Pole Creek Prescribed Fire Facilitated Learning Analysis

Bridger-Teton National Forest

9/9/2014

Contents

Executive Summary

At 1752 on June 10, 2014 the Pole Creek Prescribed Burn was declared a wildfire. The burn was located on the Bridger-Teton NF on the Kemmerer RD, approximately 25 miles northeast of Kemmerer, WY. The burn units were comprised of mixed conifer and associated with stands of aspen and separated by sage/grass meadows at elevations between 7400' and 9200'. The objective of the burn was to use stand-replacing burns to encourage the return of aspen stands.

Prescribed fire activities for the Pole Creek project began on the morning of Saturday, June 7th. A Type 2 Burn Boss and Burn Boss Trainee provided leadership for the day's operations. One hundred acres were successfully treated by the end of the day, and additional resources were requested to assist with the operation for the following day.

Late Sunday afternoon ignitions began on a 150-acre unit. Due to a miscommunication between the Burn Boss and one of the firing teams, the firing pattern was not completed as originally intended, producing very active fire behavior and spotting more than a half mile in front of the fire. Ignition operations ceased as fire personnel focused on locating and controlling spot fires. That evening the Burn Boss ordered three hotshot crews and a helicopter to assist with the spots the following shift.

Monday morning two of the three hotshot crews were canceled and the assigned resources focused on controlling the spots. Discussions started late Sunday between the burn overhead and Forest fire managers on whether to resume burning the unit, or to cease operations. A meeting was scheduled for Tuesday afternoon to make this decision.

At 1600 Tuesday the Burn Boss Trainee and Zone FMO (also acting as Firing Boss) attended the scheduled meeting to discuss the unfinished burn unit. During the meeting a spot weather forecast indicating the imminent passage of a cold front was transmitted to the fire, simultaneously the fire was experiencing high winds. A clump of trees along an open piece of line torched, spotted outside the unit and eventually slopped over the northern project boundary. High winds hindered attempts to control the spot fire, by the crews and helicopter on scene, which were ultimately not effective. Due to concerns of the fire spreading to a timber sale located north of the fire and the need for additional resources, the Burn Boss made the decision to declare the prescribed burn a wildfire.

Introduction

This Team was delegated to do a basic Facilitate Learning Analysis (FLA), but ended up completing a complex FLA. This wasn't because the unintended outcome was especially egregious or serious; it wasn't. The level of response increased because the environment in which the decisions, actions and events took place was more complex than expected.

In order to understand and learn from events like this we must view the decisions, actions and events in the context of the complex environment in which they occurred. In any complex environment, error and uncertainty persist despite our best efforts to eliminate them. This is not a critique of our ability or performance, but a fundamental character of complex systems.

Our traditional response to unexpected outcomes is to attempt to discover what errors were made so that we do not repeat them the next time. This approach is limited, mainly because complex systems rarely deliver the same conditions again. Succeeding in complex systems therefore is not creating an error free system, but an *error tolerant system*. Error tolerant systems provide room for error and uncertainty to exist without consequence. We are not suggesting that we focus solely on building room for error/uncertainty and forgo opportunities to learn to reduce the amount of error (perform better), we should focus on both. Learning from this event provides us an opportunity to learn both how to perform better and build a more error tolerant system. This FLA is designed with that in mind.

Narrative

Background

The Decision Memo for the Pole Creek Prescribed Burn Vegetation Treatment was signed in early 2010, although field personnel had been discussing the project and layout of units for years prior. The purpose of the project was to improve wildlife habitat, by prescribed burning to stimulate aspen cover types, with an objective of 80% mortality in the mixed conifer. The planning area was 6,550 acres in size and provided for burning half of those acres and mechanical treatment of 11 acres (See Figure 2). Implementation would include both spring and fall burns and would start as early as April of 2010. From the time the decision was signed, Zone fire/fuels personnel reviewed and adjusted boundaries, prepped firelines, created black-line and burned other units. They were very familiar with this piece of ground. The burn is located entirely within the Lake Alice-Commissary Ridge Integrated Roadless Area (Indicated as diagonal orange lines in Figure 2). Restrictions on activities for the Roadless Area were perceived to have precluded some mechanical fuels treatment, specifically work along roads

