Simms Declared Wildfire Facilitated Learning Analysis, Fire Environment Analysis, and Declared Wildfire Review

Grand Mesa, Uncompahgre, and Gunnison National Forests, Colorado

August 2022

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Executive Summary

On May 16, 2022, firefighters ignited a 188-acre prescribed fire on the Ouray Ranger District of the Grand Mesa, Uncompahgre, Gunnison National Forest (GMUG) near Montrose, Colorado. The burn unit was within the wildland-urban interface (WUI) and directly adjacent to private land. Throughout the day, firefighters extinguished several small spot fires outside of the unit, along with one larger, quarter-acre spot. Overall, the prescribed fire's implementation was nothing out of the ordinary and it was successful in achieving objectives. Mop up and patrol continued for the next three days, with smoldering and smoke production decreasing over time.

On May 19, a forecasted cold front arrived, producing gusty winds from the west that reached a maximum recorded speed of 26 miles per hour at a remote automated weather station (RAWS) approximately 17 miles from the unit. That afternoon, a wildfire became established adjacent to the burn unit on private land. A subsequent fire investigation found that the prescribed fire was the source of the wildfire. The wildfire quickly expanded down a drainage, prompting a significant initial attack (IA) response from multiple agencies, as well as evacuations. Ultimately, one primary residence and two other structures were destroyed, and 313 acres of private and Bureau of Land Management (BLM) land outside of the unit were burned.

As a result of the wildfire, an interagency team was assembled to conduct a complex facilitated learning analysis (FLA), in conjunction with a fire environment analysis and declared wildfire review. The declared wildfire review is intended to ensure compliance with Forest Service Manual 5140 (Wildland Fire Management - Hazardous Fuels Management and Prescribed Fire) direction, as well as required burn plan elements as identified in Interagency Prescribed Fire Planning and Implementation Procedures Guide (PMS 484). The intent of the FLA is to share 1) personal accounts and lessons learned by those involved in the events; and 2) the FLA team's observations, lessons learned, and recommendations for improvement.

The FLA process is a tool for learning from unintended outcomes and promoting "just culture" in the workplace. Just culture is described in the FLA guide (USDA 2020b) as: *a workplace where employees at all levels are accountable for their participation and their commitment to the organization's safety culture.* The FLA is not intended to place blame or judge in hindsight. Rather, lessons learned, observations, and recommendations are shared to foster understanding of the decisions that were made and contribute to forward-looking accountability and a risk-based decision-making organization. By sharing the stories of those involved in unintended outcomes, the process highlights potential weaknesses in the system and opportunities for improvement to reduce the risk of a similar unintended outcome occurring in the future.

As stated in the FLA guide, the FLA process is not the appropriate method of review if a team finds "reckless and willful disregard for safety" or when a serious criminal act may have been committed. The FLA team did not find anything to suggest gross negligence or criminal intent. Therefore, the FLA is the appropriate review tool for learning from this type of incident.

To help contribute to this learning culture, the FLA team provides the following five recommendations:

1. Provide a more robust framework to bolster the prescribed fire management program.
2. Increase support to agency administrators and prescribed fire management personnel.

3. Closely review the status of interagency relationships and work towards strengthening those relationships.
4. Use the vast array of planning tools to evaluate burning conditions, weather events, seasonal weather patterns, and potential fire behavior.
5. Evaluate the process of how prescribed fire plans are developed and reviewed to ensure a thorough, non-biased technical review is completed.

In addition, the declared wildfire review (Appendix 2) identified multiple recommendations, including:

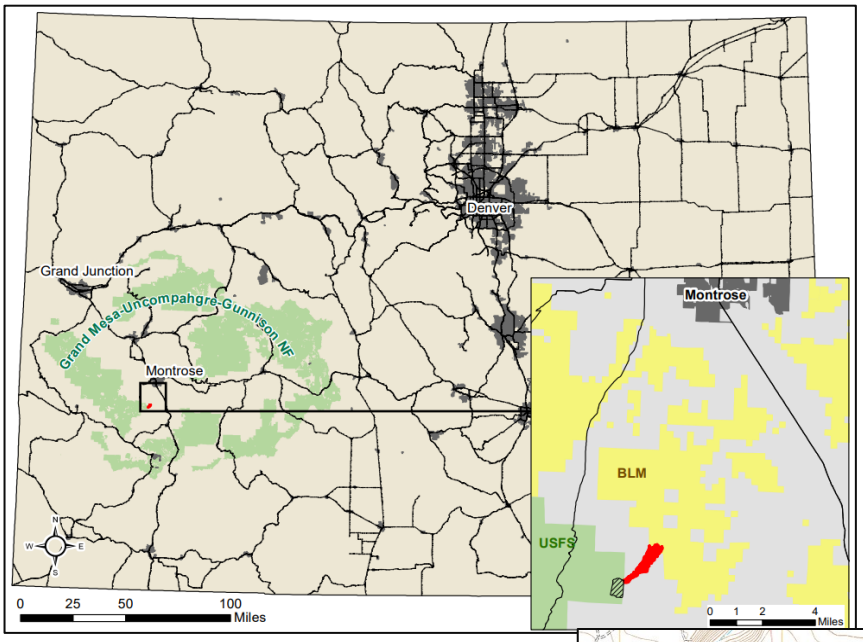
1. Complete a thorough review of fuels in and adjacent to burn areas when developing a complexity analysis. Ensure that adjacent fuels are modeled accurately for use in informed risk-based decision making.
2. Ensure that organization needs can support implementation at the high end of prescriptions.
3. Properly functioning RAWS should be located onsite and maintained as required by NWCG Standards for Fire Weather Stations to provide accurate and relevant weather data and fuel moistures.
4. Include a mop up and patrol plan that includes quantity, type of resource, and staffing time frames for mop up/patrol based on both environmental conditions and prescribed fire activity.
5. When burning adjacent to values such as homes and private land, incorporate potential contingency actions into planning and implementation, such as creating maps showing locations of access roads, structures, water sources, and hazards, to ensure contingency response is effective and efficient.
6. Incorporate the use of various resources and technology to provide accurate modeling to inform appropriate staffing.

Setting the Stage

Physical Setting

Simms Mesa Unit B was one of several units within the Simms Mesa Project and the last unit to be implemented within the project. The 188-acre unit was located just within the GMUG forest boundary, on the east side of the Uncompahgre Plateau, which drops off towards the Uncompahgre Valley and the town of Montrose, 12 miles to the north. It was bounded on its west by the pronounced canyon containing Dolores Creek, and on the east by private property. The unit was in the wildland-urban interface (WUI) as multiple structures were east of the unit on private property.

Figure 1. The location of the GMUG National Forest and the Simms prescribed fire/declared wildfire in relation to the state of Colorado



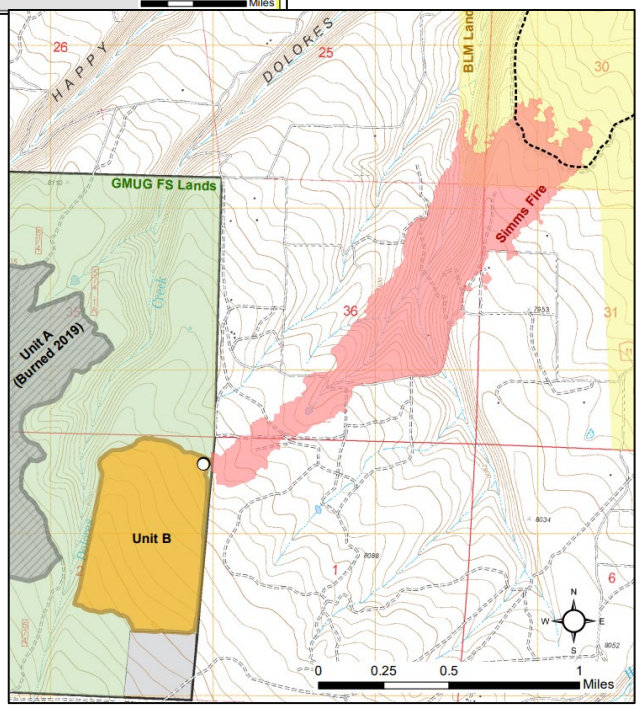


Figure 2. Closer view of the Simms Mesa prescribed fire unit, Simms Fire, and BLM. The test fire location is marked with a white dot, and the perimeter of the BLM fuels treatment with a dashed line

Main access to the unit was through private land, access which was recently secured with private landowners. In addition to a Forest Service road along the private land boundary, there were some two-track roads around the perimeter of the burn unit and multiple unmapped two-tracks on the private land adjacent to the unit, which was separated from National Forest System (NFS) lands by wire fencing.

The unit gently sloped uphill (five percent average) to the southwest, from an elevation of 8,100 feet at the northeast up to 8,300 feet in the southwest. Ponderosa pine with Gambel oak, sage, and other forest shrub species interspersed in the understory made up the unit's vegetation.

Over the past year, the western half of Colorado had observed drought conditions ranging between "abnormally dry" and "exceptional" in the Climate Prediction Center's U.S. Drought Monitor. In late February 2022, the Simms Mesa prescribed fire area was experiencing moderate drought conditions, which by May 17 had trended to "severe". Western Colorado had also been experiencing above average frequency and duration wind events that spring.

Figure 3. Typical fuels in the Simms Mesa prescribed fire area

Purpose of the Prescribed Fire

Burning the unit was the GMUG's priority prescribed fire for the spring because of its proximity to the WUI. The intent of the burn was to create a buffer for adjacent private land and homes that would slow or stop a wildfire, if one were to occur. The prescribed fire plan (burn plan) for the unit stated that "the intent [of the burn] will be to utilize fire behavior to create a more resilient landscape…[to] provide opportunity for grass and forb production as well as create more readily available seed beds on the forest floor. Elimination of these fuels will also likely reduce the threat of high intensity fire spread by unplanned ignitions in the future. The desired fire behavior will also…[leave] a good ratio of woody debris that is beneficial to this ecosystem."

While ladder fuels were minimal in the unit due to mastication that was completed in 2009, prescribed burning was also needed to fully achieve resource objectives. The burning had not yet occurred because access on the main road to the unit was not secured with the landowner until this year.

The resource objectives of the burn, as outlined in the prescribed fire plan, included:

1. Reducing the dead fuel component.
2. Limiting mortality of ponderosa pine.
3. Protecting pockets of pine regeneration to promote age class diversity and minimize mortality.
4. Generating 50 to 70 percent mortality in understory fuels (including oak and isolated pinyon-juniper).
5. Reducing the risk of high intensity fire in ponderosa pine stands and adjacent resources.
6. Limiting scorch height to the lower two-thirds of the co-dominant tree height, leaving the top third free from scorch.

Wildfire Crisis Strategy

In addition to the localized need to burn the unit to reduce fuels and wildfire risk, the recently released nation-wide emphasis on addressing the wildfire crisis from the Chief of the Forest Service calls for working with partners in the next ten years to implement additional fuels and forest health treatments. Specifically, the strategy aims to:

- Treat up to an additional 20 million acres on National Forest System lands;
- Treat up to an additional 30 million acres of other Federal, State, Tribal, and private lands; and
- Develop a plan for long-term maintenance beyond the ten years.

Risk

Prescribed fire is an important tool in the forest management and the Wildfire Crisis Strategy (USDA 2022). However, there are risks associated with using this tool that managers must consider and weigh.

- What is at risk if the burn occurs (firefighter safety, for example)? What is at risk if the burn does not occur (forest health, for example)?
- What are the consequences if an unintended outcome occurs? Will those consequences influence our ability to use the tool in the future?

Prepping for the Prescribed Fire

Figure 4. Norwood RAWS, 2.5 miles from the Simms Mesa RAWS

Burn preparations had begun in April, after access to the unit had been secured, by cleaning up the control lines and setting up a portable remote automatic weather station (RAWS). It was later observed that the wind gust function on the RAWS was not functioning properly, however everything else about the RAWS seemed to be functioning correctly and recording accurate observations. Fire personnel continually worked on troubleshooting the issue with the RAWS service center in Boise, Idaho, first swapping out sensors then looking into the internal software when that did not solve the issue. The RAWS remained in service for everything but wind observations (later in the month it was discovered that the errors were caused by a software issue).

The Forest Service prepared to burn the unit on May 5, but the burn was postponed to May 10 due to dry conditions and winds outside of the prescribed fire plan's prescription. On May 10, weather conditions forecasted for the burn unit still did not allow for ignitions and the burn was called off again. However, the forecasted winds did not materialize; the weather stayed within prescription. An integral part of prescribed burning in Western Colorado is closely tracking weather–particularly winds–to ensure a burn can safely be carried out. Delaying ignitions twice due to forecasted high winds was not out of the ordinary in this area.

It was now mid-May and spring burning season was coming to a close. Soon, conditions would not allow for burning until fall and then firefighters might still be busy fighting wildfires and unavailable to assist with prescribed burning. Going into ignition day, GMUG fire managers concluded that conditions were favorable to accomplish the burn within prescription parameters, while considering forecasted wind and weather events.

The Burn

Monday, May 16 – Ignition Day

On Monday, May 16, fuel and weather conditions were in line for implementing the prescribed fire. District firefighters, as well as firefighters brought in from neighboring districts and agencies to help with the burn, gathered in the morning outside of the Montrose Interagency Dispatch Center for the normal preparations, including briefings and the go/no go checklist.

Fuels were dry and ready to burn, and it was not windy. Higher winds were predicted for Thursday, May 19, but this was not considered an issue because the burn would be secure by then. It was the first burn of the year on the district, but it was not the first burn of the year for many of the firefighters involved as they had assisted with prescribed fires in the southeastern states earlier that year. Additionally, many of the firefighters had many years of experience with prescribed fires and this burn was considered fairly small and straightforward.

Table 1. Fire danger indices used to determine fuels availability and consumption potential and their values on ignition day. Fuel Model Y was used for modeling the value on ignition day.

Factor	Index/measurement	Value on ignition day
Potential fuel heat output	Energy release component (ERC)	52 (85th percentile)
Fire suppression difficulty	Burning index (BI)	34 (90th percentile)
1-to-3-inch diameter dead woody fuels	100-hour timelag moisture	8 (95th percentile)

The Burn Boss reviewed the prescribed fire plan and objectives with the District Ranger Agency Administrator (AA) that morning, even though the AA had already been heavily involved in pre-planning for the burn and was already familiar with the information. Firefighters traveled to the unit once briefing was finished. In addition, several observers from the District and Forest, including the District Ranger AA, District FMO, and Forest FMO, traveled to the unit to show support for the firefighters. Upon arrival at the unit, the Burn Boss and Burn Boss Trainee once again briefed resources and lined out the expectations of the day before completing the go/no go checklist and test fire.

