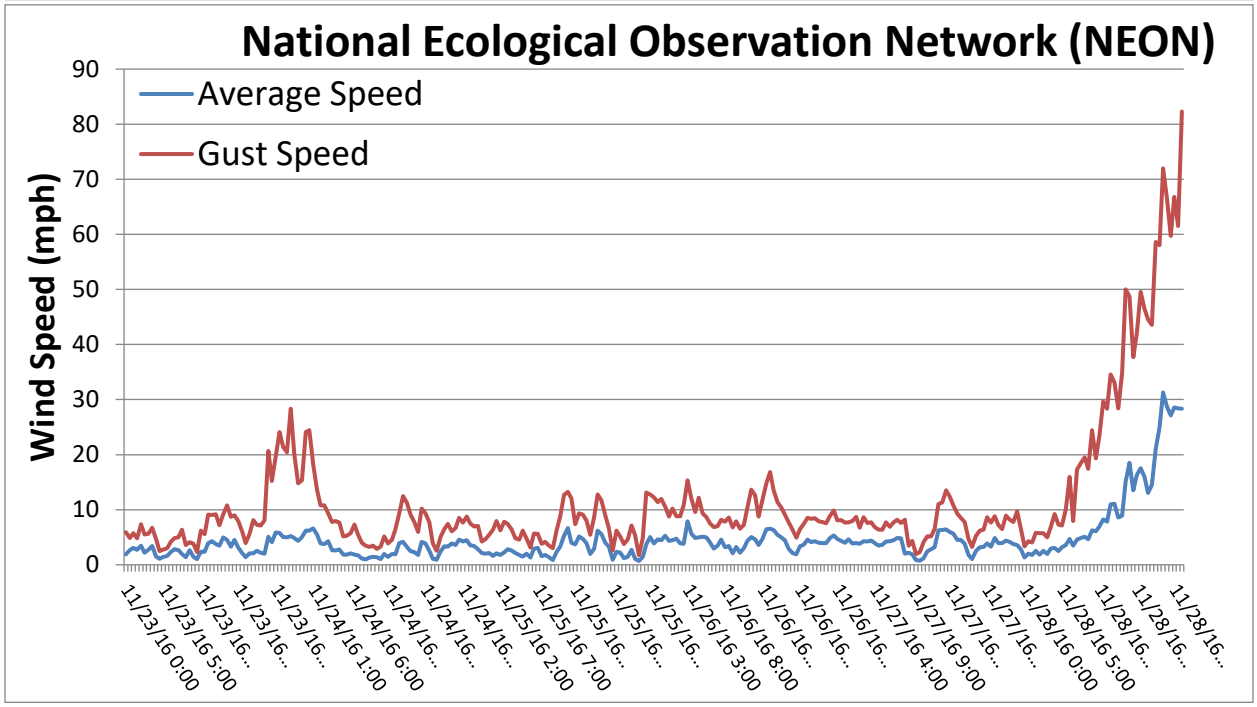

Noland Divide
Average Speed
Gust Speed
Wind Speed (mph)
50
45
40
35
30
25
20
15
10
5
0
11/23/2016 0:05
11/23/2016 4:35
11/23/2016 9:05
11/23/2016 13:35
11/23/2016 18:05
11/23/2016 22:35
11/24/2016 3:05
11/24/2016 7:35
11/24/2016 12:05
11/24/2016 16:35
11/24/2016 21:05
11/25/2016 1:35
11/25/2016 6:05
11/25/2016 10:35
11/25/2016 15:05
11/25/2016 19:35
11/26/2016 0:05
11/26/2016 4:35
11/26/2016 9:05
11/26/2016 13:35
11/26/2016 18:05
11/26/2016 22:35
11/27/2016 3:05
11/27/2016 7:35
11/27/2016 12:05
11/27/2016 16:35
11/28/2016 21:05
11/28/2016 1:35
11/28/2016 6:05
11/28/2016 10:35
11/28/2016 15:05
11/28/2016 19:35


Elkmont
Average Speed
Gust Speed
Wind Speed (mph)
50
45
40
35
30
25
20
15
10
5
0
11/23/2016 0:00
11/23/2016 5:15
11/23/2016...
11/23/2016...
11/23/2016...
11/24/2016 2:30
11/24/2016 7:45
11/24/2016...
11/24/2016...
11/24/2016...
11/25/2016 4:45
11/25/2016...
11/25/2016...
11/25/2016...
11/26/2016 2:15
11/26/2016 7:45
11/26/2016...
11/26/2016...
11/27/2016 0:15
11/27/2016 5:30
11/27/2016...
11/27/2016...
11/28/2016 3:00
11/28/2016 8:15
11/28/2016...
11/28/2016...


Indian Grave RAWS
Average Speed
Gust Speed
Wind Speed (mph)
50
45
40
35
30
25
20
15
10
5
0
11/23/2016 0:00
11/23/2016 5:00
11/23/2016 10:00
11/23/2016 15:00
11/23/2016 20:00
11/24/2016 1:00
11/24/2016 6:00
11/24/2016 11:00
11/24/2016 16:00
11/24/2016 21:00
11/25/2016 2:00
11/25/2016 7:00
11/25/2016 12:00
11/25/2016 17:00
11/25/2016 22:00
11/26/2016 3:00
11/26/2016 8:00
11/26/2016 13:00
11/26/2016 18:00
11/26/2016 23:00
11/27/2016 4:00
11/27/2016 9:00
11/27/2016 14:00
11/27/2016 19:00
11/28/2016 0:00
11/28/2016 5:00
11/28/2016 15:00
11/28/2016 20:00