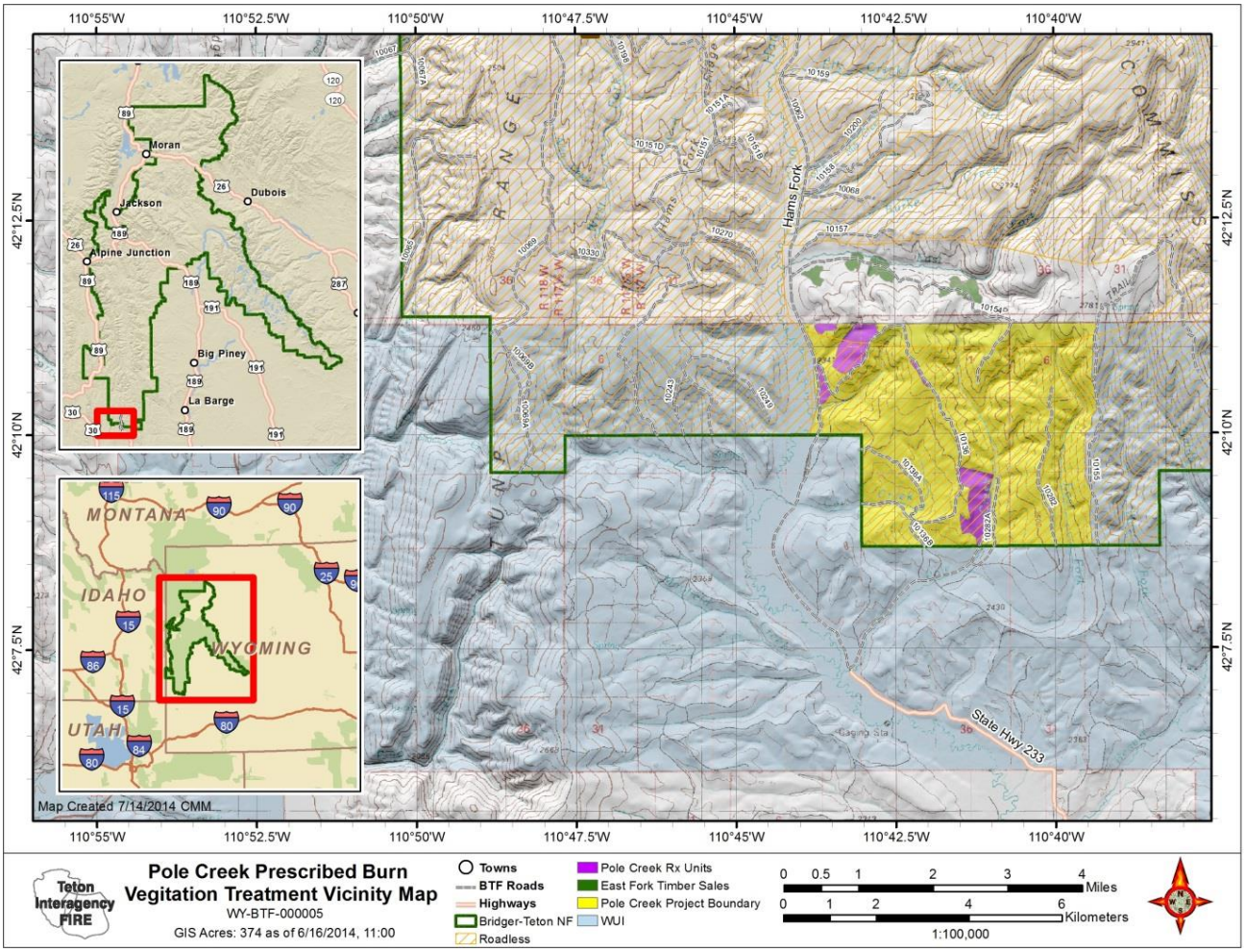

Figure 1: Introduction Map. Note that the project area is within both Roadless and WUI.

and trails[1]. The northern project boundary represents the Wildland Urban Interface's (WUI) northern extent as well[2] (Gray in Figure 2). This WUI boundary is relevant for two reasons. First, because the project is in WUI, it

[1] The Roadless Rule and its consequences for mechanical treatment options were brought up multiple times during the interviews. Discussion is ongoing to determine whether the perceptions of limitations were the result of Forest level interpretation of the law or practitioner perception.

[2] The entire project is with the Wildland Urban Interface as determined by the 2007 Lincoln County Wildfire Protection Plan.

was authorized through the Healthy Forest Restoration Act[3] to expedite planning. Second, it puts the project in *both* the WUI and Roadless area.

The Pole Creek Prescribed Burn was originally analyzed together with the East Fork Salvage and Sanitation Timber Sale. It was later decided to analyze each project independently and issue separate decisions for each project. When the projects were separated a project area boundary was established for each proposal. The northern boundary of the Pole Creek Vegetation Management Project follows the township 25N line, which is also the northern edge of Lincoln County, WY. The boundary presents problems for fuels managers because it was arbitrarily based on county lines and not on terrain features or fuels, which limited options for implementation.

The East Fork Salvage Timber Sale was directly north of the Pole Creek project (Green in Figure 2). The sale was recently re-advertised and sold to a new purchaser. The timber sale was highly valued in the local community and was scheduled to be active within a week of the first ignition of the prescribed fire. Any risk of the fire moving out of the project area and threatening the timber sale was of concern to both Lincoln County commissioners and Forest Service line officers.

[3] The Healthy Forest Restoration Act was signed into law in 2003 and is focused on reducing fuel loading especially in the Wildland-Urban Interface (WUI). There are special rules that apply to the planning an approval process for projects in the WUI to expedite and prioritize treatment in these areas.