After the go/no go checklist and test fire were completed, ignitions began at approximately 1030 in the northeast corner of the unit. Firefighters were encouraged to take their time – the unit was fairly small and there was plenty of time in the day to complete ignitions and start patrol and mop up.

Some small spot fires were picked up within a chain of the line north and east of the unit shortly after ignitions began. However, they were all quickly addressed and did not hinder firing efforts.

A larger, quarter-acre spot fire east of the unit occurred directly adjacent to the burn on private land later in the afternoon. Ignitions were paused while the spot was addressed. After about 45 minutes, the spot fire was contained with a hose lay and fireline, with the assistance of firing resources and a contingency Type 4 engine/water tender that sprayed 4,000 gallons of water on the spot fire. The spot fire was not declared a wildfire, even though it was on private land, because it was contained within a reasonable timeframe with the resources that were on scene. Once the spot fire was addressed, ignitions started up again and were completed by 1500.

Figure 5. Effects on the vegetation from the larger spot fire

Overall, the unit burned nicely with three-to-five-foot flame lengths. Some tree torching occurred, but the Zone FMO considered this “ops normal”.

Figure 6. Typical fire behavior on the southern edge of the burn

Firefighters patrolled, gridded, and mopped up, with an emphasis on checking the east side/leeside of the burn since this side was closest to private land and is where the spot fires had occurred. Mopping up was completed half a chain into the unit, beyond what would “typically” be completed.

Other than the quarter-acre spot fire, the burn was so ordinary that after ignitions were complete, the Burn Boss decided to let two crews depart to assist with prescribed burning in the North Zone. Even with the departure of these two crews, there were still more resources on the burn than the

prescribed fire plan called for: the plan required 18 personnel, but there were close to 50 personnel on the burn that day.

By 2000, all resources had left the unit, after checking that all heat near the fire line was out, checking that the larger spot fire was still secure, and mopping up around the entire fire perimeter.

Figure 7. Post-burn effects on the unit's vegetation

Tuesday, May 17 and Wednesday, May 18 – Patrol and Mop Up

Approximately 10 to 12 firefighters, including the Type 4 engine/water tender, were on the unit on Tuesday for approximately nine hours. Firefighters patrolled, gridded, and mopped up one to one and a half chains inside the unit, focusing on "duffers" and stump holes that could contain heat. Firefighters also gridded several chains out from the unit into the unburned fuels around the quarter-acre spot fire, as well as north of the unit to check for undetected spot fires. Firefighters on UTVs with tanks sprayed water drafted from a pond in the unit.

Some residual creeping within the unit was observed, but nothing out of the ordinary or anything that caused issues or concerns. "The fire was just skunking around," one firefighter remarked. The Burn Boss Trainee who patrolled the entire perimeter of the unit reported that everything looked good. The Burn Boss and Firing Boss noted that there was more patrolling and mopping up occurring on Tuesday than what would normally occur, given the minimal fire activity.

Patrol and light mop up continued Wednesday, but with a smaller group of firefighters and for a shorter duration since the work the previous day was so successful. The firefighters stayed on the unit for just over an hour in midday and concluded that the burn looked completely secure.

Warm and dry conditions continued on Tuesday and Wednesday, as predicted. And although steady winds with gusts to up to 22 miles per hour had been recorded at the Norwood RAWS, firefighters on the unit had been observing lower wind gust speeds than were forecasted by the NWS.

Cognizant of the NWS's forecast for high winds in the coming days, the neighboring BLM unit requested a spot weather forecast for a burn they were planning. The BLM canceled their plans to burn on Wednesday after the NWS issued a fire weather watch in the spot weather forecast.

Thursday, May 19 – Patrol and Mop Up; Declared Wildfire

At 0400 that morning, the NWS issued a red flag warning for the day, calling for high winds and low humidity.

Two firefighters who had been the Firing Boss Trainee and UTV Pump Operator on ignition day returned to the unit mid-morning with a UTV equipped with a water tank and sprayer. Patrolling the perimeter, looking at the area of the most intense spotting from ignition day, and completing a bit of mop up, the firefighters saw nothing besides a few smokes deep within the unit. The firefighters did not consider this heat a threat to the line.

With now three days of steady and gusty winds, but very minimal smoldering or fire activity, conditions seemed neither markedly different nor concerning to the firefighters. Overall, the fire looked dead, so they decided to pull the portable pumps. They left the unit by 1400, confident that the unit was secured and wind tested.

How Could This Happen?

At around 1500, dispatch received the first reports of smoke from the prescribed fire area. The reports were not overly concerning at first. A private party who called dispatch to report the fire said, "it's 80 by 100 feet and there's more smoke than fire. It doesn't look that bad."

The firefighters who had just left the unit were directed to head right back up with an engine, joined by the Burn Boss. When the Firing Boss Trainee arrived at the now three-to-five-acre fire, he was in disbelief. He remembered thinking, "How could this happen? How could this start here? This was the coldest part of the burn for days." The firefighters did not have much time to dwell on this thought though as initial attack (IA) firefighting was immediately needed to try and get a head start on the fire before it continued into Wildcat Canyon.

"How could this happen? How could this start here? This was the coldest part of the burn for days."

Figure 8. Simms Fire smoke column on May 19. Photo courtesy of the Montrose County Sheriff's Office

Around 1600, the Burn Boss and Forest FMO at Montrose Dispatch declared the prescribed fire a wildfire (now called the Simms Fire) to help with calling in additional resources to aggressively fight the fast-growing fire. By 1630 the fire was an estimated 15 acres and structures were threatened. An AA was contacted and was on his way to the fire. The District Ranger who had been the AA on ignition day was traveling to assist with a wildfire in Nebraska; she was also contacted and turned back to Colorado to assist with the Simms Fire.

IA was highly dynamic, challenging, and required aggressive firefighting tactics and coordination of resources from many different agencies. Firefighters, many of whom had helped light and hold the prescribed fire, were working frantically while still feeling disbelief and confusion over where the fire had come from.

They attempted at first to flank the fire with hose, but quickly became out matched as fire intensity increased. The fire made a run and cut the engine off from being able to cross Wildcat Canyon Road. A firefighter on a UTV attempted to enter an area of the fire but was forced to turn back due to the thick vegetation. An engine crew laying hose and spraying water found

Figure 9. Fuel conditions adjacent to the burn unit near the wildfire's point of origin

the deep duff (up to eight inches in some places) had drained their entire tank. The wildfire blew straight down the canyon, luckily holding within the canyon walls because of topography and wind. Air tankers that had been ordered for assistance arrived after the normal delay for mobilization and flight time and dropped thousands of gallons of retardant along the flanks of the fire (Figure 10).

At Dispatch

At the Montrose Interagency Dispatch Center, other than the fact that staffing was low that day with just two dispatchers, nothing was unusual about the day until smoke reports started to come in from the public in the afternoon. By the report, the dispatchers realized that it was not just some residual smoke from the Simms Mesa prescribed fire. This was confirmed when they looked outside and could see the smoke column. Shortly after, the radio and phone calls started pouring in and the pace got frantic. This was exacerbated by the fact that there were technology issues with the cloud-based computer automated dispatching (CAD) program not working and laptops that did not have charged batteries. Montrose Dispatch called militia to assist with the call load. A public information line was activated so that the Montrose County Sheriff's posse could also staff phones to assist with the call load.

At the nearby WestCO Dispatch, things had been relatively quiet the whole time from the day of the burn's ignition on Monday until about 1600 on Thursday. Then there were *a lot* of calls. At first, the WestCO dispatchers thought that callers were just reporting the burn and that resources were still on the unit tending to the burn. However, it quickly became apparent that was not the case. Calls between dispatchers at WestCO and Montrose Dispatch confirmed that the Simms Mesa prescribed fire was out of its boundary and rapidly running with the wind. In these critical first hours the dispatchers at both Montrose and WestCo coordinated activities, including sending out two evacuation warnings.

The first notification to go out to the general public was via the opt-in Code Red system, where only those residents who signed up received a notification. The second notification that went out a little later was via the Integrated Public Alert & Warning System (IPAWS), which sent a mass text warning to all mobile phones within a five-mile radius of the fire location.

On the Simms Fire

With the head of the fire too fast and hot to fight directly, the primary objective for the firefighters was to find and assess structures and evacuate people from the area. Evacuations took place concurrently with firefighting efforts, as both fire resources and law enforcement went door-to-door to find and evacuate residents.

Two firefighters zipped along the dirt roads in a UTV, trying to navigate without a map showing the two-tracks and private roads, with increasingly limited visibility in the tall, continuous pinyon-juniper vegetation and blowing smoke. An engine crew found a hunting cabin with its eaves on fire, but they had a difficult time accessing the area because of the chain's large diameter and the anti-theft lock. Only by jumping on the bolt cutters did they eventually open the gate for their engine, but it was too late to save the cabin. The crew continued to locate and try to defend and prep structures to withstand the fire.

As the flame front approached, two engines were stationed defending a home overlooking Wildcat Canyon. The owner of the property informed the firefighters that a neighbor was currently bedridden and could not evacuate. With this information, the engines relocated to

defend the home with the elderly resident sheltering inside. They successfully protected the structure and its occupant, and when they felt it was safe, returned to find the other home they left was now on fire. An ember had found receptive fuel in decorative wood cladding around the chimney– the only weak point in the otherwise fire-resistant home. Both engines worked to suppress the fire now burning under the roof, but it was a lost cause. The home was destroyed by the fire.

By the early evening, the fire had run through private lands in Wildcat Canyon and onto the downward sloping plateau. It was holding in place with about 25,000 gallons of retardant along its flanks. The head of the fire reached and blasted across a dirt road on BLM land, blackening the road surface and scattering embers into the recently treated pinyon-juniper fuels. The fire continued to burn, but the treated fuels, combined with retardant drops, reduced the fire intensity.

By approximately 2130, the fire was fairly calm and stable in its footprint. The final significant suppression action of the IA period, a burnout to create a hard black line, started around midnight and lasted for several hours into early Friday morning.

Figure 10. Airtanker delivering fire retardant on the Simms Fire

Post-IA

As is typical of many fires in this fuel type, the fire had quickly ramped up, but then quickly ramped down and was not very active after its initial run. The fire response remained aggressive though, with extensive work by ground crews and further use of aviation resources. The high winds had subsided in the late morning and snow soon followed. More than a dusting, the snow began to accumulate on the charred ground. As temperatures continued to drop, resources working the fire took warming breaks. The fire was contained mainly in Wildcat Canyon, while the head reached sparser fuels in a nearby BLM fuel treatment where fire behavior was significantly moderated.

Running into Treated Fuels

Separated from GMUG land by a stretch of private lands, the BLM had its own Simms Mesa project. Roller-chopped in 2003 and prepped around its perimeter again in 2018, BLM fire management planned to burn the unit in 2022. Even without the burn, the sparser treated fuels helped take some punch out the running Simms Fire.

Figure 11. Untreated fuels on the left of the road and treated BLM fuels project on the right

On Saturday morning, a Complex Incident Management Team (CIMT) that had been ordered late Thursday arrived to manage the fire. Approximately 220 personnel were assigned to the fire at that time. The CIMT, along with GMUG officials, Montrose County, Ouray County Sheriff's Office, BLM, and Colorado Division of Fire Prevention and Control, held a public meeting that evening at the Montrose County Events Center, as well as through Facebook Events. Twenty members of the public attended in person.

Emotions ran high both in person and through posted comments in Facebook Events, with much frustration displayed towards the District Ranger AA and fire staff. The District Ranger AA noted that many folks expressed support of prescribed fire but adamantly questioned the Forest Service's decision to leave the burn at 1400 on Thursday afternoon. This put the District Ranger AA in a difficult position—she wanted to express empathy and take responsibility, but she knew that the fire was under investigation, and she needed to respect the investigation process.

The following Monday, a separate meeting was held with directly impacted landowners to assist with assessment and provide available resources.

In total, the fire burned 313 acres of land and three structures before being declared 100 percent contained on Monday May 23.

Figure 12. Private land burned in Wildcat Canyon

Chronology

Table 2. Chronology of events. Weather information provided is the recorded temperature in Fahrenheit, relative humidity (RH), average wind speed, and gust speed in miles per hour (mph). On Monday May 16, weather was recorded on the unit by fire personnel; the other weather observations were taken at the Sanborn RAWS*.

Time	Activity	Weather
Thursday, May 5		
Planned Simms Mesa Unit B ignition canceled due forecasted weather.		63°F; RH: 16%; Average wind: 3 mph; Wind gusts: 15 mph
Sunday, May 10		
Planned Simms Mesa Unit B ignition canceled due to forecasted weather.		57F; RH: 12%; Average wind:5 mph; Wind gusts: 27 mph
Monday, May 16		
0730	Pre-brief and ignition authorization completed.	
0800	Briefing.	47°F; RH: 29%; Winds: calm
0930	Go/no go checklist completed.	
1000	Test fire initiated and determined adequate to proceed with ignitions.	56°F, RH: 22%; Average wind:3 mph; Wind gusts: 5 to 8 mph
1430	Spot fire outside project area detected and contained.	64°F; RH: 14%; Average wind: 1 to 3 mph; Wind gusts: 10 mph
1500	Ignitions completed.	
2000	All resources left the burn unit. Mop up around fireline completed.	
Tuesday, May 17		
0800	Seventeen personnel arrived at the burn unit to patrol perimeter of burn and grid the east side	67°F; RH: 12%; Average wind: 3 mph; Wind gusts: 8 mph
1300	Highest wind recorded.	77°F; RH: 9%; Average wind: 6 mph; Wind gusts: 22 mph
1746	All resources left the burn unit.	68°F; RH: 14%; Average wind: 2 mph; Wind gusts: 12 mph
Wednesday, May 18		
1112	Burn Boss and Firing Boss Trainee arrived at the burn unit to patrol and monitor.	70 °F; RH: 21%; Average wind: 5 mph; Wind gusts: 15 mph
1223	Burn determined secure. All resources left the burn unit.	71 °F; RH: 18%; Average wind: 6 mph; Wind gusts: 13 mph
1500	Highest wind recorded.	74°F; RH: 14%; Average wind: 8 mph; Wind gusts: 20 mph
Thursday, May 19		
1030	Firing Boss Trainee and UTV Operator arrived at the burn unit to patrol and monitor.	73°F; RH: 16%, Average wind: 8 mph; Wind gusts: 19 mph

Time	Activity	Weather
1400	Firefighters left the burn unit.	74°F; RH: 11%; Average wind: 9 mph; Wind gusts: 24 mph
1505	Montrose Interagency Dispatch Center received a report of flames.	73°F; RH: 12%; Average wind: 8 mph; Wind gusts: 22 mph
1548	Firefighters arrive on scene. Fire is approximately two acres in size.	74°F; RH: 12%; Average wind: 9 mph; Wind gusts: 22 mph
1630	Structures are reported threatened. Fire is 15 acres in size.	
1730	Pre-evacuation notices sent out.	
1835	Mandatory evacuation orders issued.	
1700	First air tanker arrives on the fire.	73°F; RH: 12%; Average wind: 9 mph; Wind gusts: 26 mph
1730	Complex incident management team ordered.	69°F; RH: 14%; Average wind: 9 mph; Wind gusts: 26 mph
1830	Fire is estimated at 380 acres. Three structures destroyed.	66°F; RH: 15%; Average wind: 6 mph; Wind gusts: 18 mph
2400	Burn out begins.	61°F; RH: 18%; Average wind: 7 mph; Wind gusts: 20 mph
Friday, May 20		
0200	Winds and fire died down.	59°F; RH: 19%; Average wind: 6 mph; Wind gusts: 22 mph
0300	Burn out completed.	57°F; RH: 22%; Average wind: 6 mph; Wind gusts: 22 mph
Montrose County Sheriff's Office lifted all evacuation orders other than for those along Wildcat Drainage		
Saturday, May 21		
0600	Fire transitioned to management by the Rocky Mountain Complex Incident Management Team One	
1800	Public meeting.	
Sunday, May 22		
All evacuation orders are lifted.		
Monday, May 23		
Meeting held with affected landowners. Fire declared contained.		
Tuesday, May 24		
Management of the fire transitions to local Type 3 Incident Command Team. Fire size updated from an estimated 373 acres to 313 acres based on field verification and mapping.		