Cades Cove
Average Speed
Gust Speed
Wind speed (mph)
70
60
50
40
30
20
10
0


Look Rock
Average Speed
Gust Speed
Wind Speed (mph)
70
60
50
40
30
20
10
0
11/23/2016 0
11/23/2016 400
11/23/2016 800
11/23/2016 1200
11/23/2016 1600
11/23/2016 2000
11/24/2016 0
11/24/2016 400
11/24/2016 800
11/24/2016 1200
11/24/2016 1600
11/24/2016 2000
11/25/2016 0
11/25/2016 400
11/25/2016 800
11/25/2016 1200
11/25/2016 1600
11/25/2016 2000
11/26/2016 0
11/26/2016 400
11/26/2016 800
11/26/2016 1200
11/26/2016 1600
11/26/2016 2000
11/27/2016 0
11/27/2016 400
11/27/2016 800
11/27/2016 1200
11/27/2016 1600
11/27/2016 2000
11/28/2016 0
11/28/2016 400
11/28/2016 800
11/28/2016 1200
11/28/2016 1600
11/28/2016 2000


National Ecological Observation Network (NEON)
Average Speed
Gust Speed
Wind Speed (mph)
90
80
70
60
50
40
30
20
10
0
11/23/16 0:00
11/23/16 5:00
11/23/16...
11/23/16...
11/23/16...
11/24/16 1:00
11/24/16 6:00
11/24/16...
11/24/16...
11/24/16...
11/25/16 2:00
11/25/16 7:00
11/25/16...
11/25/16...
11/25/16...
11/26/16 3:00
11/26/16 8:00
11/26/16...
11/26/16...
11/26/16...
11/27/16 4:00
11/27/16 9:00
11/27/16...
11/27/16...
11/28/16 0:00
11/28/16 5:00
11/28/16...
11/28/16...
11/28/16...

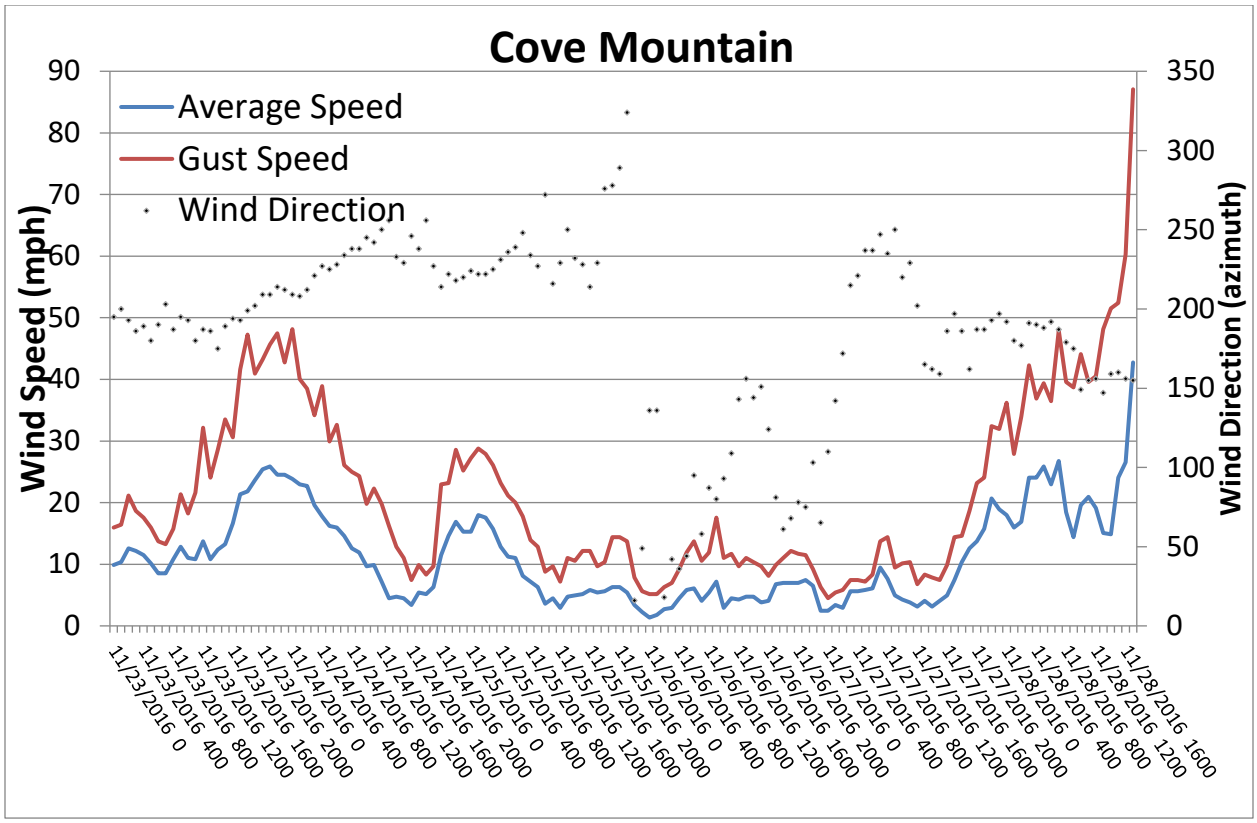


Figure 14 – Wind speeds from area meteorological stations for the time period of the Chimney Tops 2 Fire. Note differences of max speed on y-axes of the different graphs. Several stations show the fairly breezy conditions on the day of the fire discovery, November 23, and the ramping up of wind speeds beginning late on November 27 and early November 28, leading to the "mountain wave" wind event later on November 28.