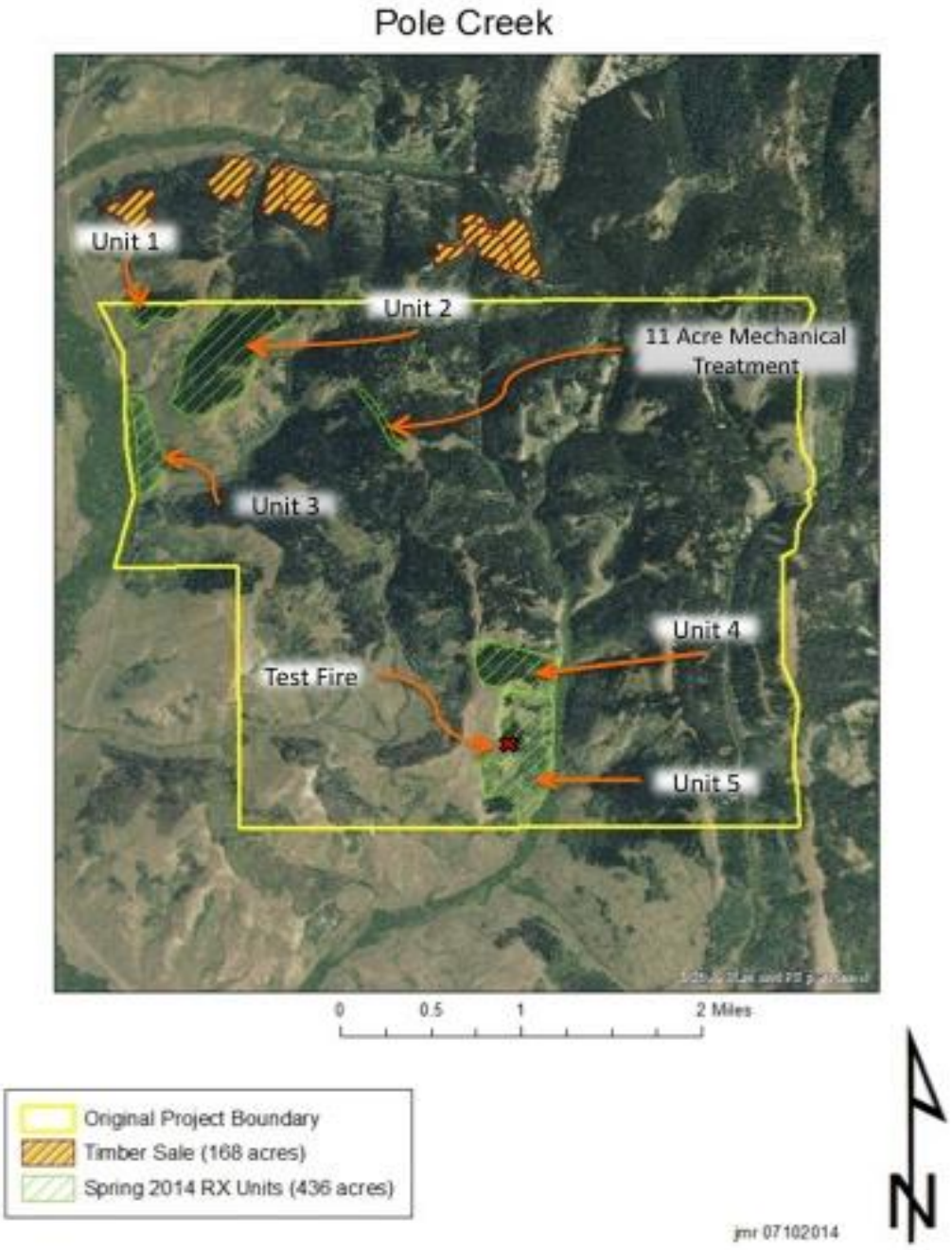

Figure 2: Project and unit boundaries. Test fire location in Unit 5.

The Burn

Saturday 6/7/2014

The initial test fire for the Pole Creek prescribed burn was lit on Saturday, June 7, 2014 at 1103 (See Figure 3). There were 12 people present including the Burn Boss, Burn Boss Trainee, and Firing Boss. The only resources on-scene were from the local Zone and they were familiar with the project area and the objective of stand-replacing fire in mixed conifer. Resources felt the briefing on the first day was adequate.

Picture 1: Looking south at Unit 5. Fire is pushed by a west wind downslope.

The test fire demonstrated that the burn would likely meet objectives of 80% mixed conifer mortality and at 1155 general ignition of Unit 5 began (Figure 3). The fire was torching groups of mixed conifer and moving downhill, aided by a slight westerly wind (Picture 1). Ignitions were completed on this section of the unit by 1300 and were meeting objectives. Resources moved further south within the unit lighting another section in the same manner. This second section burned very actively downhill, again meeting the objective. It was noted that the forecasted ridge top wind directions were anywhere from 90 to 180 degrees off of what was experienced. At 1703 with Unit 5 completed, burn resources ceased ignitions and headed off the hill. Burn Boss Trainee requested that a neighboring Fire Module be assigned to the burn the following day, as they had just been released from a burn on the neighboring Zone and were available.

Picture 2: Southern part of Unit 5; active torching downhill, meeting objectives of 80% mortality in the conifer.

Sunday 6/8/2014

At 0955 all resources, excluding the Module, were briefed and ignitions began on the north end of Unit 5. The Module was the first resource from outside the zone assigned to the burn; they had no prior involvement on this burn or any other burn within the project area and were briefed separately when they arrived at 1030. The Module felt the briefing was adequate from a safety standpoint, though they felt it lacked in prescription detail and commented on the absence of an IAP. The Google Earth map they received clearly depicted the vegetation, but lacked unit boundaries and numbers; although maps with this information were available[4]. By 1043 the Module was being utilized as a holding crew. Ignitions began from the bottom of the slope, laying strips of fire contour across the hillside and progressing upslope in this manner to the top of the stand. Many of the resources indicated that lighting from bottom to top felt odd. Despite this they felt it was a safe and appropriate firing pattern based on the previous day's activity and that like yesterday, the fire was pushing downhill and that green meadows (recognized safety zones) were easily accessible on either side of the timber stringer.

At 1300 the local Interagency Dispatch (Dispatch) relayed information about a possible thunderstorm approaching the fire. At approximately 1400, Unit 5 was completed and the Burn Boss and Burn Boss Trainee discussed whether to ignite Unit 4 (See Figure 3). After some debate the Burn Boss made the decision to move

[4] There is a discrepancy in the perspectives represented here, one party remembers more detailed maps and the other does not.

north to Units 1 & 2, due to potential for wet, slick road conditions and the potential for spotting do to the proximity of timber stands downwind and east of Unit 4 (See Figure 4).