* A weather station at the Montrose Airport recorded higher temperatures, lower humidities, and higher winds on many of these days, particularly on May 19. Neither the Sanborn RAWS nor Montrose Airport perfectly reflect weather at Simms, but comparing weather taken on May 16 at Simms to Montrose Airport weather shows that the airport's readings were significantly more extreme (hotter, drier, and windier).

Lessons Learned by Participants

This section describes the lessons learned, grouped into three main groups, shared by those involved in the prescribed fire and declared wildfire. These lessons learned are shared from a forward-looking perspective to facilitate learning from unintended outcomes.

1. Resources and Staffing

A. Expect the Unexpected

- Ensure that adequate firefighting resources are on scene at each phase of a prescribed fire, including patrol and mop up, especially during the most critical burn periods of a day, to handle unanticipated issues that may arise. This may require tough conversations if there is pressure to release resources to other projects.

- Require water delivery resources, such as a Type 4 engine and portable pumps, as a condition of implementation, rather than a happenchance. At Simms, a Type 4 engine happened to be available on burn day and assisted with the larger spot fire, but it was not a requirement in the prescribed fire plan. Portable pumps placed throughout the unit and kept in place during all phases of prescribed fire operations, and especially during critical periods, such as the hottest and driest part of the day or the time of highest forecasted winds, can provide water refills for any type of engine or tanked vehicle.

- When assigning patrol resources, consider the overall qualifications of resources to be assigned as part of a holding/contingency plan. An Incident Commander Type 4 (ICT4), for example, is qualified to organize and manage an emerging incident, if one were to occur.

B. Broad Spectrum of Resources

The broad spectrum of potential resources, rather than the most familiar or readily available resources, should be considered during planning and implementation. For example, aircraft (fixed wing, helicopter, or drones) with infrared (IR) imaging capability can help locate heat sources that may be undetected by firefighters on the ground.

C. Dispatch Center Training, Coordination, and Communication

- Consider conducting interagency dispatch center incident training and preemptive coordination, such as scenario trainings, so the standard operating procedures, roles of resources, strengths, and challenges of each center are understood, and so that an interagency plan on how to handle complex incidents can be developed. For example, dispatchers expressed the desire to help their interagency partners in ways that don't come up in day-to-day operations. These might be as simple as ordering meals for an understaffed center, or as complicated as developing public fire information and evacuation notices.

- Communicate the status of prescribed fires to adjacent dispatch centers, beyond ignition day, to reduce confusion and facilitate consistent communication and response in the event of unintended events. WestCO Dispatch was aware of the Simms Mesa prescribed fire, but when reports of smoke began coming in, they believed that burn was still amply staffed and possibly still in its ignition phase. This

confusion regarding the status of the burn contributed to public confusion and a less than ideal coordinated interagency response from the dispatch centers.

D. Agency Administrator Strain

Firefighter-level understaffing tends to get the most attention in the press and within the fire management community. However, agency administrators (AAs) are also experiencing strain from increasingly longer, more intense, and more complex fire seasons.

In the case of Simms, after completion of the Simms Mesa prescribed burn, the District Ranger AA traveled to Nebraska to assist with a wildfire. The GMUG has a solid group of qualified AAs, who are often called upon to assist other units and to cover for each other, so the Forest did not have concerns about the District Ranger AA leaving. However, when the Simms Fire was declared, this meant a different AA than the District Ranger AA was providing coverage.

This backup and coverage worked as it should but is indicative of the increasing demands on AAs and should be kept in mind in future work prioritization.

2. Slides from the Past, Different Future

Our understanding of what works, expectations, management actions, and level of risk may need to be adjusted to allow for the possibility that what worked in the past might not work in the future. Wildfires are changing in behavior, intensity, frequency, and size in response to climate change, fuel conditions, and urban growth. Longer and more active fire seasons are cutting into the traditional burn windows by keeping resources assigned out of the area earlier in the spring and later in the fall. More dedicated prescribed fire resources and higher risk tolerance may be needed to meet prescribed fire expectations and objectives, especially with the Wildfire Crisis Strategy.

Paying attention to small deviations from the norm may be key indicators of a change in activity, different from what may have been expected. More frequent spotting or spots burning more actively than anticipated are indicators of a potentially critical fire environment that may require a change in planned actions.

3. Working in the Wildland-Urban Interface (WUI)

A. Adjacent Fuel Conditions

Adjacent land's fuel conditions must be considered in planning and implementation, especially where there is private land and structures, because of the increase in potential adverse consequences.

B. Contingency Planning

Engage in more robust contingency planning, with attention to aides such as maps showing structures on adjacent private land, non-system roads and trails, locked gates, and other features that can help or hinder firefighting efforts in the event they are needed. In this event, one of the responding initial attack firefighters reflected, "maybe if we knew about all the two tracks on private land we could have gotten in on the head initially and had a chance."

C. Cross-boundary Treatments

There should be an increased emphasis on cross-boundary treatments to reduce the risk of unintended outcomes. Units on ownership boundaries can be the most important, meaningful work. However, these areas can also at the same time be the most complex treatments to successfully complete.

Findings by the Team

During the FLA process, the FLA team identified several key observations that they felt were important to share for forward-thinking learning from unintended outcomes. These are described in four main groups below.

1. Systemic Challenges

A. Staffing

The local firefighting organization is staffed with people who want to do the right thing and care deeply about land management. However, they have become accustomed to doing an increasingly complex and demanding job with fewer resources. They feel that they do not have the tools and adequate support to effectively do their jobs 100 percent of the time. The people who responded to the Simms Fire initial attack were also many of the people who worked the prescribed fire. This is not uncommon.

Fire and fuels management organizations, as well as support organizations like dispatch centers, need significantly more staff *now* to complete the work we are *already* undertaking. Increasing the pace and scale of treatments, as outlined in the Wildfire Crisis Strategy, will require additional staffing on top of the baseline that is already not being met. Without adequate staffing, success, risk management, and employee well-being may all suffer.

B. Changing Conditions

A changing climate, coupled with an expanding WUI and fuel load build-up, is changing the conditions in which prescribed fires are being planned and implemented: fire seasons are becoming longer and more intense; fire behavior is becoming less predictable. This new reality must be recognized and adapted to. The need to adapt to these changing conditions is a cornerstone of the Wildfire Crisis Strategy, which recognizes this as a national-scale issue.

Prescribed fire best practices and expected outcomes are often calibrated to burns that were implemented in the past, outside of these new conditions. Continuing to use this same lens will likely result in more unintended outcomes. Staffing, planning, and standard operating procedures that fit in past prescribed fires must be reviewed in this new framework and updated to provide an accurate, risk-based decision-making framework. In the case of the Simms Prescribed Fire, for example, a more thorough fire environment analysis and holding plan, may not have been as necessary ten years ago, but may be essential now and in the future.

Additionally, even without these changing climactic conditions, each prescribed fire is unique with its own nuances of conditions, weather, and personnel. No prescribed fire is identical from one place or one time to another. Diligence must be taken to ensure expectations, assumptions, and practices are continually being evaluated for effectiveness.

C. Pressure

Participants emphasized that local management did not specifically pressure them to complete the burn. However, there was evidence of an unspoken, larger pressure in the background: the pressure to implement prescribed fires in response to the agency's sense of urgency to increase the pace of prescribed burning and treat areas before a wildfire occurs. While local units and firefighters want to be part of the solution, perhaps this pressure is hindering an honest

communication of the risks of prescribed burning, both to those within the wildland fire and fuels management community and with the public.

2. Improving Decision Support

A. Fire Environment Analysis

A Red Flag Warning forecast covering a period between 1100 to 2200 on Thursday, May 19 was originally posted by the Grand Junction National Weather Service at 0204 on Wednesday, May 18. This original Red Flag Warning was then updated several times (expanding areas and changing maximum wind gusts) until the final applicable posting at 0400 on the day of escape on Thursday, May 19. The warning forecast combinations of gusty winds (20 to 30 miles per hour with gusts up to 50), low relative humidity (7 to 12 percent), and dry fuels for the forecast area in which the prescribed fire had been implemented. Impacts cited in the warning note easy ignition and rapid spread. Escalating the significance of this Red Flag Warning was a fire environment that had trended with drought condition for over a year.

It was evident throughout the FLA process that prescribed fire personnel were aware of the Red Flag Warning. Through interviews it was also evident that these personnel felt that the implemented burn unit had been sufficiently moped up, wind tested, and was secure. This is demonstrated by resources departing the burn at 1223 on May 18, and at 1400 on May 19. It was noted that the fire had received winds of 20 miles per hour on each of the days post-prescribed fire implementation and before the declared wildfire.

As described in the Declared Wildfire Review (Appendix 2), one factor that potentially contributed to the declared wildfire was the inaccurate modeling of fuels outside the project boundary, especially in the area where the escape occurred. Had these fuels been modeled for fire spread and containment using more representative fuel models, the heightened risks associated with burning adjacent to these fuels may have been better understood and further factored into decision making.

In addition, it is unclear to what extent an environmental risk assessment was completed prior to the implementation of the prescribed fire. A thorough analysis could have brought more attention to certain indicators, such as severe drought conditions and fire danger indices at the 90th percentile, that could have influenced subsequent choices, including the development of a more robust monitoring and patrol plan, commensurate with both daily and long-term seasonal weather and effects. A more in-depth review of the fire environment and its implications is in the Fire Environment Analysis (Appendix 1).

B. Remote Automated Weather Stations (RAWS)

Remote Automated Weather Stations (RAWS) monitor weather and provide data that assists land management agencies with planning. Fire managers use this data to monitor fire danger, predict fire behavior, and monitor environmental conditions. However, it was noted by the NWS during previous attempts to find burn windows that the onsite Norwood portable RAWS wind gauge was registering hourly wind speed higher than the hourly gust level. After the burn and fire, this error was determined to be caused by a software issue.

C. Technical Review of the Prescribed Fire Plan

A prescribed fire plan is a critical planning and implementation framework that lays out how to effectively, and with minimized risk, burn an area to meet certain objectives. An integral aspect of

the development and finalization of the prescribed fire plan is the technical review process. The technical review of a prescribed fire plan provides for an opportunity for a reviewer to validate the prescribed fire plan and find areas that may need improvement to contribute to a higher probability of success.

A more rigorous process for technical review for the Simms Mesa prescribed fire plan may have identified areas for improvement in the plan. These areas include modeling of fire behavior in adjacent fuels (outside the burn unit) and in defining the holding organization beyond the ignition day. The prescribed fire plan is reviewed in more detail in the Declared Wildfire Review (Appendix 2).

3. Internal and External Coordination and Communication

A. National Weather Service (NWS)

Interviews with the NWS during the FLA process provided insight on forecasting that is helpful to share with prescribed fire planner and implementers. Communications between NWS and firefighters in the field were sometimes strained, with neither group at times feeling heard nor understood by the other. Observations from the field are key for accurate spot weather forecast. However, the field did not provide these observations to the NWS. In turn, firefighters discounted the validity of the spot weather forecasts because the forecasts received from NWS did not match what the firefighters were observing on the ground.

B. BLM and Forest Service

There appeared to be little information sharing between the co-located BLM and Forest Service offices. For example, the BLM and Forest Service Simms Mesa prescribed fire plans were vastly different and fuel sampling data was not shared between the agencies. Where there once was an interagency “Service First” organizational structure, the agencies’ staff have become more siloed from each other. The COVID-19 pandemic added to this separation as the ability to intermix had been deeply affected. Despite this, it appeared the two agencies worked well together when they were in the field on shared projects and on wildfires.

C. Dispatch

While staff at the WestCO and Montrose Interagency Dispatch worked well with each other during the challenging initial attack phase of the fire, this coordination was developed on the fly during the event because there was not a formal coordination protocol for the centers to rely on. Some dispatchers expressed frustration at wanting to help more but not being able to because there were not avenues to provide additional assistance.

D. Crisis Communication

The AAs wanted to provide clear, consistent messaging and be as transparent to the public as the situation allowed. However, they were unsure about what information could be provided since the wildfire was under investigation. The AAs did not feel as adequately prepared in crisis communication going into the public meeting as they would have liked. While the Forest did coordinate with the Sheriff’s Office during the meeting, the AAs did not have any discussions with Forest Service law enforcement before the meeting to obtain advice. There also was not a template to follow as a framework for the meeting.

This lack of clarity likely contributed to a news release that prematurely stated the Simms Mesa prescribed fire was the cause of the fire; this was later updated to clarify that the prescribed fire was the source of the fire. It also likely contributed to the public meeting coming across as a tactical, information providing meeting, when the public may have appreciated a more empathetic approach.

4. Value of Adjacent Fuel Treatments

In the wildfire behavior triangle of fuels, weather, and topography, the only factor the fire community can alter is fuels. While the spatial scale of fuels treatments may not always be extensive enough to significantly impact wildfires, studies do consistently find that fuels treatments are effective in reducing fire behavior when fires burn into them. This seems to have been the case with the Simms Fire: when the fire reached the BLM's recent fuels treatment, it dropped from a running crown fire to a surface fire and burned in discontinuous patches. While this change in fire behavior was certainly influenced by the change in topography (from a canyon to a mesa) and the transition to nighttime, the BLM's treatments also likely influenced the reduction in fire behavior.