Table 3 – Wind Measurement Height Above Ground.

Station Name	Height of Wind Measurement (feet)
Tow String	20
Cherokee	20
Noland Divide	12
Indian Grave	20
Elkmont	33
Cades Cove	33
Look Rock	33
NEON	130
Cove Mountain	98

Heavy smoke on November 28 obscured much of the Chimney Tops 2 Fire's movement between where the spot fire was observed in the morning and the fire's arrival at points near Gatlinburg. The fire

footprint between Chimney Tops and the Great Smoky Mountains National Park boundary at Gatlinburg in many places is three miles wide.

In addition to the spotting from ridges by the crown fires in the pine stands, much of the landscape was covered with dry, fluffy deciduous leaf litter. Conditions for fire spread in that fuel bed, with increasingly high wind speeds throughout the day, would be favorable for ubiquitous short-range spotting by ground level ember showers. Fire interactions, where many separate fires grow together, can substantially increase spread rate and even create simultaneous ignitions (Cheney and Bary 1969, in Finney and McAllister 2011).

The fire had been subject to strong winds all day and had progressed north by surface spread as well as both short- and long-range spotting. The extreme wind speeds that occurred during the afternoon of November 28 were a result of a critical fire weather pattern called a “mountain wave.” Mountain wave wind events typically occur in the winter half of the year and several hours prior to the passage of a cold front. They are fairly common in the southern Appalachians, with an average of two to four events occurring per year. These downslope winds accelerate and are most severe on the lee side of mountain barriers, the orographic position of both the Cove Mountain Air Quality Monitoring Station and the City of Gatlinburg, given the strong southerly surface flow that day.

At the time the fire was positioned near the northern park boundary late in the afternoon, the mountain wave winds intensified. The November 28 maximum gust speed recorded at the Look Rock Air Quality Monitoring Station occurred at 1600 hours, at Cades Cove 1800 hours, at the Elkmont Meteorological Station at 1830 hours, at Indian Grave RAWS 1900 hours. and at the NEON site 2032 hours. The Cove Mountain station lost power after its 1700 hours’ measurement, but gust speed between 1600 hours and 1700 hours jumped significantly—even compared to the high average wind speeds and peak gust speeds of previous hours.

The time that the fire breached the northern park boundary south and east of Gatlinburg was also the time that resistance to control of the fire was greatest, due to the nature of the deciduous fuel bed that was carrying the fire and the extreme wind gusts due to the mountain wave. This violent fire environment persisted into the early morning hours of November 29.

References

Cheney, N.P and Bary, G.A.V. 1969. The propagation of mass conflagrations in a standing eucalypt forest by the spotting process. In Mass Fire Symposium, Defense Standards Laboratory, Canberra, Australia.

Finney, M.A. and McAllister, S.S. 2011. A review of fire interactions and mass fires. Journal of Combustion 2011. 14p.

Wagenbrenner, N.S., Forthofer, J.M, Lamb, B.K., Shannon, K.S., and Butler, B.W. 2016. Downscaling surface wind predictions from numerical weather prediction models in complex terrain with WindNinja. Atmospheric Chemistry and Physics 16, 5229-5241.

Appendix Seven

[The review team solicited the professional opinion of human factors and sensemaking for the Chimney Tops 2 Fire, which was provided by Dr. Branda Nowell.]

Human/Organizational Factors and Sensemaking During the Chimney Tops 2 Wildland Fire

By
Branda Nowell, PhD
Professor – School of Public and International Affairs
North Carolina State University

Introduction

Wildfires that do unexpected things create valuable opportunities for reflecting upon our expectations and the factors that shape how we think. The Chimney Tops 2 wildland fire (CT2), ignited November 23rd, 2016 within the Great Smoky Mountains National Park (GRSM), offers one such opportunity. This report, commissioned by the CT2 Fire Review Team, provides an independent analysis of the human/organizational factors and sensemaking of action by NPS personnel involved in preparedness and decision-making during wildland fire operations for the CT2 fire.

Analysis for this report was based on a review of transcripts and summaries of testimonies taken from GRSM personnel involved in the CT2 fire, a review of a preliminary draft report from the Fire Review Team [excluding Team Recommendations], as well as a series of conversations with Joe Stutler, the Fire Review Team Lead to clarify details of the incident.

Assumptions, Relevant Concepts, and Definitions

Several conceptual frameworks were used to guide this assessment. A brief introduction of these concepts, their definitions, and their relevance is provided below.

Wildland fire is part of a complex adaptive system. Complex adaptive systems are systems characterized by a high degree of variability in dispersed localized processes that interact to result in unanticipated large scale patterns that change over time, resulting in "perpetual novelty" (Levin et al., 1998). Put more simply, complex adaptive systems are systems fraught with the *possibility* for outcomes that are both novel and difficult to foresee.

Risk management is a concept embraced by the wildland fire community, referring to a process by which risk is identified, assessed, and managed in order to "minimize, monitor, and control the probability and/or impact of unfortunate events" (Taber, Elenz, and Langowski, 2013, pg. 4). However, *all decisions are constrained* by the *information available to the decision-maker at the time*. Further, when working in complex adaptive systems, observed outcomes and preceding decision processes are loosely coupled (Levin et al 2013). This means that bad outcomes can still occur despite well-justified decisions. Conversely, as a result of chance, very risky decisions can still result in good outcomes.

R*isk management action in a complex adaptive system must therefore be understood as probabilistic* – It can improve the likelihood of a good outcome, but it cannot ensure it. Accordingly, we cannot infer problematic decisions based solely on observed outcomes. Inversely, success should never be used as the exclusive criteria to applaud effective decision-making.