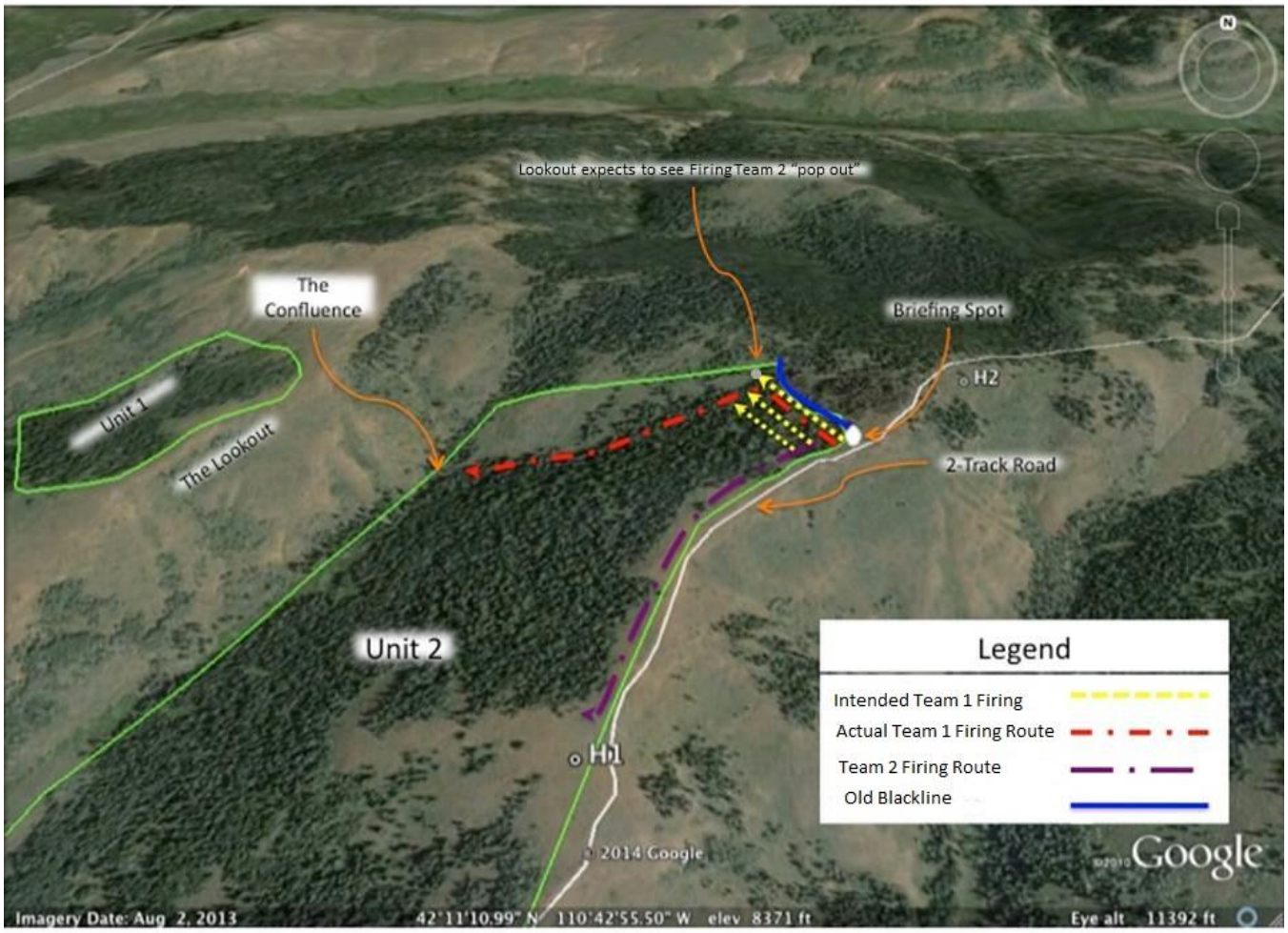

Figure 3: Unit 1 and 2 in the Northwest corner of the project area. Intended and actual lighting patterns indicated.

By 1500 all personnel were repositioned to Units 1 & 2 in the northwest corner of the project area and were briefed. All Zone personnel (local personnel) were assigned to light Unit 1, while the Module was once again assigned as a holding crew. Getting adequate consumption on the moist, north aspect was difficult; as a result spotting was limited. At 1600 the Module was reassigned as ignition forces for Unit 2. The Module casually expressed to the Firing Boss Trainee that they believed it was pretty late to start ignitions. The Firing Boss Trainee agreed, admitting he felt "a little bit of a push" to get things moving[5].

[5] Firing Boss(T) wasn't sure if he was just being extra sensitive to the operational pace because he was in a trainee role.

The Burn Boss, Burn Boss Trainee, and the Module briefed at the intersection of the old black line (Solid blue line in Figure 4) and the road southwest of H2 (White dot, Figure 4). A plan to light Unit 2 was discussed in which lighters would burn from south to north along the old blackline adding depth to the black line. This much is corroborated by all interviewees and beyond this point perception of the plan diverged.

The Module believed the intent was to continue along the conifer edge around to the west lighting the bottom of the unit (Red dash-dot-dash line, Figure 4). The Module felt "the water was muddy"; they were uncomfortable with bottom lighting the unit, unsure if resources on hand were enough to hold the amount and intensity of fire they expected from this firing pattern. One of the Module leaders remembered repeated attempts to clarify, stating that they directly asked the Burn Boss and Burn Boss Trainee, "You want me to buffer the top [to increase the depth of the existing blackline] and then come around the bottom?" "Yes." "We figured they wanted to slick this unit off." Just prior to ignitions, the Burn Boss/Burn Boss Trainee broke up the Module into two firing teams. One team (Firing Team 1) was to buffer (create a blackline to add depth to the control line) the 2-track to towards H1 (Purple dash-dot-dash line, Figure 3) and Firing Team 2 was to light along the old black and continue west along the bottom of the unit.

According to the Burn Boss/Burn Boss Trainee the intent was to split the Module into two groups. Firing Team 1's mission was as stated above (Purple dash-dot-dash, Figure 3). Firing Team 2's mission was to burn strips progressing downhill from south to north to deepen the existing blackline and *progressively* bring the fire edge west into the unit (Yellow dotted line, Figure 4). Burn Boss and Burn Boss Trainee adamantly believed the module did not express unease with the plan and appeared clear on the intent. Burn Boss had a confident demeanor and stated that his style was to provide intent and not micro-manage. He stated that he trusts his resources to implement his intent, but admits in this case, "They didn't do what was in my head."

Firing Team 1 began to get depth moving south paralleling the 2-track road (Purple dash-dot-dash, Figure 3). Prior to Firing Team 2 initiating ignitions, Firing Team 2 called Firing Boss and asked "Will you be my eyes? Will you make sure I am not under-lighting them (Firing Team 1)?" The Firing Boss agreed to serve as lookout as he was on a ridge to the northwest with good eyes on their location (See Figure 4). As Firing Team 1 began to get depth along the road, Firing Team 2 began burning to the north along the old blackline (Solid blue line, Figure 3).

Firing Team 2 got to what the Burn Boss Trainee described as lighter fuels/vegetation marking the northern edge of the unit. This was where the Firing Boss, Burn Boss, and Burn Boss Trainee expected to see Firing Team 2 "pop out" (Gray dot, Figure 4) of the conifer stand, before returning to the south towards the 2-track road with another line of fire.

Firing Team 2 began to turn to the west near the drainage bottom and along the bottom of the unit, according to the plan as they understood it. As they did this, they called the lookout (Firing Boss) to ask how it was going and lookout responded that things "look good". As Firing Team 2 was lighting the bottom of the unit to the west (Red dash-dot-dash line), they heard radio chatter between the Firing Boss, Burn Boss and Burn Boss Trainee about increased fire activity and fallout and a possible change in the plan for Firing Team 2. The lookout

informed Firing Team 2, that there appeared to be spots below where they were lighting, which was confusing because they were very near the bottom of the drainage. Firing Team 2 responded by increasing the pace to finish lighting along the bottom of the unit. This was also confusing to the Firing Boss, Burn Boss and Burn Boss Trainee because the slope, winds and smoke did not support there being spots below where they believed Firing Team 2 was lighting.

Firing Team 2 called the lookout again to ask "should we stop?" Lookout responded "Where are you? Have you seen the spots?" Firing Team 2 responded "we are at the confluence" (See Figure 4). Lookout responded "Oh, that's not spots, that's you lighting." Firing Team 2 replied, "Yes, should we stop?" Lookout replied, "Yes, stop."

Picture 3: Looking at Unit 2 after ignitions were complete. Picture taken from the lookout spot under Unit 1 (Figure 4). The "confluence" is at lower right of picture.