Recommendations

As with any organization, there are and will likely always be opportunities for improving strategic and tactical operations, as well as improving risk-informed decision making at all levels. The review team provides the following five recommendations, based on information provided in lessons learned by participants and findings by the team, in the spirit of supporting growth so that the organization can better meet the challenges of land management.

1. Provide a More Robust Framework to Support the Prescribed Fire Management Program

The FLA team recognizes that the way the agency evaluates, manages, and engages fire has evolved over the past decade. The same best practices utilized in managing wildland fire should be mirrored in the implementation of prescribed fire as well. The agency should provide a more robust support framework for prescribed fire, similar to the wildland fire framework. There are many ways this could occur, some of which may be more concrete, and some of which may be accomplished at the system-level. The team has developed a few ideas for consideration and to help facilitate additional conversations:

- Provide regional and/or geographic area overviews of seasonal severity to local prescribed fire practitioners.
- Build prescribed fire organizations based on the best available science, fire modeling and local values at risk.
- Build more redundancy into the system to allow for practitioners to take the time necessary to keep pace with innovations in tools, research, and practices.
- Improve the development and dissemination of lessons learned from declared wildfire reviews. One option to explore is a spatially based database of FLAs and declared wildfire reviews, like the Wildland Fire Library.

2. Increase Agency Support to Agency Administrators and Fire Management Personnel

The responsibility delegated to AAs and line officers provides them the ability to manage situations as they deem appropriate, within the framework of laws, regulations, and policies. This allows incidents to be managed, to an extent, in a unique and personalized manner, which can be beneficial. However, it also has the potential to leave AAs and line officers with a lack of direction and support in the face of unprecedented and irregular situations.

- Develop consistent, science-based messaging that promotes the use of prescribed fire while accurately communicating the risks. Prepare the public and build support for the bold action needed to address hazardous fuel accumulation and degraded ecosystems.
- Develop crisis communication guidance to use in the event of a prescribed fire being declared a wildfire.
- Consider staffing prescribed fire more like a wildfire incident to support local prescribed fire objectives. This may alleviate organizational pressures and perceptions that are

inherent in any organization and may lead to a more successful outcome. It is critical to include all phases of the prescribed fire in these staffing considerations, not just during ignitions. Staffing at all phases should be informed by environmental conditions, forecasts, and risk assessment.

3. Improve Coordination with Interagency Partners

Wildland fire planning and implementation often has extensive interagency coordination, such as through the Wildland Fire Decision System (WFDSS) and meetings with stakeholders. Similar principles may be beneficial to incorporate into the prescribed fire arena.

- Clearly list all interagency partners, communicate the role they play in prescribed fire implementation, and develop working relationship to prepare for both successful operations and unintended outcomes. This includes dispatch centers that cover different services on overlapping lands. Planning for both regular coordination and for the unintended outcomes like the Simms Fire could help inform best practices and a framework for interagency incidents in the future.

- Prescribed fire practitioners and managers should evaluate current processes for submitting spot weather forecasts and consider additional training and relationship building with their local NWS office. For example, because prescribed fires are seasonal, planned events, coordination calls, and even perhaps a field reconnaissance (including looking at proposed RAWS site location), with the NWS pre-prescribed fire season and pre-individual prescribed fires would be beneficial. For some prescribed fires, it may also be appropriate to have NWS forecasters on the prescribed burn during implementation as incident meteorologists (IMET). During this pre-season/pre-burn coordination, the NWS could advise on the placement of project RAWS, which could improve forecasting.

  Lastly, spot weather forecasts are submitted as single data points, however the NWS provided feedback that a polygon would be much more useful. A polygon upload feature to the NWS spot forecast page could be developed to facilitate this.

- In areas with multiple land management agencies and landowners adjacent to each other, it would be advantageous to increase communication and collaboration in the planning and implementation of vegetation treatments. Fuel reduction projects that leverage the work of neighboring landowners – whether government agencies or private landowners – would increase the effectiveness treatments.

4. Diversify the Toolbox

There are multiple planning tools available for predicting and considering burning conditions, weather events, seasonal weather patterns, and potential fire behavior. Throughout the planning and implementation process, the fire environment should be continually assessed to identify and mitigate risk, using a broad, diverse array of tools such as other fire environment assessments, outlooks, and spatial analysis tools when developing prescribed fire plan components.

Examples of these additional tools include:

- NOAA's Climate Prediction Center (Climate Prediction Center). The center provides information related to current drought condition as well as short- and long-term weather outlooks.

- U.S. Drought Monitor (U.S. Drought Monitor)
- NOAA's Advanced Hydrologic Predictive Service (AHPS) Percent of Normal Precipitation (NOAA AHPS)
    - Last 7-Day Percent of Normal Precipitation for Colorado Basin
    - Last 30-Day Percent of Normal Precipitation for Colorado Basin
    - Last 90-Day Percent of Normal Precipitation for Colorado Basin
- Wildland Fire Assessment System (WFAS) Severe Fire Danger Index (SFDI) forecast
- WildfireSAFE Fire Weather and Fire Potential Situational Awareness Tool
- Predictive Services National 7-Day Significant Fire Potential (National Predictive Services 7-Day Significant Fire Potential)
- The Risk Management Assistance Dashboard (RMA Dashboard) offers many risk identification and mitigation tools, such as:
    - Geographic Area Long-term Assessment Resources
    - Suppression Difficulty Index (SDI)
    - Potential Control Locations (PCL)
    - Potential Operational Delineations (PODs)
    - Estimated Ground Evacuation Time
    - Snag Hazard
- Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model (Standard Fire Behavior Fuel Models)
- FlamMap is a fire behavior mapping and analysis program that computes potential fire behavior characteristics (spread rate, flame length, fireline intensity, etc.).
- Both the Wildland Fire Decision Support System (WFDSS) and the Interagency Fuels Treatment Decision Support System (IFTDSS) could be used to assess fire behavior characteristics.

5. Strengthen the Technical Review Process

A prescribed fire plan is the bread and butter of a prescribed fire. A technical review occurs as part of the development of this plan, which can serve to highlight potential areas of improvement before the plan is finalized. The team finds that there may be room for this review process to be strengthened with the following recommendations, which focus on providing a non-biased, broader scope of review.

- Use more rigor in the technical reviews of prescribed fire plans so that the review serves as a strong check on the ecological and operational validity of the plan.

- To help minimize bias and increase the potential of recognizing local practices that may be areas of vulnerability, the team provides several recommendations for selecting technical reviewers:
    - The technical reviewer should have local knowledge of the area, experience burning in similar fuel types, and/or previous experience conducting an onsite review, especially in the case of more complex prescribed fire plan.
    - The technical reviewer should be objective and, ideally, have separation from the prescribed fire plan development, such as being employed by a different agency.
    - It may also be beneficial to have multiple reviewers, instead of just one.

Appendix 2 provides more detailed recommendations on the prescribed fire plan as part of the Declared Wildfire Review.

Summary

The Simms Mesa prescribed fire was ignited with an approved prescribed fire plan and adequate resources, within the environmental prescription described in the plan. Fire effects on the day of ignition were deemed favorable and the burn was completed with one quarter-acre spot fire onto adjacent private land. The burn unit was mopped up extensively for a total of about 16 hours over two and a half days and patrolled each day. The third day after ignition of the unit, during forecasted Red Flag Warning conditions with higher winds, the burn escaped its lines. Patrollers had left the unit approximately an hour before the fire occurred. Subsequently, the burn was declared a wildfire. The fire was aggressively initial attacked with ground and aerial resources and forward progress on the fire was stopped after one burning period at a final fire size of 313 acres and the loss of three structures.

Many firefighters who responded to the Simms Fire were the same people who had assisted with lighting the prescribed fire a few days before. They expressed genuine surprise, to the point of disbelief, that the fire had escaped its containment lines. A combination of low humidity and high winds kindled an undetected ignition source and spread fire onto private property.

As a result of the FLA, fire environment analysis, and declared wildfire review, the team provides several recommendations for the agency and firefighters to consider:

FLA Recommendations

1. Provide a more robust framework to bolster the prescribed fire management program.
2. Increase support to agency administrators and prescribed fire management personnel.
3. Closely review the status of interagency relationships and work towards strengthening those relationships.
4. Use the vast array of planning tools to evaluate burning conditions, weather events, seasonal weather patterns, and potential fire behavior.
5. Evaluate the process of how prescribed fire plans are developed and reviewed to ensure a thorough, non-biased technical review is completed.

Declared Wildfire Review Recommendations

1. Complete a thorough review of fuels in and adjacent to burn areas when developing a complexity analysis. Ensure that adjacent fuels are modeled accurately for use in informed risk-based decision making.
2. Ensure that organization needs can support implementation at the high end of prescriptions.
3. Properly functioning RAWS should be located onsite and maintained as required by NWCG Standards for Fire Weather Stations to provide accurate and relevant weather data and fuel moistures.
4. Include a mop up and patrol plan that includes quantity, type of resource, and staffing time frames for mop up/patrol based on both environmental conditions and prescribed fire activity.

5. When burning adjacent to values such as homes and private land, incorporate potential contingency actions into planning and implementation, such as creating maps showing locations of access roads, structures, water sources, and hazards, to ensure contingency response is effective and efficient.
6. Incorporate the use of various resources and technology to provide accurate modeling to inform appropriate staffing.

Acknowledgments

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Appendix 1. Fire Environment Analysis

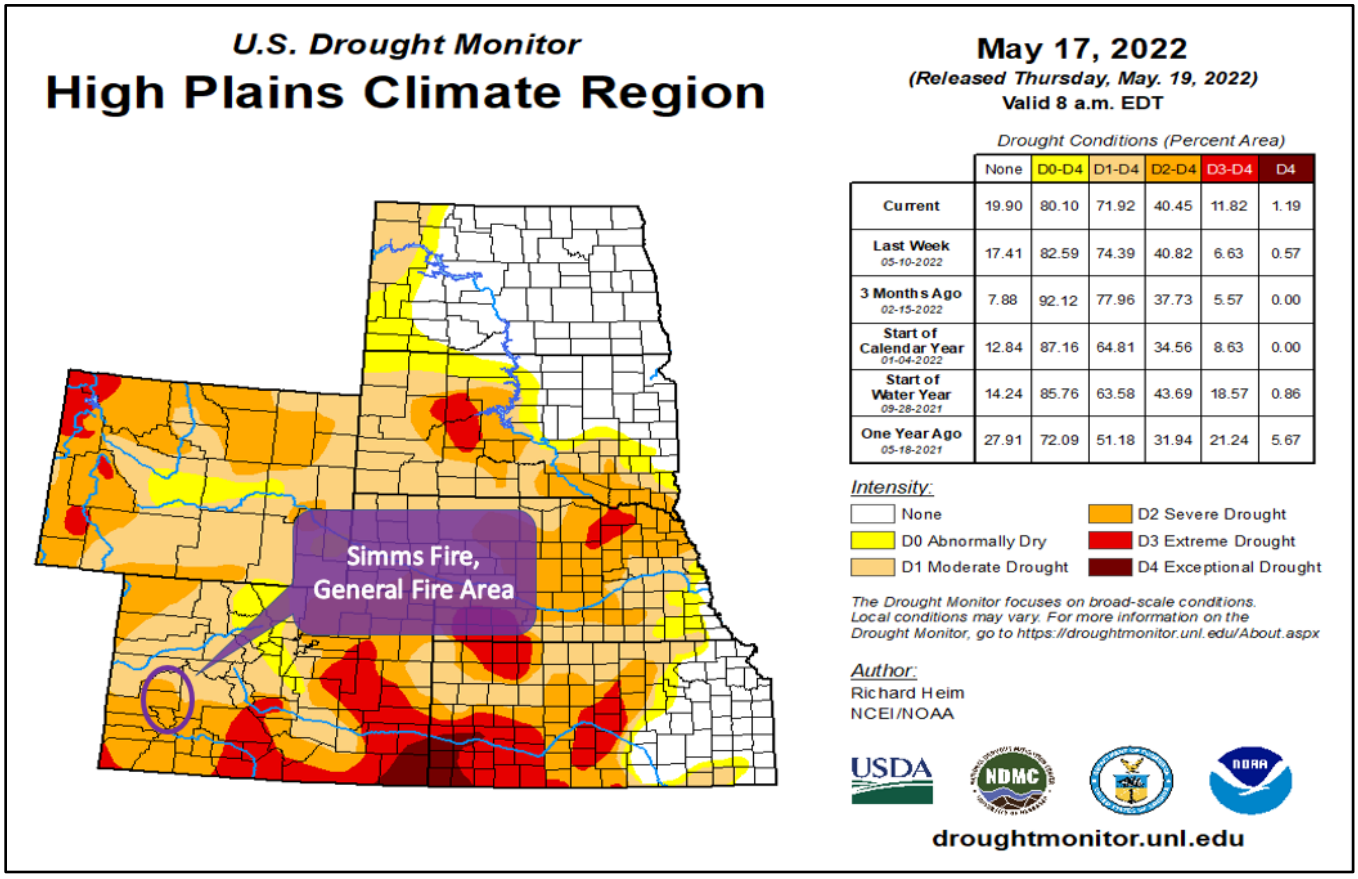
Introduction and Review Elements

This fire environment analysis was conducted as part of the Simms FLA and Declared Wildfire Review. Fire environment is an important consideration in both planned and unplanned ignition and spread because, as is typical in the Rocky Mountain geographic area, prescribed and wildland fire seasons can overlap and occur concurrently. This was the case at the time of Simms prescribed fire and the days that followed. This analysis reviewed four fire environment factors that may have contributed to events: seasonal severity, fire weather, fuels, and fire behavior.