Organizational learning is the systematic effort of an agency to develop insights, knowledge and associations between past actions and the effectiveness of those actions in order to inform future actions (Fiol and Lyles, 1985). *Complex adaptive systems create unique challenges to organizational learning.*

"Sensemaking is the process through which people work to understand issues or events that are novel, ambiguous, confusing or in some other way violate expectations" (Maitlis and Christianson, 2014, pg. 57). *This review of the Chimney Tops 2 Fire is an exercise in sensemaking in order to facilitate organizational learning.* The Chimney Tops 2 Fire resulted in outcomes that were both surprising and troubling. The goal of this Review is an attempt to make sense of these events in such a way as to inform future action to "reduce the chances of a similar incident in the future" (Delegation of Authority, Chimney Tops 2 Fire Review).

What Was The Role Of Sensemaking On The Chimney Tops 2 Fire?

Sensemaking is a popular term often referring generically to the cognitive process by which one comes to understand something. However, for this analysis, it is useful to use a more restrictive definition.

Sensemaking is initiated when something is observed that is perceived as surprising; something that challenges existing frames of reference and expectation leading to a cognitive effort aimed at reconciliation between what has been observed and what one expected (Brown, Colville, and Pye, 2014; Maitlis and Christianson, 2014; Sandberg and Tsoukas, 2015; Weick and Sutcliffe, 2007). Sensemaking, in this definition, emphasizes the role of the unexpected as a vital cognitive resource for assessing and evaluating whether one's existing situational frame is appropriate. A situational frame, also sometimes referred as a mental model or one's situational awareness, is the set of assumptions one has within a situation that serves to guide their decision making and action. It is the answer to the question, "what is going on?". When discrepant information that challenges one's current situational frame is noticed, it can trigger a sensemaking episode that can lead one to either modify or entirely discard and replace their situational frame.

Sensemaking, by this definition, appeared to play a minimal role in defining the management decisions and actions during the Chimney Top 2 fire prior to Sunday, November 27th , the day before the fire escaped the park boundaries.

From the ignition of the fire on November 23rd until the morning of November 27th, testimonies of the NPS personnel were consistent in their description of a relatively small, smoldering fire near the top of remote, difficult to access mountain, backing slowly into vegetation that was understood to not carry fire well. The situational frame that appeared to be shared by those involved was articulated in the complexity analysis completed by the FMO/IC on November 25th: "*Fire is small with low potential to make a significant run as it is on top of a mountain and can only back down slope*". The assessment of the fire being low risk was coupled with repeated accounts of the risks to firefighters in considering both direct and indirect tactics due to the terrain. The fire was also described as likely to self-

extinguish either through contact with natural barriers and/or the introduction of forecasted rain. No testimony reviewed suggested this situational frame was challenged during the first three days of the fire.

On the morning of Sunday, November 27th, testimonies describe the FMO/IC viewing the fire from Newfound Gap Road. This was the first description of a significant sensemaking episode, with one testimony stating "*it appeared as if the fire had grown overnight…from the previous day in a manner that was more than expected*". At this point, the FMO/IC was described as changing tactics – immediately turning his vehicle around, aborting the scouting mission initially intended, and instead returning to the office to order additional resources. Exactly what the situational frame was in the mind of the FMO/IC and other responders during this day is less clear. On the one hand, change in tactics suggests an altered situational frame that necessitated a more aggressive course of action. On the other hand, the decision was made to not staff the fire overnight with the justification being that this was standard protocol. This suggests the fire was still perceived to be a situation that fell within normal operating parameters.

Numerous episodes of sensemaking were described on the following day as responders attempted to adjust and respond to what was described as an incomprehensible series of events. Both the FMO/IC and the deputy superintendent were reported to state that it never crossed their minds that the fire had the potential to leave the park boundaries and threaten Gatlinburg until the point at which the fire reached Twin Creeks and Mynatt Park areas. As one responder described it, "*I mean, your brain cannot comprehend what is happening at this point cause you can't really see the fire but you know what you're on. You have a sense of where it is just based on what you're barely able to see and then we're hearing this stuff out here. And again, the time frame on that… it was definitely during the day and - I mean, that's when the chaos really got good… [the fire] it's just not makin' sense in your brain*."

Sometimes disasters are the product of such a complex series of micro-dynamics that they are impossible, given our current technology, to predict or even imagine. Sometimes, in hindsight, we can identify cues that portended of the possibility of the eventual outcome but, at the time, these cues were insufficient to shift the situational frame early enough to alter the outcome. And sometimes, even if the situational frame was able to accurately illuminate all the risks, there is nothing that could have been done differently that would have significantly altered the outcome. As humans, we vehemently dislike the first and last of these realities. Accordingly, we invest significantly energy into the diagnosis of the second, and rightly so.

In critically examining the micro-processes that make the unimaginable possible, we hopefully gain the tools to amplify the signal that these cues can send out to inform sensemaking in future situations.

However, risk perception is not computational. Rather, it is a social-cognitive process that must be understood within a cultural context (Slovic et al, 1981). Dominant situational frames are "sticky" (Maitlis and Christianson, 2014) and resistant to change. Discrepant cues from the environment can trigger sensemaking to alter situational frames but *only* if they are noticed, bracketed and assigned meaning in such a way as to signal "this isn't normal" (Weick, Sutcliffe, and Obstfeld, 2005). *Research has demonstrated that discrepant cues can fail to trigger sensemaking if organizational culture and structures mitigate against it* (Weick and Sutcliffe, 2006; Maitlis and Christianson, 2014). Therefore, in addition to examining micro-dynamics that resulted in the outcomes observed during CT2, it is useful

to also consider what factors may have shaped and constrained the risk perception of those involved. In doing so, we can pro-actively consider vulnerabilities that could hinder sensemaking in future events.