It took time for the perceptions of the Firing Boss, Burn Boss, and Burn Boss Trainee and Firing Team 2 to align, amidst a preponderance of mixed signals. Misalignment was evident based on the conviction with which each party believed initial intent was shared and understood and that they were all acting in accordance with the original plan.

Firing Team 1 had to hurry to stay ahead of the fire making runs toward the two-track road and stopped blacklining operations somewhere near H1. The fire was now putting up a very large column. Firing Team 1 moved into holding operations and was picking up a lot of spots on the ridge top in grass and sage, none of which were establishing.

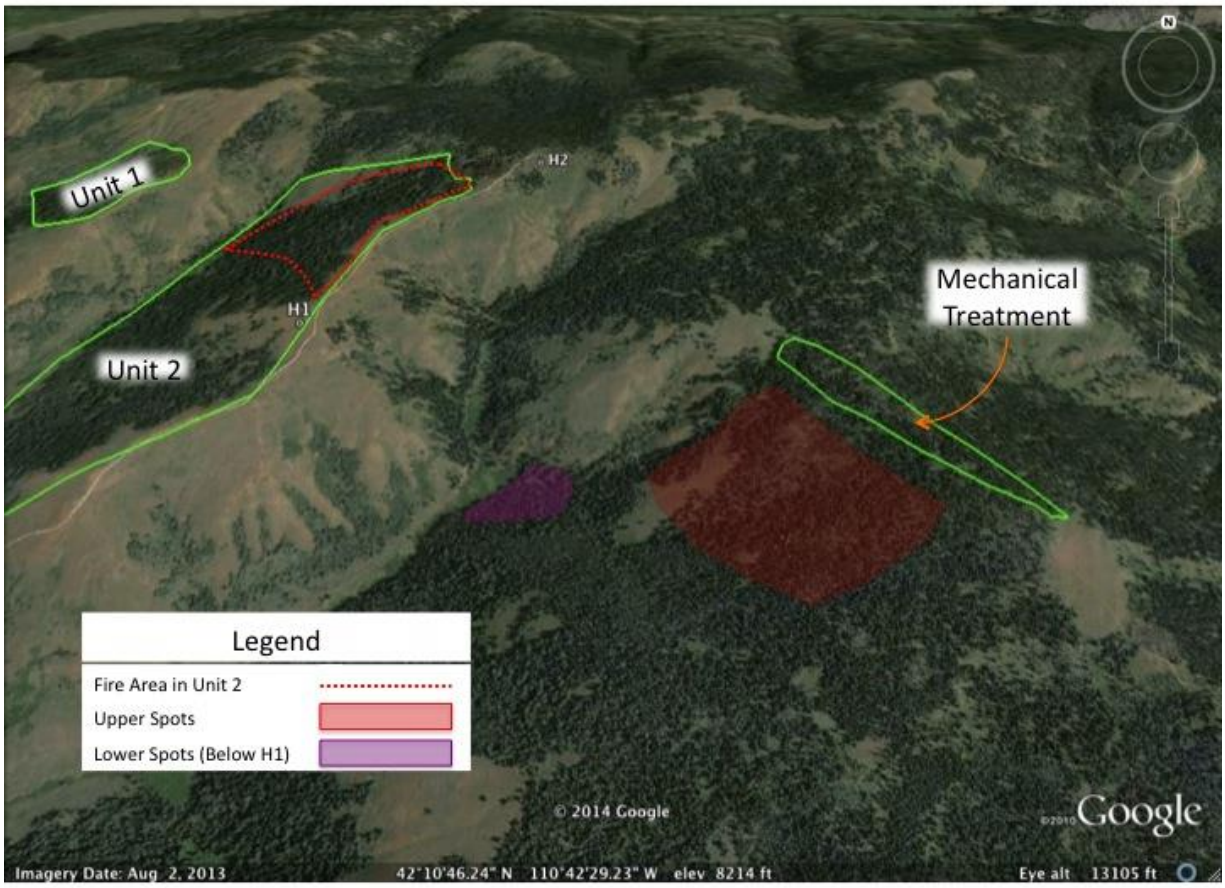

Figure 4: Spots resulting from Sunday's firing operations. Location of spots is approximate.

Sometime between 1828 and 1938, spots were discovered east of Poison Hollow Creek, seven-tenths of a mile east of the main fire[6] (See Figure 5). All of these spots, although outside the burn area, were still within the project area. At 1938, the Burn Boss called Dispatch to request three Type 1 crews and one Type 2 helicopter, as no contingency resources had been identified in the plan[7]. The dispatcher who received this information was an "All-Risk" interagency dispatcher who was unfamiliar with ordering procedures for fire and called a fire dispatcher back to work to assist. At 1956 the fire dispatcher contacted the Forest FMO[8] to apprise him of the order. At 2004 Dispatch placed the order with the Geographic Area Coordination Center (GACC), indicated the Pole Creek Burn had spotted ½ mile from the main fire, but the spot was still within the project area. GACC

[6] Typical spotting distances on the burn had been 200-300 ft.

[7] The burn plan did not require any and therefor they were not identified or used. According to the Interagency Prescribed Fire Planning and Implementation Procedures Guide (PSM 484), there is no requirement for the assignment of contingency resources and the approved burn plan did not require contingency resources.

[8] And currently the Forest Duty Officer (DO)

ordered three Forest Service Hotshot crews at 2016. No action was taken on the spots that night because they could see the spots were not an immediate threat and they were approaching a 16-hour day. The overall feeling was it would be safer and more effective to hit them in the morning. GACC called the fire dispatcher at 2101 to inform him that[9], "Just so you know, since the crews are ordered on a fuels code, if there is a fire code they will be pulled from your fire."[10] GACC added that this is unlikely given the current activity level and crew availability and in addition, they will need to order agency specific crews (in this case Forest Service) because other agencies cannot charge to a USFS management code, but instead require P-Codes which are the codes assigned to wildfires.

The Firing Boss called the Forest FMO at some point that evening to discuss how many crews he expected to need. They discussed whether the burn needed all three crews or could get by with one. The basis for this discussion was the tradeoff between the impact to project funds and the tactical needs of the burn. A decision on the number of crews was postponed until, "the smoke clears and we can see this thing in the morning." By 2200 all resources were off the line and bedding down at H1.

Monday - June 9

By morning many of the local resources had left or were leaving the fire to attend mandatory training and certification. The Burn Boss Trainee estimated it was a 25% reduction in the number of resources on the burn, this was also noted as relevant by the Module leaders. Just after 0606 a Type 3 helicopter (25HX), a shared forest resource, was en route to the burn[11]. By 0700 the Module and the remaining crew from an engine began to work spots in the Poison Hollow drainage supported by Helicopter 25HX.