Seasonal Severity

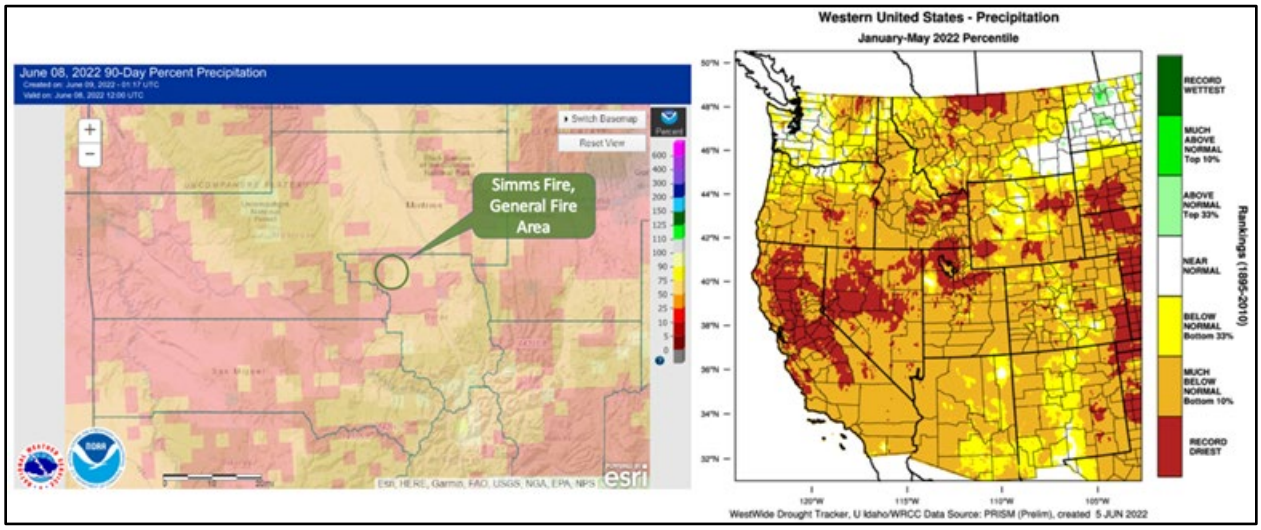
Prior to prescribed fire implementation and over the past year the western half of Colorado had observed drought conditions ranging between "abnormally dry" and "exceptional". In late February 2022 the Simms prescribed fire area was experiencing moderate drought conditions, which by May 17, 2022, had trended to "severe", as displayed in the Climate Prediction Center's U.S. Drought Monitor displayed in Figure 1.

Figure 1. U.S. Drought Monitor displaying the May 17, 2022 drought trend in the High Plains Climate Region



Below normal precipitation amounts since January promoted severe drought. Both the 90-Day Percent of Normal Precipitation and 5-Month Precipitation Anomaly show below normal precipitation during the months leading up to implementation of the Simms Prescribed Burn (Figure 2).

Figure 2. Advanced Hydrologic Prediction Service 90-Day Percent Normal Precipitation and WestWide Drought Tracker Precipitation Percentile



The Simms prescribed fire area is in the far southwestern edge of the Uncompahgre Fire Danger Rating Area (FDRA), which is in the Montrose Zone Fire Danger Operating Plan (FDOP). The Montrose Zone FDOP describes National Fire Danger Rating System Version 4 (NFDRS Ver4) Fuel Model Y as the best statistical fit for all fire danger plan components for the Uncompahgre FDRA. The Montrose FDOP references both energy release component (ERC) and burning index (BI) for identifying and mitigating risk. As NFDRS Ver4 is new and still being validated and calibrated, this review used both NFDRS Ver4 FMY and the older NFDRS78 Fuel Model G (FMG). 1000-Hour fuel moistures were also assessed to better understand fuel dryness.

The closest permanent remote automated weather station (RAWS) is the Sanborn Park RAWS (WIMS ID 053804), approximately 16 miles west-southwest of the Simms prescribed fire area. There was also a portable RAWS station set up 2.9 miles from the prescribed fire area (Norwood RAWS). The Norwood RAWS was not used in analysis due two factors:

1. The Norwood RAWS does not include an onsite history of weather observations long enough for detailed analysis; and
2. The Norwood RAWS, at the time of prescribed fire implementation and analysis, had a software malfunction that, at a minimum, resulted in inaccurate wind speed records.

Through analysis and comparison of both the Sanborn Park RAWS and the portable Norwood RAWS, it was determined that the Sanborn Park RAWS typically observed temperatures five to ten degrees warmer and three to five percent drier than conditions at the Norwood RAWS. Because the Sanborn Park RAWS ran hotter and drier than the Norwood RAWS, the Uncompahgre FDRA Special Interest Group (SIG) has also been used in the analysis. The Uncompahgre SIG contains weather data for the Dominguez (WIMS ID 052409), Sanborn Park, and Carpenter Ridge (WIMS ID 053808) RAWS and for comparison purposes have been included in this analysis.

Within the context of the NFDRS, the Uncompahgre FDRA on the day of Simms prescribed burn implementation was at 85th percentile ERC and 90th percentile burn index. Fire danger in both the adjective rating and preparedness plan components trended at "very high" from May 16 through May 19. 1000-hour fuel moisture values were dry and at the 88th percentile. Again, as NFDRS Ver4 is new and still being evaluated, results from FMG from the 1978 system are also included in Figure 3 and Figure 4. As these figures show, both models showed similar trends.

Figure 3. Energy Release Component, Burning Index, and 1000-hour fuel moisture for the Uncompahgre FDRA. Green text blocks on each graph include percentile values for fuel models Y and G.

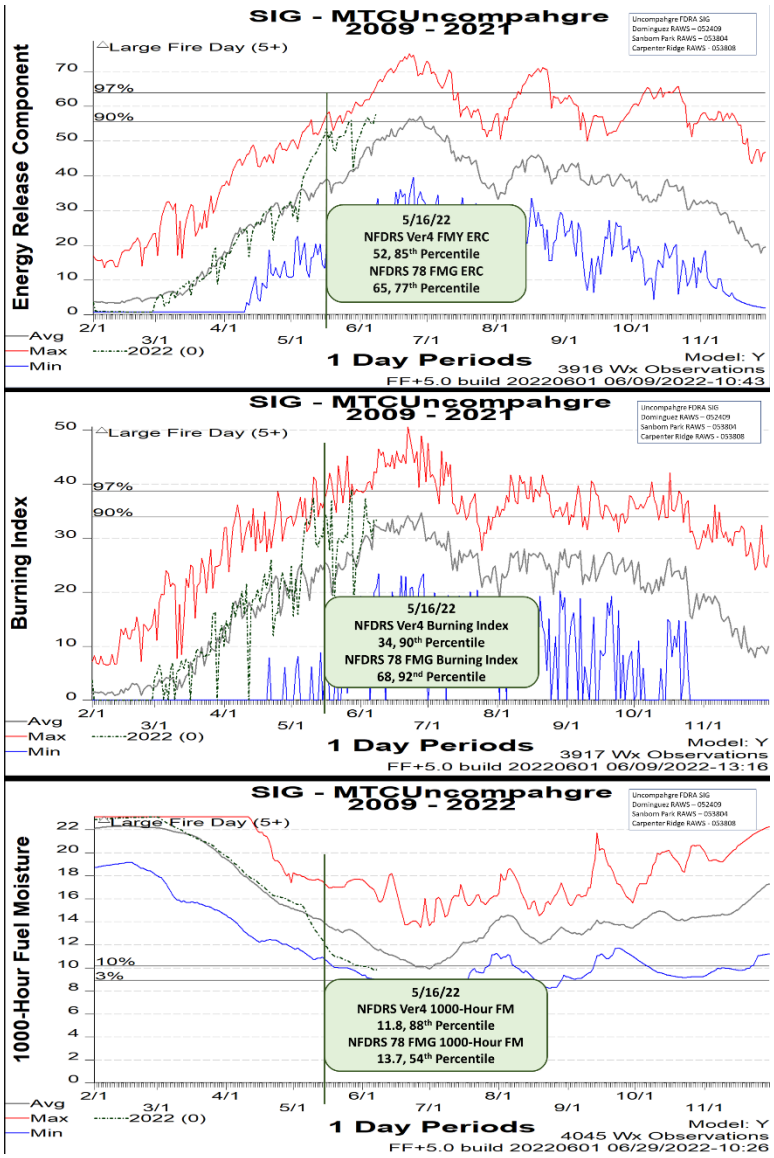
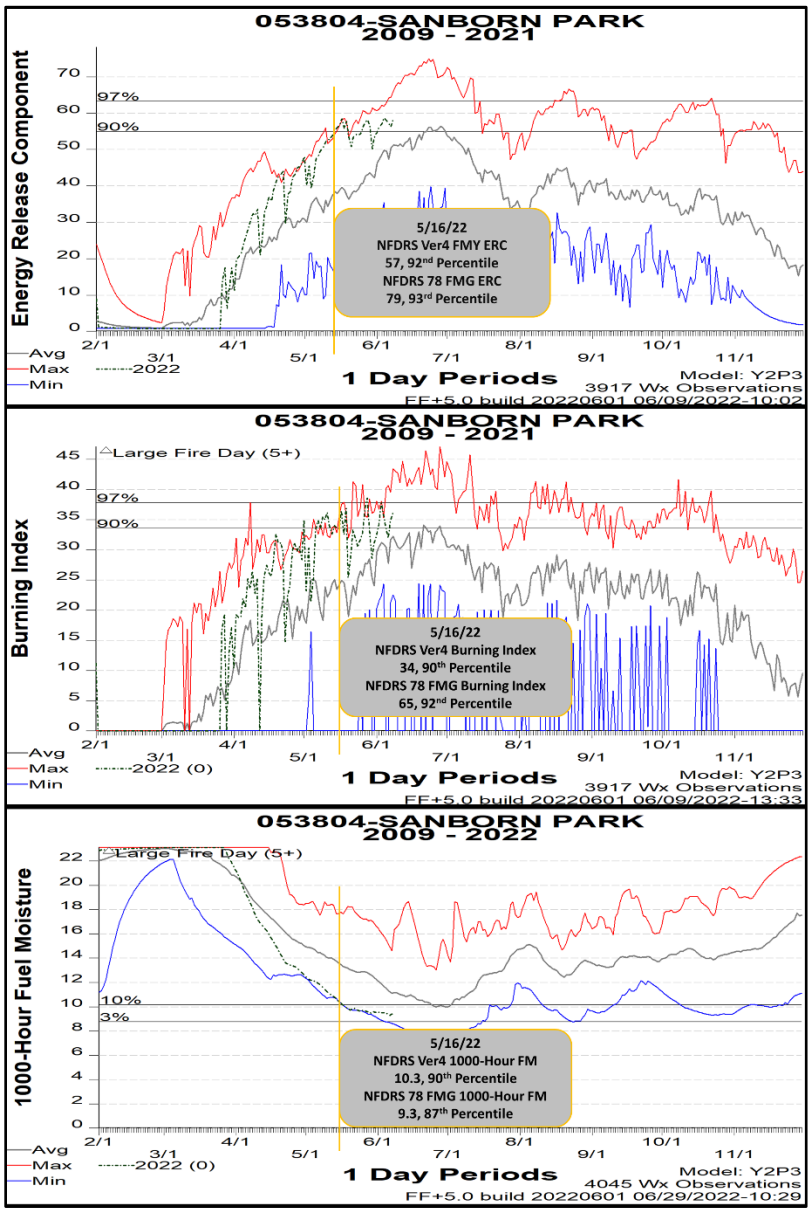


Figure 4. Energy Release Component, Burning Index, and 1000-Hour Fuel Moisture for the Sanborn Park RAWS. Gray text blocks on each graph include percentile values for fuel models Y and G. Sanborn Park is the closest single representable station however, values trend slightly warmer and drier.



Fire Weather

On May 16, the day of ignitions, onsite weather observations at the Norwood RAWS (excluding the wind speed software error) were consistent with National Weather Service (NWS) spot weather forecasts requested for the burn. Over the next three days through May 19, warm and dry conditions continued with near record low relative humidity levels.

Norwood RAWS served as the onsite station and although wind data is unreliable, the stations readings held close to those observed at the Sanborn Park RAWS. Figure 5 displays those observations experienced late in the burn period on May 18 and May 19. There is no record of wind gusts recorded on

the Simms prescribed fire area during the burn period of May 19 and those recorded at Sanborn Park RAWS will be used as the closest representative for this analysis (Figure 6). As shown in Figure 5 below, poor overnight humidity recovery was reported at both RAWS stations overnight on May 18.

Figure 5. Temperature and relative humidity observations at Norwood and Sanborn Peak RAWS

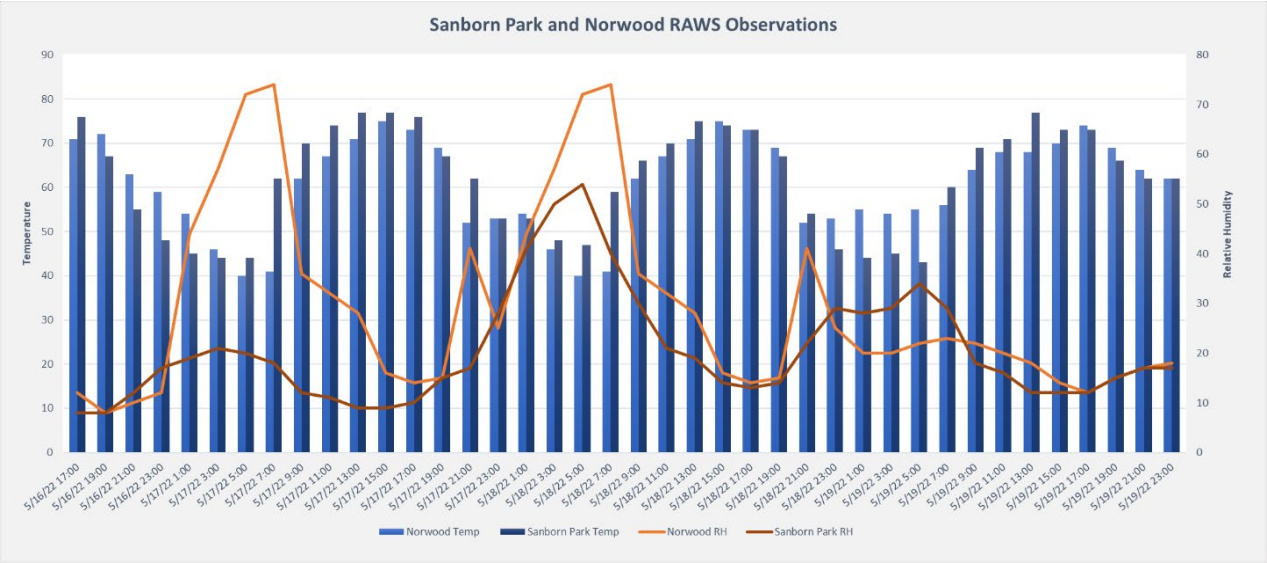
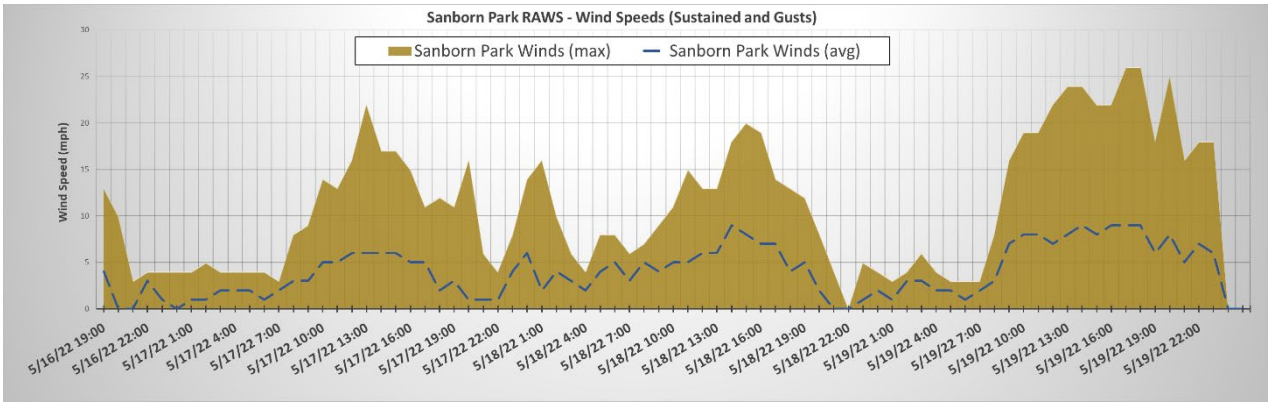


Figure 6. Wind speeds observed at Sanborn Park RAWS



Gusty conditions followed poor overnight relative humidity recovery on May 18 and continued through May 19. The NWS posted a red flag warning at 0400 on May 19, noting that red flag conditions were expected from 1100 through 2200. The warning noted low relative humidity (seven to twelve percent) and strong southwest winds at a sustained 20 to 30 miles per hour with gusts up to 50 miles per hour. These conditions were observed at the Sanborn RAWS. A spot weather forecast was not requested on May 19.