Risk Perception

Risk perception on a specific fire is best characterized as an aspect of situational awareness. Cognitive theorists describe situational awareness as consisting of three levels: 1) perception of the elements, 2) comprehension of the situation, and 3) prediction of future states (Endsely, 1995). Like sensemaking, this framework is useful in it highlights the complexity involved in defining situations that enable people to act. Out of the enormous array of information in the environment, individuals have to first identify what to pay attention to and then translate what they attend to into a situational frame that can inform future predictions and current actions. Research on intuition finds that humans, particularly under conditions of stress, do not naturally consider multiple possible situational frames. Rather, the brain instantaneously classifies situations that define appropriate action without alternative options ever coming to mind (Kahneman, 2003). Risk perception is part of this situational frame but it is shaped and constrained by several dynamics.

At an individual level, risk perception is fundamentally tied to past experience and exposure (Kahneman, 2003; Slovic, Fischhoff and Lichtenstein, 1981). Individuals will have a difficult time perceiving risks for events they have never directly or indirectly experienced. The GRSM has never in its history had a significant fire escape the boundaries of the park. Cues of risk for conditions outside of experience are more likely to be re-framed/downplayed as reflecting normal experience.

At an organizational level, lack of prior experience with a particular level of hazard can have even greater significance. Organizations develop formal and informal structures, practices, and understandings that evolve to reflect the realities and resource constraints of their normal operating environment. Over time, these ways of doing and ways of thinking becoming structurally and culturally embedded into the fabric of the organization (Naslund and Pemer, 2012).

The Fire Review Team analysis of the GRSM portrays an agency organized around the logic of low complexity/low risk fires. For example, the Zone FMO covers 19 satellite parks as well as the GRSM. There are limited trained wildland fire personnel within the National Park (NP), the unit responsible for initial attack had only one person with qualifications at the Incident Commander Type 5 (ICT5) level. During severity conditions, practices emphasized allocating budgets toward overtime for existing staff rather than additional staffing to bolster response capability. A single person covered the responsibilities of an FMO, IC, and duty officer. Radio communications were not set up to allow for communication between NP personnel and Gatlinburg Fire while at the same time NP evacuation and wildland fire operations had competing radio traffic on the same channel. Expanded support functions were not set up and leadership has limited training in the use of decision support tools.

These features have both singular and collective consequences. In addition to limiting response capability during a more complex incident, these features communicate a dominant cultural message about the kinds of situations the agency expects to encounter that reinforces itself over time (Geiger and Antonacopoulou, 2009). The longer a given organizational logic has endured and has been proven effective, the more entrenched it becomes. The more entrenched an organizational logic is,

the more resilient it is against sensemaking processes that could challenge it, even if significant discrepant cues are available in the environment.

Risk Management for Low Probability/High Consequence Events in Complex Adaptive Systems

CT2 is a type of incident referred to in the literature as a low probability/high consequence event. Events that are perceived of as low probability are notoriously problematic (Mechler et al, 2014). By definition, a low probability event is going to be novel and therefore, more likely to be outside the experience of those affected by it and require response patterns that are beyond organizational resources and the established organizational routines. Risk management relies on being able to a) accurately perceive risk within a given situation early enough to be able to do something about it and b) have the capability to take action to minimize risks. While there is always more that can be done, we have significant capacity within our federal and state land agencies to scale up response capability when needed. The greater vulnerability for low probability/high consequence events lies in our ability to perceive risks in time to mobilize this capacity.

This suggests the need to bolster *organizational* capacity for sensemaking. Sensemaking capacity can be strengthened in several ways.

Create triggers that amplify the signal when conditions are NOT normal. Effectively working in complex adaptive systems means being sensitized to the idea that *deviations from normal in lower order phenomenon can cascade to have major consequences.* The problem is that accumulated changes in this lower order phenomenon often go unnoticed and rob managers of a sensemaking opportunity.

Understanding risk requires being explicit about what "normal" looks like and when deviations from normal have occurred that may be associated with new or increased risks. Risk factors often present themselves in isolation (i.e., moss turning to dust) but interact in complex ways with other risks, necessitating the need for tracking compounding risk. As illustrated by the testimony of one CT2 responder, the true level of risk can be easily obscured, "*I've worked on several fires in the Smokies in my career here where the drought was equally as extreme and I would not have ever predicted fire to spread through that kind of drainage under those types of fuel and moisture conditions*".

Support sensemaking processes when deviations are present. Sensemaking is generally done out loud and through interaction (Weick, 1995). Having adequate space and time for reflection is critical to the sensemaking process. Staff fatigue and having key leadership dividing their attention across multiple positions limit opportunity for reflection. This is a risk factor, particularly when cues such as Severity Conditions are present suggesting the organization is nearing the boundaries of its operating parameters. Having structured opportunities for discussion when conditions deviate from operating parameters can facilitate sensemaking. A great example of this was found in an email sent by the NPS Regional FMO to the FMO/IC a little over a week prior to the CT2 fire in response to another fire in the same area. In this email, the Regional FMO stated that the "big one" was right around the corner for the GRSM and that a conversation needed to take place to "start thinking about scenarios". It is not clear what the outcome of that conversation was, what the "big one" was understood to mean, and whether triggers and contingent strategies were concretely identified and assessed in terms of their feasibility given resource constraints.