At 0807 Dispatch contacted GACC to clarify the traffic from the previous night at 2100[12]. The dispatch log states, "A wildfire would take precedence, if we declare a wildfire, we can keep them. No resource shortage [so the chance of having to pull them is low]. [Needed to send]FS crews since it is on fuels dollars." At 0809 Dispatch passed this information onto the fire. This information generated a clear and robust perception among the Firing Boss, Burn Boss and Burn Boss Trainee of reluctance from GACC to assign the number of resources requested if the burn was not declared a wildfire. The "reluctance" appeared to the FLA team to have three

[9] According to the Dispatch log.

[10] The FLA team has attempted to find written clarification of the prioritization of IA over prescribed or extended attack fire as it appears to be a commonly held truth. We have looked in the National Interagency Mobilization Guide, The Red Book and have inquired with dispatch centers. As of this writing we have not yet found a clear reference indicating this prioritization. Research is still underway.

[11] The Type 2 ship ordered was unable to be filled the previous night, so 25HX is brought on in its place until it can be replaced.

[12] The fire dispatcher who was brought on Sunday night was replaced by another dispatcher on Monday morning, who contacts GACC to clarify the conversation from the night before.

elements: the impact to the fuels budget[13], the necessity of ordering Forest Service crews and the potential for the loss of the crews if it was not declared a wildfire. This frustrated the leadership at the burn.

At 0848 Burn Boss Trainee updated Dispatch; "if the Module can get saw line, may turn two crews around." A little over an hour later at 0953 Burn Boss Trainee contacted Dispatch, "Talked with the Forest FMO, would like to turn around 2 of the shot crews. With bucket drops, looking decent. Keep one [shot crew] going to button up the spots."

At 1400 the single hotshot crew arrived on scene and began to hike in. A Type 2 helicopter (933CH) arrived around this time and began bucket work on the spot fires, relieving 25HX, which was no longer available due to duty-hour limitations. The hotshot crew was briefed at H1 and began work on additional spots just below H1 (Purple area, Figure 5); crew from Engine 631 was reassigned there as well.

Since the spots were discovered Sunday afternoon, attention shifted there, although discussions had been underway between burn overhead and fire/fuels/Forest leadership as to how best to finish the unit. In the afternoon, as significant progress was made on the spots, the Firing Boss and the hotshot crew superintendent scouted open line on Unit 2 to assess the feasibility of building direct handline to tie off the open piece of fireline, indicating a return of the focus to the burn and a development of a plan to finish the burn. A meeting with Forest leadership to discuss options was scheduled for the following day (Tuesday, June 6). At 1800 the remaining crew from the engine left the burn to attend a previously scheduled training session. By 2051 all resources were moving off the line and returning to camp.

Tuesday - June 10

At 0645 burn resources began to hike into the unit. On scene, resources were briefed; there had been little to no activity overnight and the objective for day was to continue to mop up spots. The Module and individuals from one of the helicopters mopped up upper spots (Red area, Figure 5). The hotshot crews worked on mopping up spots below H1 (Purple area, Figure 5). Determination regarding what to do with Unit 2 was still a question for leadership. After the hotshot crew had completed work on the spots below H1 they began to grid for spots and improve saw line along the north and east flanks of Unit 2.

Just before 1400, the Burn Boss Trainee and Firing Boss, who is also the Zone FMO, drove to the District office to meet with the District Ranger and conference call with the Deputy Forest Supervisor and Forest AFMO, who oversees the fuels program. The Deputy Forest Supervisor was also the responsible administrator for this burn. En route they requested an updated spot weather forecast and at 1513 observations were called in from the burn. At 1552 dispatch read the spot weather forecast over the radio (but it was not heard by the Burn Boss Trainee or Firing Boss/Zone FMO):

[13] This is not from GACC; rather it is from the FMO via previous night's conversation and may have been reiterated in this morning's conversation with Dispatch.

> A dry cold front is moving across the fire site right now…with drier air in the wake of the front which should allow humidity to drop into the upper teens or lower 20 percent. Winds should be breezy from the west to the northwest through the evening hours…

Dispatch added that they (the weather service) removed the chance of thunderstorms previously predicted. The burn resources had believed the wind events experienced at the fire were tied exclusively to the outflow winds from thunderstorms which had not developed over the fire area this afternoon. They expressed surprise when this spot weather forecast led off with a mention of a cold front. The Burn Boss, Burn Boss Trainee, and Firing Boss all reported that they had no memory of a cold front being mentioned in any previous forecasts.

At the same time, the Burn Boss was experiencing winds out of the west well in excess 20 mph on the burn. The hotshot crew superintendent and one squad were working bucket drops from Helicopter 33CH down an area of open line northwest of H1 when they witnessed a group of trees torch just north of the intersection of the open line and the drainage bottom (Purple dot, Figure 6), casting embers to the north[14] into a clump of trees outside the unit (Red dot, Figure 6). The spot established and began to progress to the north toward the ridge top and the project's northern boundary. Once on the ridge, the fire was influenced by the prevailing westerly winds and began to move eastward along, and slopping over the northern boundary of the project (Figure 7). The Burn Boss made several attempts to contact the Firing Boss and/or Burn Boss Trainee, who were in the 1600 meeting, to notify them of the developments.

[14] Ridge top winds were west, but terrain influence could likely account for the southerly, upslope/drainage wind.