Fuels and Fire Behavior

Fire effects monitoring noted slow fire activity during the prescribed fire's 0800 test fire on May 16, due to low temperatures and high relative humidity. By 1600 though, rapid horizontal growth through the oak with little to no vertical growth, flame lengths of one to three feet, and rates of spread between two to three chains per hour was observed.

Figure 7. Photo showing fire behavior on the prescribed burn's southern edge

Fuels within the burn unit were modeled as Moderate Load Dry Climate Shrubs (SH2, 142 fuel model type), and Moderate Load Conifer Litter (TL3, 183 fuel model types). Prior to implementation, the ponderosa understory with mixed oak had not observed fire in recorded history. The only vegetation treatment had been mastication, which primarily focused on the oak brush, over a decade ago.

Fuels adjacent to the burn unit (figure 9 and 10), near the point of escape, were initially modeled as identical to interior fuels (SH2 and TL3). Upon review, however, it has been noted that the primary carrier of fire in those adjacent fuels would be better characterized as a mix of High Load, Dry Climate Shrub (SH5, 145 fire behavior fuel model), and Very High Load, Dry Climate Shrub (SH7, 147 fire behavior fuel type model). These fuel models have higher rates of spread and flame lengths, more in line with what suppression resources encountered on May 19.

Figures 8 through 10 show the typical fuel and topography within and exterior to the Simms prescribed fire area.

Figure 8. Fuel conditions adjacent to and on the northwest perimeter of the burn unit. These fuels are representative of the Simms Prescribed Fire area

Figure 9. Fuel conditions adjacent to the burn unit near the wildfire point of origin

Figure 10. Adjacent fuels on the east line near the wildfire point of origin

In 2022, fuel moisture sampling occurred once prior to prescribed fire ignitions on May 14 and once after ignitions on June 7. Fuel sampling also occurred in 2021. Table 1 below shows those fuels moisture values collect pre and post burn; Table 2 shows comparative data from the Uncompahgre FDRA SIG and Sanborn Park RAWS.

Table 1. Fuel moisture data collected on May 14 and June 7

		May 14: Norwood Ranger District, Sanborn Unit 8A		June 7: Simms Prescribed Fire Area	
Fuel type	**Sample number**	**Individual sample fuel moisture**	**Average moisture**	**Individual sample fuel moisture**	**Average moisture**
Ponderosa pine	1	76.9%	74.8%	-	-
Ponderosa pine	2	74.4%		-	-
Ponderosa pine	3	73.1%		-	-
1,000-hour	1	16.4%	16.8%	-	-
1,000-hour	2	17.0%		-	-
1,000-hour	3	16.9%		-	-
Litter	1	14.1%	12.0%	-	-
Litter	2	13.4%		-	-
Litter	3	8.5%		-	-
10-hour	1	6.8%	7.1%	-	-

		May 14: Norwood Ranger District, Sanborn Unit 8A		June 7: Simms Prescribed Fire Area	
Fuel type	**Sample number**	**Individual sample fuel moisture**	**Average moisture**	**Individual sample fuel moisture**	**Average moisture**
10-hour	2	7.4%		-	-
10-hour	3	7.2%		-	-
Oak	43	-	-	122%	121.3%
Oak	39	-	-	121%	
Oak	42	-	-	121%	
1,000-hour	1	-	-	8%	8.3%
1,000-hour	2	-	-	13%	
1,000-hour	3	-	-	4%	
Pine	51	-	-	76%	73.7%
Pine	55	-	-	72%	
Pine	47	-	-	73%	

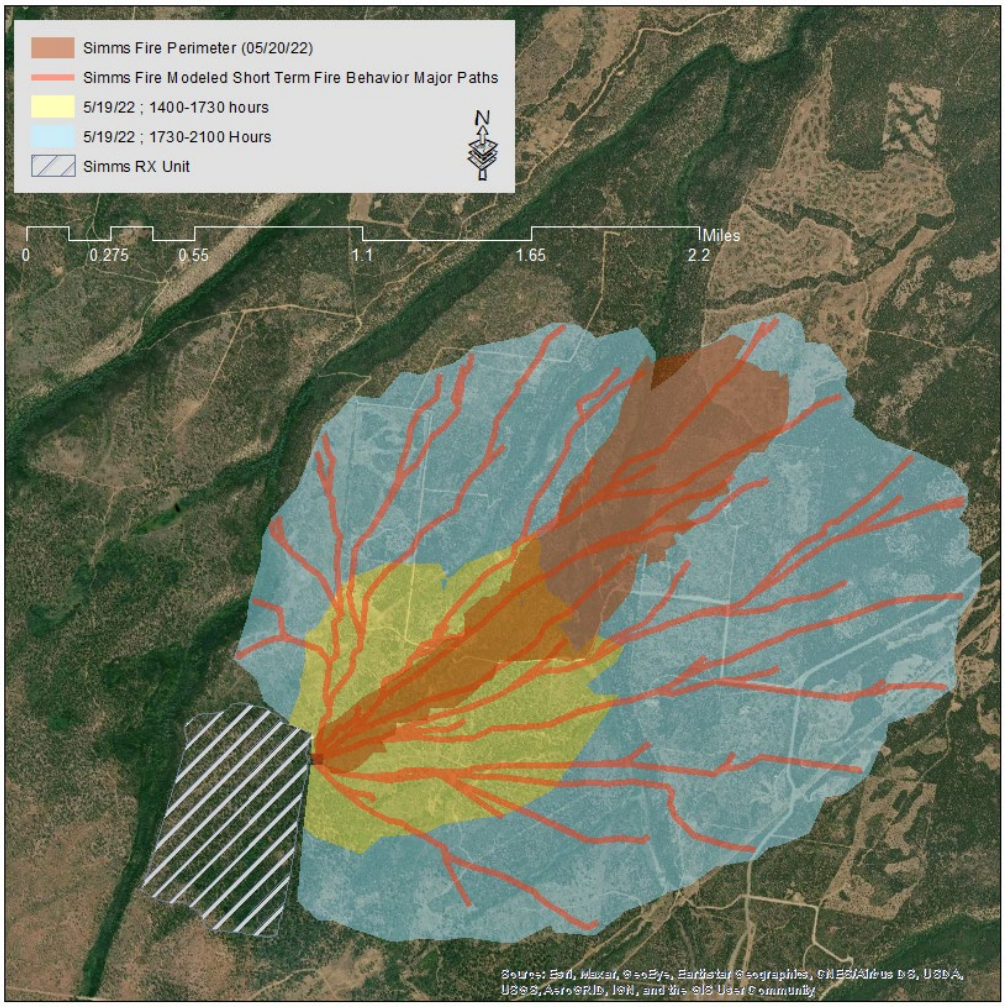
Table 2. Fuel data from the Uncompahgre FDRA SIG and Sanborn Park RAWS

	Uncompahgre FDRA, FireFamilyPlus SIG				Sanborn Park RAWS			
10-hour	**May 13**	**May 16**	**May 19**	**June 7**	**May 13**	**May 16**	**May 19**	**June 7**
1,000-hour	6.5%	6.7%	7.5%	9.7%	6.3%	6.6%	7.2%	9.9%
Herbaceous fuel moisture	12.7%	11.8%	11.1%	9.8%	10.8%	10.3%	9.8%	9.4%
Woody fuel moisture	33.4%	66.5%	79.9%	93.4%	30%	48.4%	66.6	95.4%

When modeling the Simms declared wildfire from an unknown single point of ignition, a Short-Term Fire Behavior (STFB) model was completed using the Wildland Fire Decision Support System (WFDSS). A random ignition point was created on the east side of the Simms prescribed fire containment line in the fuels shown in figures 9 and 10. Within WFDSS, the only landscape edit completed was converting all Fuel Model 183 fuels to Fuel Model 145 fuels. Figure 11 below shows the STFB model results. Again, it should be noted that the ignition point used for this analysis was randomly chosen and only used to model fire paths and fire behavior attributes.

Results of the STFB analysis project a range in flame lengths from one foot to thirty-two feet, and rates of spread from one to one hundred seventy-nine chains per hour.

Figure 11. Map depicting the STFB analysis results



To further assess flame length, rate of spread, and fire containment probability on May 19, an analysis was completed using BehavePlus 6.0.0. Figure 12 below displays inputs used in the surface fire spread and fire containment modeling. As rates of spread experienced on the day of escape exceeded those modeled outputs using the SH2 and TL3 analysis, additional dry climate shrub models were assessed as part of this analysis.

Figure 12. BehavePlus surface spread and fire containment input

BehavePlus 6.0.0 Thu, Jun 23, 2022 at 10:33:00 Page 1

Inputs: SURFACE, CONTAIN

Description		May 19,2022 - Simms Fire Contaiment Point Ignitio
Fuel/Vegetation, Surface/Understory		
Fuel Model		SH7, SH5, SH2, TL3
Fuel Moisture		
1-h Fuel Moisture	%	5
10-h Fuel Moisture	%	7
100-h Fuel Moisture	%	9
Live Herbaceous Fuel Moisture	%	75
Live Woody Fuel Moisture	%	90
Weather		
20-ft Wind Speed	mi/h	5, 10, 15, 20, 25, 30
Wind Adjustment Factor		0.50
Direction of Wind Vector (from upslope)	deg	180
Terrain		
Slope Steepness	%	9
Fire		
Fire Size at Report	ac	.1
Suppression		
Suppression Tactic		Rear
Line Construction Offset	ch	5
Resource Line Production Rate	ch/h	12.6
Resource Arrival Time	h	0.1
Resource Duration	h	10

Run Option Notes

Maximum effective wind speed limit IS imposed [SURFACE].
Fire spread is in the HEADING direction only [SURFACE].
Wind is in specified directions [SURFACE].
Wind and spread directions are degrees clockwise from upslope [SURFACE].
Direction of the wind vector is the direction the wind is pushing the fire [SURFACE].
Suppression input is for a single resource [CONTAIN];
multiple values can be entered for any input variable.

Output Variables

(continued on next page)

Outputs of the BehavePlus analysis are shown in Table 3. The contain module was based upon a rear suppression attack with a line production rate of 12.6 chains per hour. This value was selected based on the resources identified in the prescribed fire plan as needing to be onsite for holding and implementation.

Table 3. BehavePlus surface fire spread and fire containment outputs

Fire Behavior Fuel Model	May 19, 2022 - Simms Fire Containment Point Ignition											
	Head Fire - Surface Rate of Spread (ch/h)						Surface Fire Flame Length (ft)					
	20-ft Wind Speek (mi/h)						20-ft Wind Speek (mi/h)					
	5	10	15	20	25	30	5	10	15	20	25	30
SH7	17.5	37.9	60.3	84	108	134.7	9.2	13.1	16.2	18.8	21.2	23.4
SH5	36.5	58.3	93.4	130.9	170.2	210.9	9.7	13.9	17.2	20.1	22.7	25.1
SH2	2.1	5	8.5	12.5	16.9	21.7	2.3	3.4	4.3	5.2	5.9	6.7
TL3	0.8	1.8	3	3.4	3.4	3.4	0.8	1.1	1.4	1.4	1.4	1.4
	Midflame Windspeed (mi/h)						Contain Status					
	20-ft Wind Speek (mi/h)						20-ft Wind Speek (mi/h)					
	5	10	15	20	25	30	5	10	15	20	25	30
SH7	2.5	5	7.5	10	12.5	15	Withdrawn	Withdrawn	Withdrawn	Withdrawn	Withdrawn	Withdrawn
SH5	2.5	5	7.5	10	12.5	15	Withdrawn	Withdrawn	Withdrawn	Withdrawn	Withdrawn	Withdrawn
SH2	2.5	5	7.5	10	12.5	15	Contained	Contained	Withdrawn	Withdrawn	Withdrawn	Withdrawn
TL3	2.5	5	7.5	10	12.5	15	Contained	Contained	Contained	Contained	Contained	Contained

Summary

It is unclear to what extent an environmental risk assessment was completed prior to the implementation of the Simms prescribed fire. A thorough analysis could have brought more attention to certain indicators, such as severe drought conditions and fire danger indices at the 90th percentile, that could have influenced subsequent choices. Further, more accurate modeling of fuels adjacent to the burn unit may have provided different fire spread and containment outputs. This could have highlighted the increased risk of burning adjacent to these fuels and informed different choices in burn preparation and implementation.

Declared Wildfire Review

The objective of the Simms Declared Wildfire Review is to provide information and recommendations that will lead to growth and improvements in the system in support of better risk-informed decision-making in the future. Most conclusions reached on compliance do not represent absolutes, but rather the team's interpretation of documentation and events.

Analysis of Seasonal Severity, Weather, and Conditions

Prior to prescribed fire implementation and over the past year the western half of Colorado had observed drought conditions ranging between "abnormally dry" and "exceptional". In late February 2022 the Simms Mesa prescribed fire area was experiencing moderate drought conditions, which by May 17, 2022, had trended to "severe".

Within the context of the National Fire Danger Rating System (NFDRS), the Uncompahgre Fire Danger Rating Area (FDRA) was at the 85th percentile energy release component (ERC) and 90th percentile burn index (BI) on ignition day. Fire danger in both the adjective rating and preparedness plan components trended at "very high" from May 16 through May 19. 1000-hour fuel moisture values were dry and at the 88th percentile. Both the 90-Day Percent of Normal Precipitation and 5-Month Precipitation Anomaly show below normal precipitation during the months leading up to implementation of the Simms Mesa prescribed fire.