Make sensemaking a team sport. The patterns that underlie low probability/high consequence events are difficult to see in advance. In complex situations, having multiple sense makers with the training, knowledge and experience to provide an informed perspective on a situation as it evolves can improve the chances that the situation frame will align with the actual risks (Nowell, Bodkin, and Bayoumi, in press). The Fire Review analysis suggests that the organizational relationship of the FMO/IC with the rest of the park leadership was predominantly one of "sensegiving" (Maitlis and Lawrence, 2007), with the FMO/IC briefing the leadership on the situation and needs as he came to understand it. All testimonies suggested that everyone relied upon the FMO/IC to singularly define the situation. It was not clear the extent to which the park leadership had the training and experience in wildfire necessary to provide support to the FMO/IC in the sensemaking process.

Use tools to discern patterns in complexity. While the human brain has remarkable information processing capability, it is limited in its ability to accurately discern patterns and probabilities in complex adaptive systems. Technology can be a critical ally to managers, helping to illuminate risks and considerations that may otherwise be overlooked (Mendonca, Beroggi, and Wallace, 2001). Leaders working in these complex systems must become proficient in the use of decision support tools. Decision support tools appeared to play a limited role in supporting the risk management decisions during the CT2 Fire. Reports indicate that there was limited capacity within the park in the use of WFDSS. Further, testimonies indicated that fire prediction maps were given limited consideration. Collectively, this suggests there may have been both technical and cultural barriers in the use of these tools to inform sensemaking during CT2.

Conclusion

It appears that we are entering an era where the "unprecedented" is happening with increasing frequency (Field, 2012). This signifies a massive organizational challenge for our federal land agencies – particularly those that have worked in relatively stable systems for a long time and that are simultaneously facing increasing budget constraint. Incidents like CT2 are critical opportunities for learning that must not be wasted. These incidents provide new technical insight into the bio-physical micro-dynamics that can challenge our assumptions about what is possible. We can use this information to identify patterns that suggest possibilities that may be, heretofore, unimaginable. However, vague predictions of the "big one" will have little effect if organizational logics inoculate an agency against sensemaking. Therefore, it is also vital that we use incidents like CT2 to illuminate organizational vulnerabilities and opportunities for enhancing adaptive capacity.

References

Brown, A. D., Colville, I., & Pye, A. (2015). Making sense of sensemaking in organization studies. *Organization Studies*, *36*(2), 265-277.

Endsley, M. R. (1995). Toward a theory of situation awareness in dynamic systems. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *37*(1), 32-64.

Field, C. B. (Ed.). (2012). *Managing the risks of extreme events and disasters to advance climate change adaptation: special report of the intergovernmental panel on climate change*. Cambridge University Press.

Fiol, C. M., & Lyles, M. A. (1985). Organizational learning. *Academy of management review*, *10*(4), 803-813.

Geiger, Daniel, and Antonacopoulou,E. (2009). Narratives and organizational dynamics exploring blind spots and organizational inertia. *The Journal of Applied Behavioral Science* 45, no. 3: 411-436.

Kahneman, D. (2003). A perspective on judgment and choice: mapping bounded rationality. *American psychologist*, *58*(9), 697.

Levin, S., Xepapadeas, T., Crépin, A. S., Norberg, J., De Zeeuw, A., Folke, C., ... & Ehrlich, P. (2013). Social- ecological systems as complex adaptive systems: modeling and policy implications. *Environment and Development Economics*, *18*(02), 111-132.

Maitlis, S., & Christianson, M. (2014). Sensemaking in organizations: Taking stock and moving forward. *The Academy of Management Annals*, *8*(1), 57-125.

Maitlis, S., & Lawrence, T. B. (2007). Triggers and enablers of sensegiving in organizations. *Academy of management Journal*, *50*(1), 57-84.

Mechler, R., Bouwer, L. M., Linnerooth-Bayer, J., Hochrainer-Stigler, S., Aerts, J. C., Surminski, S., & Williges, K. (2014). Managing unnatural disaster risk from climate extremes. *Nature Climate Change*, *4*(4), 235-237.

Mendonca, D., Beroggi, G. E., & Wallace, W. A. (2001). Decision support for improvisation during emergency response operations. *International journal of emergency management*, *1*(1), 30-38.

Näslund, L., & Pemer, F. (2012). The appropriated language: Dominant stories as a source of organizational inertia. *Human Relations*, *65*(1), 89-110.

Nowell, B. Bodkin, C and Bayoumi, D. (in press) Redundancy in Disaster Response Systems: A Pathway to Resilience or a Recipe for Disaster?. Manuscript in press with the *Journal of Contingencies and Crisis Management.*

Sandberg, J., & Tsoukas, H. (2015). Making sense of the sensemaking perspective: Its constituents, limitations, and opportunities for further development. *Journal of Organizational Behavior*, *36*(S1), S6-S32.

Slovic, P., Fischhoff, B., Lichtenstein, S., & Roe, F. J. C. (1981, April). Perceived risk: psychological factors and social implications [and discussion]. In *Proceedings of the Royal Society of London A: Mathematical, Physical and Engineering Sciences* (Vol. 376, No. 1764, pp. 17-34). The Royal Society.

Taber, Mary A.; Elenz, Lisa M.; Langowski, Paul G. 2013. Decision Making for Wildfires: A Guide for Applying a Risk Management Process at the Incident Level. Gen. Tech. Rep. RMRS-GTR-298WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 59 p.

Weick, K. E. (1995). *Sensemaking in organizations* (Vol. 3). Sage.

Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. (2005). Organizing and the process of sensemaking. *Organization science*, *16*(4), 409-421.

Weick, K. E., & Sutcliffe, K. M. (2006). Mindfulness and the quality of organizational attention. *Organization Science*, *17*(4), 514-524.

Appendix Eight

The Southern Area Multi-Agency Coordinating Group Daily Briefings

SOUTHERN AREA MULTI-AGENCY COORDINATING GROUP (MAC) DAILY BRIEFING – NOV. 25, 2016

MAC Priorities *Updated 20161124 1500*

1	2	3	4	5	6	7	8	9	10
Initial Attack	Horton	Roaring	2 Mile	Clear Creek	Rock Mountain	Mt. Pleasant	Pinnacle Mtn	Party Rock	Tatum Gulf
11	12	13	14	15	16	17	18	19	20
Tellico	Boteler	Chestnut Knob	Maple Springs	Chimney Rock	Rough Ridge	Eads Hollow	Eastern Cherokee	Old Roughy	East Miller Cove

New and Emerging Fires

State	Jurisdiction	Description	Notes

IMT Rotation work in progress

Team	Assignment	Notes	Team	Assignment	Notes
Blue Team (Quesinberry)	Boteler, Tatum, Maple Springs	LWD – 12/2	Hamilton (T3) MT	Mount Pleasant	LWD – 12/4 Ext
Livingston (T1) NW	Rock Mountain	LWD – 11/29 trans. w/ Dueitt	Ostler (T3) UT	Pinnacle Mountain	LWD – 11/30
Fogle (T2)	Rough Ridge	LWD 11/27 NW Hunter T3 arr. Sat	Smith(ORT1)	Party Rock	LWD – 12/4
Kern (T2) FL	Chestnut Knob	LWD – 11/30	Kauffman (T3) VA	Eades Hollow	
CO T3	Preposition	arrive 11/29	Saucedo (T3) NV	Eastern Cherokee	LWD – 11/25…11/27 to local
Kline/Ingram (T2) GA	Tatum Gulf	LWD – 11/29 Rotate internally	Pisarek (T2 short) MN	Managing MOB Center	LWD – 12/3
Thompson (T2) NR	Clear Creek	LWD – 11/30	Esperance	Staged at Asheville	LWD-11/28
Chadwick (T2) GB	KY	LWD-11/26	Weeks (T3) ID	Going to Horton Fire	
Bentley/ParishT2	Avail. 11/26		Dueitt T1	Avail. 11/28	

Crews and Modules

Outgoing	Incoming	On Deck
	7 Crews	5 Crews Sat, 5 Crews Sun, 8 MODs Mon

SOUTHERN AREA MULTI-AGENCY COORDINATING GROUP (MAC) DAILY BRIEFING – NOV. 26, 2016

MAC Priorities

Updated 20161126 0900

1	2	3	4	5	6	7	8
Initial Attack	Rock Mtn	Mt Pleasant	Pinnacle	Camp Branch	Horton	Clear Creek	Party Rock
9	10	11	12	13	14	15	
Tellico	Boteler	Chestnut Knob	Maple Springs	Chimney Rock	2 Mile	Roaring	

New and Emerging Fire

State	Jurisdiction	Description	Notes
TN	TNS	Little Brushy Road – near Stephens, TN 331 acres on IR - no further intel at this time	

IMT Rotation work in progress

Team	Assignment	Notes	Team	Assignment	Notes
Blue Team Quesinberry (T2)	Boteler, Tatum, Maple Springs	LWD – 12/2	Hamilton (T3) MT	Mount Pleasant	LWD – 12/4 Ext
Livingston (T1) NW	Rock Mountain	LWD – 11/29 trans. w/ Parish	Ostler (T3) UT	Pinnacle Mountain	LWD – 11/30
Fogle (T2)	Rough Ridge	LWD 11/27 NW Hunter T3 arr. Sat	Smith(ORT1)	Party Rock	LWD – 12/4
Kern (T2) FL	Chestnut Knob	LWD – 11/30	Kauffman (T3) VA	Eades Hollow	
CO T3	Preposition	arrive 11/29	Saucedo (T3) NV	Eastern Cherokee	Trans to local 11/26
Kline/Ingram (T2) GA	Tatum Gulf	LWD – 11/29 Rotate internally	Pisarek (T2 short) MN	Managing MOB Center	LWD – 12/3
Thompson (T2) NR	Clear Creek	LWD – 11/30 extend decision 11/26	Esperance	Staged at Asheville	LWD-11/28
Chadwick (T2) GB	KY	LWD-11/26	Weeks (T3) ID	Going to Horton Fire	
Bentley/ParishT2	Avail. 11/26	To Rock Mtn	Dueitt T1	Avail. 11/28	

Crews and Modules

Outgoing	Incoming	On Deck
	5 T2IA and 1 MOD	5 Crews Sun, 8 MODs Mon

Aviation *(This information was not part of the MAC daily briefing document for this date, but gathered by the review team)*

Location	Resource	Quantity	Resource	Quantity	Resource	Quantity
Alabama	Type 1 helicopter	1				
Georgia	Type 1 helicopter	1				
Kentucky	Type 2 helicopter	1				
North Carolina	Type 1 helicopter	1	Type 2 helicopter	1		
South Carolina	Air Attacks	2				
Tennessee	Lead Plane/ASMs	3	Airtankers	4	Super Scoopers	2

Tennessee IA Helibase	Type 1 helicopters	2	Type 2 helicopter	1		
Unlisted	Infrared (IR) Aircraft	1	Passenger/Cargo	1		