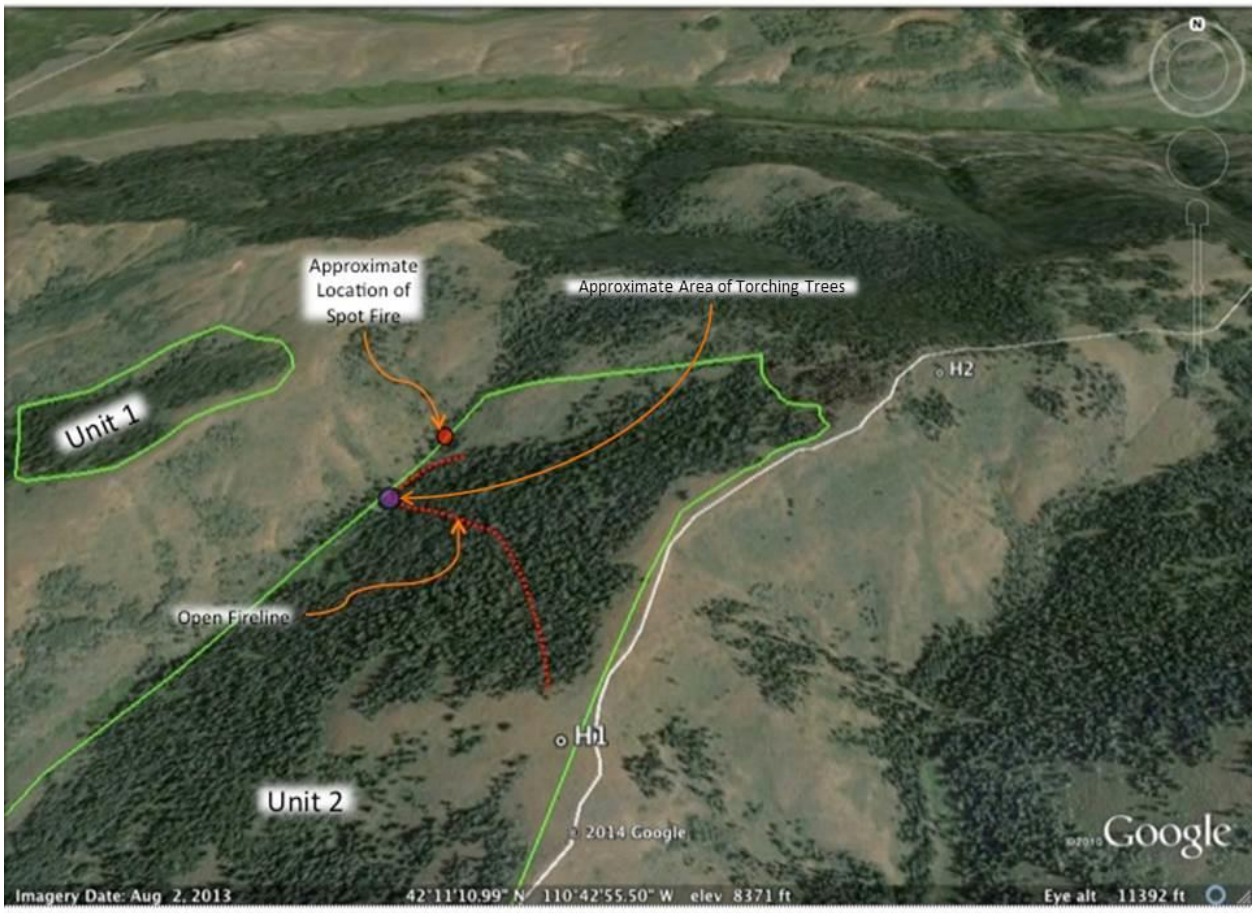

Figure 5: Tuesday afternoon, group of trees torch in the drainage bottom (Purple) and send spots north to an area outside the unit (Red). This is the beginning of the fire run that leads to the declaration of a wildfire.

Concurrently, at the meeting in town, they were discussing choices to wrap up the main fire. The choices were to either go direct with saw and handline or continue to burn the unit; burn overhead preferred to burn the unit. The decision was made to continue ignition and finish burning the unit.[15] As the meeting was concluding, the Firing Boss received a call from the Burn Boss informing him of the new fire activity.

The hotshot crew and the Module, after a brief attempt to contain the spot fire, began to construct direct fireline, anchoring at the intersection of the open line and the drainage bottom (Purple dot, Figure 6). Helicopter 933CH attempted bucket drops but the winds were too high to be effective and the helicopter had to return to town for fuel, by the time ship arrived back on fire, the fire was well established.

[15] It is important to note, that from the time of the original spot fires in Poison Hollow until the time of the spots on the north side, the decision to light or go direct was discussed numerous times with district and forest management positions.