On May 16, the day of ignition, onsite weather observations at the Norwood RAWS (excluding a wind speed software error) were consistent with National Weather Service (NWS) spot weather forecasts requested for the burn. Over the next three days through May 19, warm and dry conditions continued with near record low relative humidity levels. Wind speed in the Simms Mesa area during the time of escape is not known due to the Norwood RAWS data error.

Refer to the Fire Environment Analysis (Appendix 1) for further environmental analysis.

Analysis of Prescribed Fire Plan for Consistency with Policy and Guidance, and Whether Implementation Actions Were Consistent with the Plan

The review team was tasked with analyzing the prescribed fire plan ("burn plan") in relation to the NWCG Standards for Prescribed Fire Planning and Implementation ("PMS 484"; USDA 2017). The 2017 version of this document was used because it was the version in effect when the Simms Mesa prescribed fire plan was drafted in 2019.

In addition to reviewing the prescribed fire plan, the review team analyzed whether the plan was implemented as written and approved. The team determined that implementation of the Simms Mesa prescribed fire followed the approved prescribed fire plan, and in many cases exceeded the plan, such as in minimum staffing requirements.

The team's analysis of the plan is summarized in Table 1 below, which identifies elements that fully met the PMS 484 criteria, elements that met the PMS 484 criteria with areas for future improvement, and one element that did not meet the PMS 484 criteria. For some elements of the prescribed fire plan, it was a clear "yes" or "no" determination on whether the PMS 484 criteria

were met. However, for other elements, it was a qualitative judgement call based on the experience of team members.

Ultimately, the review team rated an element as fully meeting the PMS 484 criteria if the required components were in the prescribed fire plan. In some cases, the components were in the plan, but the team found room for improvement. In those cases, recommendations for improvement are provided. The team also reviewed if each of the elements may have played a role in the eventual declared wildfire; those elements are shaded in grey in Table 1 below.

Following the table, an analysis of those elements that met the criteria with opportunities for improvement and the one element that did not meet the criteria is provided.

Table 1. Prescribed fire plan elements/agency requirement and whether each met agency direction and if it was a potential contributing factor to the declared wildfire

Element/agency requirement	Met agency direction?	Potential contributing factor to the declared wildfire?
Element 1: Signature Page	Met. The Simms Mesa Prescribed Fire Plan was written in the winter/spring of 2019, reviewed May 2019, and approved June 2019. The plan was recertified in 2022.	No
Element 2: Agency Authorization Ignition Authorization	Met	No
Element 2B: Prescribed Fire Go/No Go	Met, with opportunities for improvement.	No
Element 3: Complexity Analysis	Met, with opportunities for improvement.	No
Element 4: Description of Fire Area	Met, with opportunities for improvement.	Yes
Element 5: Objectives	Met	N
Element 6: Funding	Met	No
Element 7: Prescription	Met, with opportunities for improvement.	No
Element 8: Scheduling	Met	No
Element 9: Pre-burn Considerations	Met, with opportunities for improvement.	No
Element 10: Briefing	Met	No
Element 11: Organization and Equipment	Met, with opportunities for improvement.	Yes
Element 12: Communications	Met	No
Element 13: Personnel and Public Safety, Medical	Met	No
Element 14: Test Fire	Met	No
Element 15: Ignition Plan	Met	No
Element 16: Holding plan	Did not meet.	Yes
Element 17: Contingency Plan	Met, with opportunities for improvement.	No
Element 18: Wildfire Declaration	Met	No

Element/agency requirement	Met agency direction?	Potential contributing factor to the declared wildfire?
Element 19: Smoke Management	Met	No
Element 20: Monitoring	Met	No
Element 21: Post Burn	Met	No
Agency requirement: Annual recertification	Met	No

Element 2B: Prescribed Fire Go/No Go

- **Finding 2B:** Overall, the go/no go checklist requirement of Element 2B was met; this was confirmed in interviews with participants. However, there was a minor oversight in not fully completing the documentation for this by answering/circling the preliminary questions in the checklist. Because this was a minor, technical oversite, the team concludes that this did not contribute to the declared wildfire.

  Recommendation 2B: Ensure that the Burn Boss, Burn Boss Trainee, Holding Specialist, and Firing Boss work together to ensure documentation is complete before implementing the prescribed fire.

Element 3: Complexity Analysis

Overall, Element 3 was met in the Simms Mesa Prescribed Fire Plan. While there were two areas that could have been improved upon (see below), the team concludes these areas of improvement did not likely contribute to the declared wildfire. Specifically in relation to Finding 3B, even though the adjacent fuels were not modeled accurately, the firefighters were able to contain the spot fires that occurred on ignition day. The team determined this was an indication that the opportunities for improvement in Element 3 likely did not contribute to the declared wildfire.

- **Finding 3A:** The Complexity Analysis of the Simms Mesa Prescribed Fire Plan stated that "[two] real time particulate monitors will be in place to capture any down drainage smoke impacts" in response to the smoke management element (p. 22 of section 4). However, smoke monitors were not specifically included in the plan.

  Recommendation 3A: Ensure consistency between mitigating actions within the complexity analysis and prescribed fire plan.

- **Finding 3B:** The Complexity Analysis of the Simms Mesa Prescribed Fire states that "fuels adjacent to the unit are the same make-ups as within the project and therefore will be consistent in moisture scenarios" in response to the resistance to containment element (p. 21 of section 4).

  During the FLA review team's onsite visit, the team observed that adjacent fuels were not treated and varied notably from those within the burn unit.

  Recommendation 3B: Consider completing a thorough review of the fuels and values at risk in and adjacent to the burn area when developing a complexity analysis. In addition to the agency administrator, resource specialists may be able to assist with identifying values at risk.

Element 4: Description of Fire Area

- **Finding 4:** Element 4 of the Simms Mesa Prescribed Fire Plan states that "fuels adjacent to the project are mostly consistent with fuels on-site. Variations from this however are increased Pinyon-Juniper on the north and east perimeters of the unit," (p. 13 of section 1). However, during the review team's onsite visit, the team observed that adjacent fuels were not treated and varied notably from those within the burn unit. The fuels within the unit on Forest Service land consisted of two-to-six-foot tall high Gambel oak beneath a ponderosa pine overstory, and transitioned rapidly to a dense, twelve-to-eighteen-foot-tall, unaltered pinyon-juniper woodland intermixed with Gambel oak, scattered Ponderosa pine, sagebrush and pockets of aspen east of the unit on private land. The adjacent fuels were more representative of SH5/SH7, rather than the TL3/SH2 that the prescribed fire plan stated.

  Overall, Element 4 was met in the Simms Mesa Prescribed Fire Plan. However, the team concludes that the notable difference between fuels in the unit and fuels adjacent to the unit potentially contributed to the declared wildfire.

  Recommendation 4: Care should be taken to model adjacent fuels accurately for use in informed risk-based decision making.

Element 7: Prescription

Element 7 is a building block of the prescribed fire plan and can be a key contributor to the outcome of a prescribed fire. The prescription within the plan is shown below.

Table 2. The Simms Mesa Prescribed Fire Plan's environmental and fire behavior prescriptions

Environmental prescription		
	Acceptable range of environmental parameters	
Fuel models	SH2/TL3 Low Fire Intensity	SH2/TL3 High Fire Intensity
	SH1/TL3 Oak/Mod Load Conifer Litter	SH1/TL3 Oak/Mod Load Conifer Litter
Temperature (F)	35	89
Relative humidity	39%	5%
Mid-flame wind	0-6 mph	0-6 mph
1-hour fuel moisture	12	3
10-hour fuel moisture	13	4
Live fuel moisture	14	5
Percent slope	90/120	60/90
Fire behavior prescription		
	Fire prescription range	
	Low fire intensity with two-dimensional fuel modeling	**High fire intensity with two-dimensional fuel modeling**
Fuel models	TL3/SH2	TL3/SH2
Rate of spread	0.1-1.6 chains/hour	0.6-7.8 chains/hour
Flame length	0.3-1.1 feet	1.6-5.7 feet

Environmental prescription		
Scorch height	0 feet	8-36 feet
Probability of mortality	6%	6-7%
Probability of ignition	18%	88%

Element 7 was met on the day of ignition. While there were two areas that could have been improved upon (see below), the team concludes these areas of improvement did not likely contribute to the declared wildfire.

- **Finding 7A:** The environmental prescription describes fuel model SH1 as within the acceptable range. However, no modeling or description of SH1 was included anywhere in the prescribed fire plan or appendices. If SH1 is a considered fuel model, additional descriptions and modeling should also be included.

  Recommendation 7A: Ensure consistency in the fuel models used in the plan.

- **Finding 7B:** Resource objectives would not be met across range of the prescription. 1,000-hour fuels were not incorporated in the prescription table, though they were mentioned in the objectives. On the day of implementation, 1,000-hour fuels derived from the Sanborn Park RAWS (Fuel Model G) were at 9 percent.

  Recommendations 7B:

  - When burning on the high end of the prescription, a thorough seasonal assessment may be warranted to identify and mitigate unforeseen risk exacerbated by conditions such as drought.
  - Ensure prescriptions can meet prescribed fire plan objectives. The low end of the prescription would have been unlikely to meet the resource objectives such as 70-90 percent reduction in fuels 1/10 hour fuels and 50 to 70 percent mortality in understory fuels. Narrative can be used to support a wide prescription range that may not meet all the objectives but may serve as a valuable first entry into a unit targeting a specific objective, such as blacklining.
  - Consider including 1,000-hour moistures within the prescription if that is a resource objective. The high end of the prescription would likely exceed the 20 to 30 percent consumption of 1,000-hour fuels.
  - It may be beneficial to include a description of the local fire behavior and fuels knowledge within the prescription to provide rationale to support the prescription's range.

Element 9: Pre-Burn Considerations and Weather

Overall, Element 9 was met in the Simms Mesa Prescribed Fire Plan. However, there were two areas that could have been improved upon (see below). The team concludes these areas of improvement did not likely contribute to the declared wildfire.

- **Finding 9A:** The prescribed fire plan states that "pre-burn monitoring of fuel moisture conditions should begin 1-2 weeks prior to ignitions. 1/10/100-hour fuels and representative fuel moistures should be collected within 1 week of planned ignition. If it

is determined that there are areas adjacent to the unit in which the risk of spread may be desirable to collect fuels from those adjacent areas accordingly as well."

Fuel moisture samples were not taken on site prior to ignitions on May 16. Samples were taken at Sanborn Park and/or Sanborn Unit 8a on April 13 and April 26, which is approximately eight to ten miles away from the burn unit.

Recommendation 9A: Samples should be taken within the burn unit if possible or at sites that are representative of fuels within the burn unit.

- **Finding 9B:** The onsite portable RAWS at Norwood that was used for project planning and implementation was having issues that resulted in unreliable data (later determined to be the result of a software error).

  Recommendation 9B: Properly functioning RAWS should be located onsite and maintained as required by NWCG Standards for Fire Weather Stations (NWCG 2019) to provide accurate and relevant weather data and fuel moistures, which may help to reduce the risk of unintended consequences.

Element 11: Organization and Equipment

Overall, Element 11 was met in the Simms Mesa Prescribed Fire Plan. However, there were two areas that could have been improved upon (see below). The team concludes these areas of improvement potentially contributed to the declared wildfire.

- **Finding 11A:** As quoted in the prescribed fire plan: "a minimum of 6 holding personnel and 2 engines (any type) are needed for holding operations. Behave modeling shows that half of the needed holding resources responding to a spot fire initially reported at [0.1] acres could contain the fire at 0.5 acres in [0.6] hours with a conservative line construction rate of 12 [chains per hour]. (*Fireline handbook, Appendix A, not attached).* These numbers are the minimum required for the project however on-sight personnel will likely exceed this minimum."

  On ignition day, the burn organization exceeded the minimum number of personnel required in the plan. However, modeling with BehavePlus, utilizing the Contain Module with inputs from the prescription and holding forces, shows that the plan was inadequate at catching a tenth acre spot at the upper end of the prescription.

Table 3. BehavePlus model results, from the upper end of the prescription for SH2/TL3

Mid-flame wind speed (miles per hour)	Surface fire rate of spread (chains per hour)	Surface flame length (feet)	Contain status	Time from report (hour)
0	0.6	1.6	Contained	0.5
2	2.2	3.1	Contained	0.7
4	4.8	4.5	Contained	2.3
6	7.8	5.7	Withdrawn	4.1

Recommendation 11A: Develop an organization that can contain a spot fire on the high end of the prescription.

- **Finding 11B:** PMS 484 (2017) states that "before implementation (all phases) of prescribed fire, documentation in the form of an organization chart must be completed. Changes to the staffing and assignments during implementation should be documented in units logs or prescribed fire organizers and included in the project file," (p. 28) and that "no less than the minimum organization, identified for the applicable phase, described in the approved prescribed fire plan will be used for implementation," (p. 28).

  Patrol and mop up phases were not included in the prescribed fire plan, incident action plan, or the burn boss documentation.

  Recommendation 11B: Include a mop-up and patrol plan as part of the prescribed fire plan that includes the quantity, capability, and staffing time frames for mop-up/patrol based on both environmental conditions and prescribed fire activity.

Element 16: Holding Plan

The Simms Mesa Prescribed Fire Plan states that "holding resources will initially be located where black line begins and will follow black line operations while also patrolling previously lit lines. The areas that are inaccessible to engines (the entire south unit currently and all control lines on the northern units except the north) will require ATV/UTV or foot patrol and due to the large perimeter, motorized patrol is suggested for maximum coverage and efficiency. Holder will watch for spotting and slops and will manage these as quickly as possible with the appropriate response. In some instance (remote locations, proximity to other burn units, limited growth or spread potential) spots may be allowed to spread or to bum themselves out. Control lines for the burn include roads, ATV lines, and mechanical lines that have been brushed out, ladder fuels removed and there are many areas of discontinuous fuels throughout the burn area. There are 2 seasonal ponds, l in the north and south unit. They both will need to utilize a portable pump due to soft ground around the pond that machinery will not be able to get into."

PMS 484 (2017) directs to "describe minimum capabilities needed for all phases of implementation, including needs for critical holding points and associated mitigation actions (Element 11: Organization and Equipment)," (p. 31). It additionally highlights an important lesson learned: "A significant number of prescribed fires are declared wildfires during mop up and patrol phase of implementation. Consideration of which conditions will trigger either step up or step down of mop up and patrol efforts will help reduce risk of having to go to a wildfire declaration," (p. 31).