SOUTHERN AREA MULTI-AGENCY COORDINATING GROUP (MAC) DAILY BRIEFING – NOV. 27, 2016

MAC Priorities *Updated 20161127 1015*

1	2	3	4	5	6	7	8
Initial Attack	Rock Mtn	Mt Pleasant	Pinnacle	Camp Branch	Horton	Clear Creek	Party Rock
9	10	11	12	13	14	15	
Tellico	Boteler	Chestnut Knob	Maple Springs	Chimney Rock	2 Mile	Roaring	

New and Emerging Fires

State	Jurisdiction	Description	Notes

IMT Rotation work in progress

Team	IC	Assignment	LWD
Wilkins (T1) SA	Quesinberry	Boteler – NC	2-Dec
Kern (T2) FL	Kern	Chestnut Knob – NC	30-Nov
Kline (T2) GA	Ingram	Tatum Gulf – GA	2-Dec
Kauffman (T3) VA	Kauffman	Eades Hollow – VA	5-Dec
Jaca (T3) TN	Vick	Chimney Rock – TN	
Lewis (T3) NC	Lewis	2 Mile – NC	
Miller (T3) TN	Miller	East Miller Cove – TN	
Smith (T1) OR	Smith	Party Rock – NC	5-Dec
Livingston (T1) NW	Livingston	Rock Mountain – GA Parish inbrief on Nov 28	29-Nov
Esperance (T2) RM	Esperance	Maple Springs – NC	28-Nov
Fogle (T2) SO	Fogle	Rough Ridge – GA Transition tomorrow w/ Hunter	27-Nov
MNICS (T2 short) MN	Pisarek	Knoxville Mob Center – TN checking on extension	3-Dec
Thompson (T2) NR	Thompson	Clear Creek – NC (extending a two days?)	4-Dec
CAT (T3) MT	Hamilton	Mount Pleasant – VA	3-Dec
Ostler (T3) UT	Ostler	Pinnacle Mountain – SC	30-Nov
Weeks (T3) ID	Weeks	Horton – NC	
Hunter (T3) OR	Hunter	Mob enroute - Rough Ridge - GA	
Daniels (T3) CO	Daniels	Into Staging Monday	Traveling 27/28

Crews and Modules

Outgoing	Incoming	On Deck
Jetload Today	4 T2IA, 1 T2 and 4 MOD	8 MODs Mon

Aviation

AVIATION RESOURCES	Region 8 Support								SACC Support							
	AL	FL	GA	KY	NC	SC	TN	VA	AL	FL	GA	KY	NC	SC	TN	VA
Air Attack Platforms														2	1	1
Lead Plane/ASM															3	
Large Airtankers															4	
Type 3 ME Airtankers							2									
Other Aircraft							1									
Type 1 Helicopters									1		1		1		2	1
Type 2 Helicopters												2			1	
Type 3 Helicopters			1							1						

SOUTHERN AREA MULTI-AGENCY COORDINATING GROUP (MAC) DAILY BRIEFING – NOV. 28, 2016

MAC Priorities *Updated 20161128 1015*

1	2	3	4	5	6	7	8
Initial Attack	**Rock Mtn**	**Mt Pleasant**	**Pinnacle**	**Camp Branch**	**Clear Creek**	**Horton**	**Party Rock**
9	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Chimney 2	**Tellico**	**Boteler**	**Chestnut Knob**	**Maple Springs**	**Chimney Rock**	**2 Mile**	**Roaring**

New and Emerging Fires

State	Jurisdiction	Description	Notes
FL	State	A couple of new starts	

IMT Rotation work in progress

Team	IC	Assignment	LWD
Wilkins (T1) SA	Quesinberry	Boteler – NC	2-Dec
Kern (T2) FL	Kern	Chestnut Knob – NC	30-Nov
Kline (T2) GA	Ingram	Tatum Gulf – GA	2-Dec
Kauffman (T3) VA	Kauffman	Eades Hollow – VA	5-Dec
Jaca (T3) TN	Vick	Chimney Rock – TN	
Lewis (T3) NC	Lewis	2 Mile – NC	
Miller (T3) TN	Miller	East Miller Cove – TN	
Smith (T1) OR	Smith	Party Rock – NC turn back to local Tuesday	5-Dec
Livingston (T1) NW	Livingston	Rock Mountain – GA Parish inbrief on Nov 28	29-Nov
Esperance (T2) RM	Esperance	Maple Springs – NC	28-Nov
MNICS (T2 short) MN	Pisarek	Knoxville Mob Center – TN checking on extension	3-Dec
Thompson (T2) NR	Thompson	Clear Creek – NC	4-Dec
CAT (T3) MT	Hamilton	Mount Pleasant – VA	3-Dec
Ostler (T3) UT	Ostler	Pinnacle Mountain – SC	30-Nov
Weeks (T3) ID	Weeks	Horton – NC	
Hunter (T3) OR	Hunter	Rough Ridge - GA	
Daniels (T3) CO	Daniels	Going to Chimney 2	

Crews and Modules

Outgoing	Incoming	On Deck
	1 MODs	

Aviation

AVIATION RESOURCES	Region 8 Support								SACC Support							
	AL	FL	GA	KY	NC	SC	TN	VA	AL	FL	GA	KY	NC	SC	TN	VA
Air Attack Platforms														1	1	1
Lead Plane/ASM															2	
Large Airtankers															4	
Type 3 ME Airtankers							2									
Other Aircraft							1								1	
Type 1 Helicopters									1	2	1		1		2	
Type 2 Helicopters												1	1		1	
Type 3 Helicopters			1							1						