The Simms Mesa Prescribed Fire Holding Plan did not meet the requirements of Element 16 and potentially contributed to the declared wildfire review.

- **Finding 16A:** The plan did not address all phases of implementation, specifically the mop up and patrol phase.

  Recommendations 16A:

  - Include a mop up and patrol plan in the prescribed fire plan that includes quantity, type of resource, and staffing time frames for mop up/patrol based on environmental conditions and prescribed fire activity.
  - Ensure that patrol continues past ignition day, particularly when there are masticated fuels or slash on the ground from other fuels treatments creating fuel

loads that may be resistant to complete consumption. Masticated fuels have been known to hold heat and result in escapes within similar fuel types within Colorado, such as was described in the Lower North Fork Escaped Fire Review.

- As part of the patrol plan, consider requiring more robust staffing on critical fire weather days during the burn period until the burn is called out. An example of what this may look like is provided below.

Figure 1. Example patrol plan

Phase	Trigger point	Management	Standard	Timeframe	Spot weather
Mop up	Slops/spots are located during mop up or patrol and/or 1 day post ignition.	RXB1 or ICT3	Return to Contingency Plan and select appropriate trigger point and activate response.	Immediately.	Obtain a spot weather forecast.
	Smoke present within 2 chains of any perimeter.	TFLD or ICT4	Mop up any hot spots within two chains of the perimeter that have potential to compromise control. Monitor the burn unit throughout the burn period.	Ensure resources are on scene throughout the burn period daily until no smoke is present within two chains of perimeter.	If general fire weather forecast indicates winds greater than 15 mph and HR less than 20%, obtain a spot weather forecast.
Patrol	Smoke present within 2 chains of any perimeter.	ENGB/CRWB	Patrol the burn unit daily and mop up any hot spots that have potential to compromise control.	Patrol daily during the peak of the burn period until no smoke is present within the burn unit.	If general fire weather forecast indicates winds greater than 15 mph and HR less than 20%, obtain a spot weather forecast.
	No significant smoke visible OR smoke visible but no potential to compromise line.	FFT1/ICT5	If general fire weather forecast indicates winds greater than 15 mph and HR less than 20%, have personnel on scene patrol the burn and mop up as needed.	Patrol burn until wind/RH trigger points subside.	No spot needed unless smokes appear that could compromise control.

1. A patrol will be used at least until sunset after firing has ceased on burn day. The patrol will be led by an ICT3 minimum immediately post-burn. The burn will be patrolled for at least three days after the completion of burning, depending on weather and thereafter as needed. Mop up will be done on heavy fuels adjacent to control lines as necessary or if high winds are experienced or predicted.
2. A spot weather forecast will be obtained for the day after ignitions. General fire weather forecasts will be obtained daily until mop-up is completed. Reference the table above for spot weather needs.
3. The Burn Boss and the Duty Officer are the only individuals that can call the fire out.

- **Finding 16B:** The holding plan did not document how the transfer of command from the Burn Boss to other individuals authorized to pull pumps/call the burn "out" should occur. Correspondingly, there was not any documentation of the Burn Boss transferring command of the burn to other individuals. The Burn Boss did not visit the burn during the morning patrol (when those who were patrolling decided to pull the pumps and depart at 1400) on the day of the escape.

  Recommendation 16B: Include clear direction on the transfer of responsibility for prescribed fire operations (mop up, patrol, etc.) after ignition day.

- **Finding 16C:** Adjacent fuels were not modeled accurately, therefore the resulting rates of spread and flame lengths may have been inaccurate. Accurate modeling data may have produced different rates of spread and flame lengths that would have resulted in different resources and strategy described in the holding plan.

  Recommendation 16C: Ensure adjacent fuels are modeled correctly.

Element 17: Contingency Plan

Overall, Element 17 was met in the Simms Mesa Prescribed Fire Plan. However, there were two areas that could have been improved upon (see below). The team concludes these areas of improvement did not likely contribute to the declared wildfire.

The Simms Mesa Prescribed Fire Plan designated six management action points (MAPs) with corresponding recommended actions (Table 4), as well as the minimum number of contingency resources and their response time (Table 5).

Table 4. The Simms Mesa Prescribed Fire Plan's management action points (MAPs) and recommended actions

Management action point	Recommended action
MAP 1: Spot/slop located on or adjacent to private property.	Immediately control spot/slop at smallest size possible and notify Holding Specialist and Burn Boss.
MAP 2: Spot/slop located within the project area and not immediately threatening private property.	Holding Specialist and Burn Boss will analyze spot and determine control/monitor strategy, dependent on location, prescription, time of day, etc.
MAP 3: Spots/slops needing control are numerous enough or intense enough that holding resources cannot pick them up and maintain patrols.	Halt or at least slow ignition with the intent to secure the burn unit as able. Move ignition resources to holding as necessary to control slop/spot and continue patrol of perimeters.
MAP 4: Slops/spots are either numerous, growing, or more than 1 chain from perimeter. Holding resources cannot control them while maintaining patrol.	Slow ignition or halt if conditions dictate, move ignition resources to holding to assist with control of slops/spots and patrol of perimeters. Once the situation has moderated consider continuing ignition, possibly under cooler prescription.
MAP 5: Slops/spots becoming either too numerous or growing beyond capability of on-site resources to control them while maintaining patrols of the perimeters.	Activate contingency resources (see below) or other needed resources through dispatch. Halt ignition if not already halted, secure burn unit while working to control priority slops/spots and the burn perimeter within 24 hours.
MAP 6: Fire that eminently threatens private land or spread cannot be controlled within 24 hours.	Refer to Wildfire Conversion.

Table 5. The Simms Mesa Prescribed Fire Plan's contingency resources

Prescription parameters	Resource	Maximum response time
Low end of the prescription	5+ additional personnel	3 hours
High end of the prescription	2 engines (any type)	3 hours

- **Finding 17A:** The Contingency Planning Aid Appendix B in of PMS 484 (2017) was not used, which could have been helpful to prepare a more robust contingency plan. Well-prepared contingency planning should consider the low probability, high consequence events and mitigation actions.

  Recommendations 17A:

  - When burning adjacent to values such as homes and private land, incorporate potential contingency actions into planning and implementation, such as creating maps showing locations of access roads, structures, water sources, and hazards, to ensure contingency response is effective and efficient.
  - Elaborate on and clarify specific contingency recommended actions based on MAPs. Also consider MAPs for medical emergencies, smoke impact, aviation mishap, and smoke report for initial attack response. Using the Contingency Planning Aid Appendix in PMS 484, such as the example format of a MAP, could assist with this.

- **Finding 17B:** More accurate modeling of adjacent fuel types would have demonstrated that the planned contingency resources would be inadequate for immediate containment of an escape from the prescribed fire unit.

  Recommendation 17B: Incorporate the use of various resources and technology (LandFire, WFDSS, IFTDSS, etc.) to provide accurate modeling to inform appropriate staffing.

Annual Recertification

- **Finding:** Forest Service Manual 5100 – Wildland Fire Management, Chapter 5140 – Hazardous Fuels Management and Prescribed Fire, Section 5142.6 – Prescribed Fire Plans (USDA 2020) provides direction on annual recertification of prescribed fire plans:

  1. Prepare a site-specific Prescribed Fire Burn Plan as described in the Interagency Prescribed Fire Planning and Implementation Procedures Guide (PMS 484; PMS 484-1) for each prescribed fire in advance of the ignition. If more than one year has elapsed since approval, a burn plan will be reviewed, updated, as necessary, and approved before implementation.

  The Burn Boss signed the Simms Mesa Prescribed Fire Plan more than a year before implementation. However, this is irrelevant, as it is not a requirement to have the Burn Boss sign the plan. Furthermore, the AA reviewed and signed the burn plan within a year of implementation (on March 10, 2022).

  Recommendation: Remove Burn Boss signature from this section as it is not required per Forest Service Manual direction.

Analysis of Qualifications

Agency Administrators (AA)

The original AA that signed the original prescribed fire plan in 2019 was qualified at the Moderate level for prescribed fire.

The prescribed fire's District Ranger AA who approved the recertification of the prescribed fire plan was qualified at the Moderate level and was heavily involved with the prescribed burn until she received an assignment in Nebraska on May 19. She had signed Element 2A, attended the morning briefing, and was on scene during the day of ignitions.

The relieving AA was also qualified at the Moderate level. Once he was notified of the escaped fire, he went to Montrose to be in person for his AA duties.

Key Personnel Involved

The team reviewed IQCS Red Card qualifications and experience for the key personnel involved in the prescribed fire. The AA, Burn Boss, Firing Boss, Holding Boss, and their trainees had appropriate level of qualifications, experience, and training for their assigned position.

Appendix 3: List of Acronyms/Glossary

1/10/100/1000 Hour Timelag: A fuel's timelag is defined as the time (in hours) needed for a fuel particle to lose about 63 percent of the difference between its internal moisture to the moisture of the surrounding atmosphere. Small fuels such a dead grass take an hour or less (1-hour timelag), while larger fuels like logs take weeks (1000-hour timelag).

AA: Agency administrator. Managing officer of an agency, division thereof, or jurisdiction having statutory responsibility for incident mitigation and management. Examples: BLM District Manager, USFS Forest Supervisor, etc.

BI: Burning index. An estimate of the potential difficulty of fire containment as it relates to the flame length at the head of the fire.

BLM: Bureau of Land Management. A federal agency in the Department of the Interior that manages 245 million acres of public lands and 700 million acres of mineral estate.

Engine Type: Fire engines transport firefighters and provide water and pumping capacity to fight fires. Engines range in size, pumping power, tank size, and other factors. They are classified into seven types: Type 1 (largest) to Type 7 (smallest). Large wildland engines are often Type 3 and Type 4, while smaller engines are Types 5, 6, or 7.

ERC: Energy release component. The computed total heat release per unit area (British thermal units per square foot) within the flaming front at the head of a moving fire.

Fire behavior fuel models: A set of input parameters that describe the inherited characteristics that have been found in certain fuel types in the past. The environmental parameters of wind, slope, and expected moisture changes may be superimposed on the fuel models, which are used in a variety of fire behavior modeling systems.

FIRB: Firing Boss. The Firing Boss leads ground and/or aerial ignition operations and coordinates with holding resources on prescribed fire and wildfire incidents.

FLA: Facilitated Learning Analysis. A process grounded in social science research designed to promote learning across an organization. It is a safety investigative process that chooses to promote a culture of learning than a culture of blame.

FMO: Fire Management Officer. Responsible for coordinating the development of short and long-range fire management program plans, fire management activities on the unit, and integrating the unit's fire management program with other disciplines and interagency partners.

FFT1: Firefighter, Type 1. The Firefighter Type 1 leads a small group (usually not more than seven members) and is responsible for their safety on wildland and prescribed fire incidents.

FFT2: Firefighter, Type 2. The Firefighter Type 2 serves on a hand crew, engine crew, or helitack crew, performing fire suppression and fuels management duties in the most adverse climate, fuel, and terrain conditions.

Fuels: In a wildland fire context, fuels refer to vegetative material (grass, shrubs, pine litter, logs, etc.) that sustain and propagate fire.

GMUG: Grand Mesa-Uncompahgre-Gunnison National Forests.

IA: Initial Attack. An aggressive action to put the fire out by the first resources to arrive, consistent with firefighter and public safety and values to be protected. Fires that are not contained in initial attack are classified as extended attack fires.

ICT4: Incident Commander, Type 4. All incident commanders (IC), regardless of type, develop strategies and oversee the implementation of tactics, while providing for the safety of the public and all personnel assigned to the incident. Typing ranges from 1 to 5, depending on the complexity of the incident. ICT5 and ICT4 are classified as initial attack ICs.

IFTDSS: Interagency Fuels and Decision Support System. A web-based application used in fuels treatment planning and analysis.

IMT: Incident Management Team. Any type is dispatched or mobilized during complex emergencies to provide command and control infrastructure to manage the operational, logistical, informational, planning, fiscal, community, political, and safety issues associated with complex incidents and will include people from federal, state, and local agencies.

IMET: Incident Meteorologist. A support position that provides weather expertise to firefighters on an incident.

IPAWS: Integrated Public Alert & Warning System. The Integrated Public Alert & Warning System (IPAWS) is FEMA's national system for local alerting that provides authenticated emergency and life-saving information to the public through mobile phones, radio, and television.

IQCS: Incident Qualifications and Certification System. An interagency system to track incident responder qualifications.

IR: Infrared. In wildland fire, aircraft equipped with IR provide aerial observations of heat in an area.

Large Airtanker: Airtankers, like other wildland fire sources, are classified by types according to their liquid volume capacity. Airtankers types range from 1 to 4, with an additional “Very Large” type above Type 1. Type 1 and 2 airtankers are grouped together as “large airtankers.”

Militia: In a wildland fire context, militia are personnel whose occupation within the agency is not in fire management but can be called upon to assist in fire management settings. These personnel are fully qualified for the fire management role they are asked to temporarily fill.

NOAA: National Oceanic Atmospheric Administration. A federal agency under the U.S. Department of Commerce that provides a range of services, such as weather forecast, climate monitoring, and fisheries management.

NWS: National Weather Service. An agency of the federal government in the National Oceanic and Atmospheric Administration, NWS is tasked with providing weather forecasts, warnings of hazardous weather, and other weather-related products to organizations and the public for the purposes of protection, safety, and general information.

Red flag warning: A red flag warning is issued for weather events which may result in extreme fire behavior that will occur within 24 hours. A Fire Weather Watch is issued when weather conditions could exist in the next 12 to 72 hours. Both are issued by the NWS.

RAWS: Remote Automatic Weather Station. A weather station that transmits weather observations via GOES satellite to the Wildland Fire Management Information system.

RXB2: Prescribed Fire Burn Boss, Type 2. Ensures that all prescribed fire plan specifications are met before, during, and after a low or moderate complexity prescribed fire. The RXB2 is responsible to the Agency Administrator, prescribed fire manager, Fire Management Officer (FMO), or local fire management organization for implementing the prescribed fire plan.

USFS: United States Forest Service. A federal agency in the Department of Agriculture that manages 154 national forests and 20 national grasslands.

UTV: Utility terrain vehicle. In the context of fire management, an off-highway vehicle with seating capacity for multiple people, a roll cage, and sometimes a small utility bed. Sometimes a small water tank and pump is mounted in a UTV.

WestCO: Western Colorado Regional Dispatch Center. Formed in 2015, the dispatch center provides emergency communication for law enforcement, fire protection and emergency medical services for the region.

WFDSS: Wildland Fire Decision Support System. A web-based application that provides spatially oriented data to support strategic wildland fire management decision making.

WUI: Wildland-urban interface. The private lands where homes adjoin or intersect with larger areas of fire-adapted vegetation (USDA 2022).

Appendix 4. References Cited

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