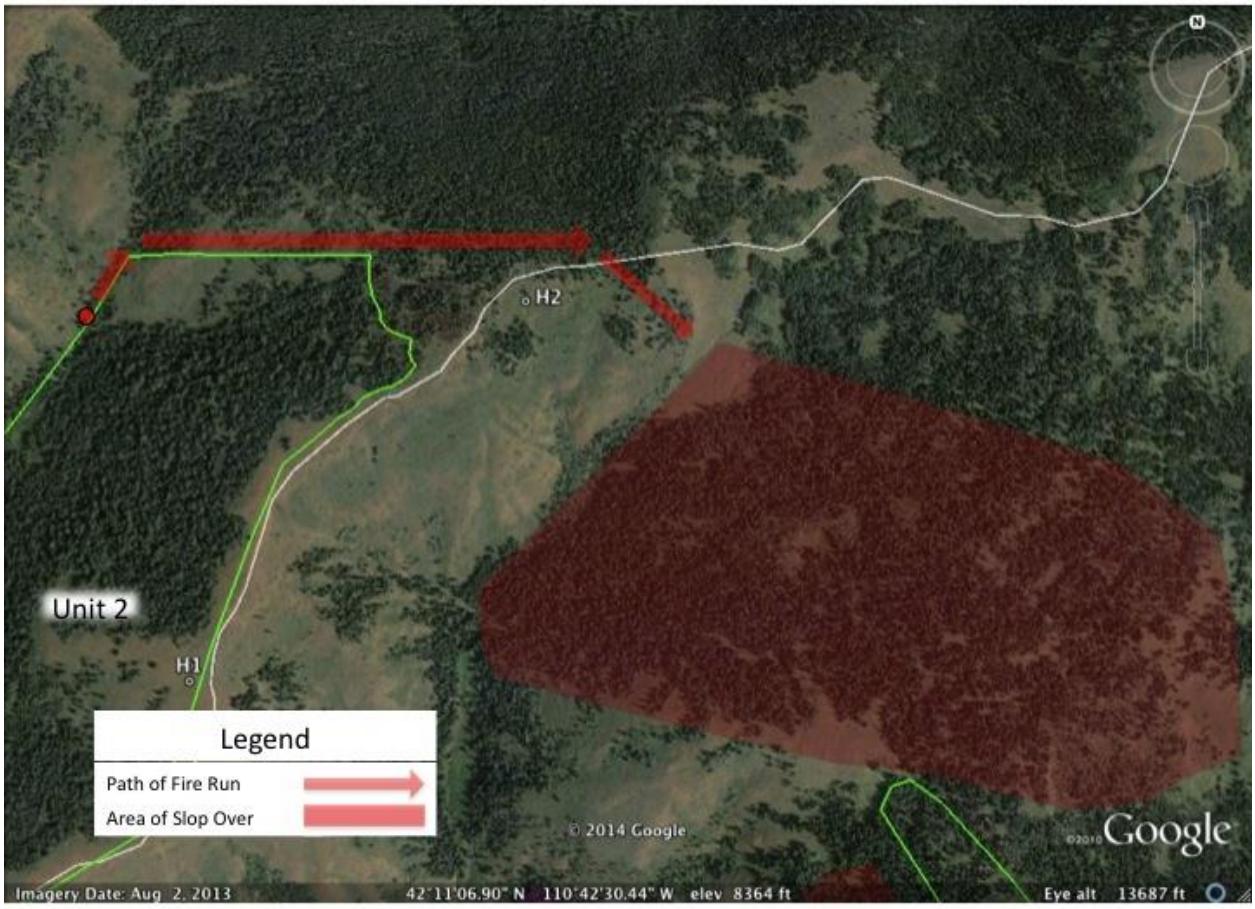

Figure 6: Fire progresses from spot (red dot) north to the unit and project boundary, then turn west running along and slopping over the northern project boundary and spots across into the Poison Hollow Drainage.

Picture 4: Looking at fire run in Poison Hollow from H1.

The Burn Boss watched the progression of the fire, and weighed the decision to declare a wildfire. To the north was the highly valued timber sale and the fire was steadily advancing to the west. Between approximately 1600 and 1730, the Burn Boss watched the fire move up to the ridge, "seeing what it was going to do." Once the fire crossed outside the project boundary, "it was really just semantics…I knew I would need more resources to catch the thing, we were not going to catch it within 24 hours and given the reluctance to give us resources unless we declare it a wildfire, [at 1752] I declared it a wildfire."

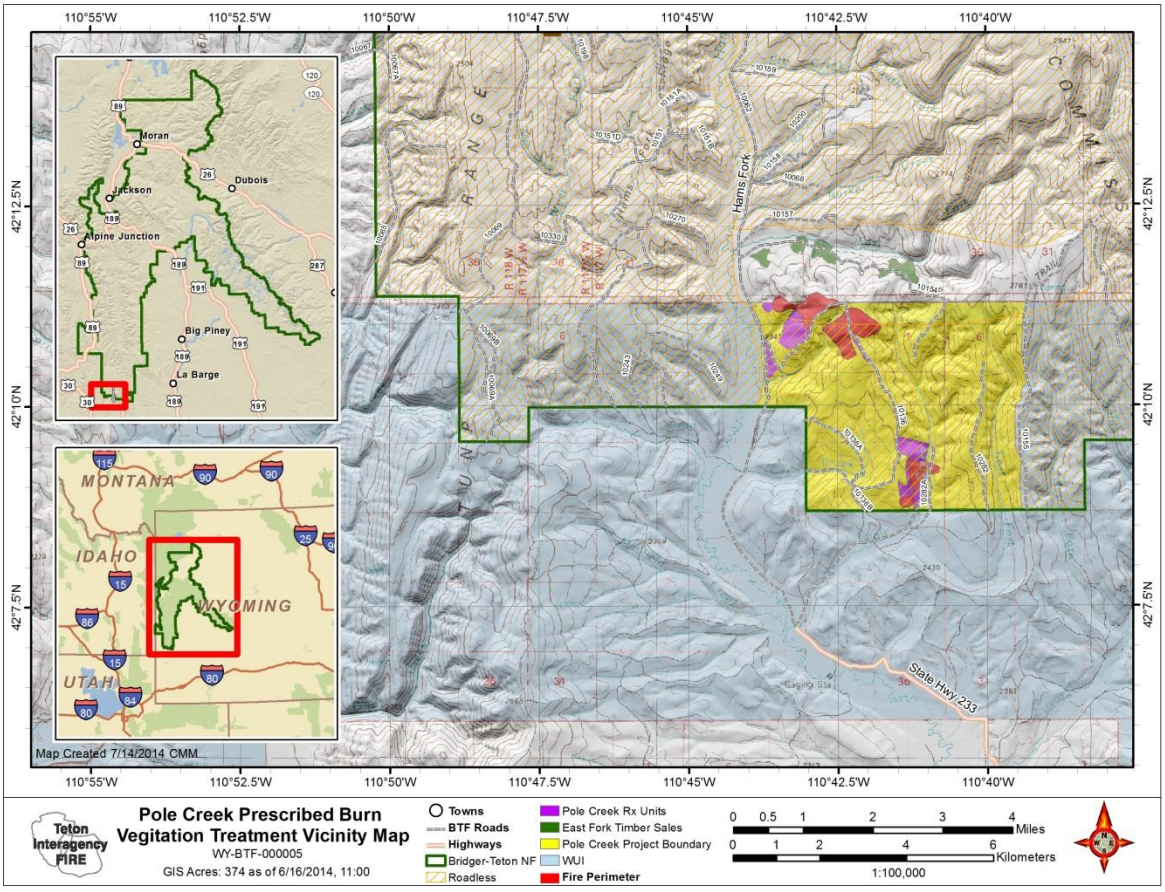

Figure 7: Final area for the Pole Creek Fire. Monday spots and Tuesday's fire run are included.

Lessons Learned Analysis

In this section we feature the decisions, actions and events that we believe were relevant to the unintended outcome, followed by a statement as to why we believe it was relevant. The bulleted statements are the conditions we believed influenced the decision, action or event.

Restricted Operating Environment, Prior to Ignition

By the time the first test fire was lit, the operating environment for the burn managers had been significantly restricted, leading to a more error-intolerant system.

Conditions that may have influenced this situation were:

- The northern boundary of the Pole Creek Vegetation Management Project follows the township 25N line (also the northern edge of Lincoln County, WY) and represents the Wildland Urban

Interface's northern extent. The boundary presents problems for fuels managers because it is not based on terrain features; and being unable to adjust the boundary was a frustration for them.

- The burn is located within the Lake Alice-Commissary Ridge Integrated Roadless Area. Restrictions on activities in roadless areas, was perceived to have limited mechanical fuels treatment along roads and trails in preparation for the burn.
- The fact that it was in *both* the WUI and a Roadless area had the potential to generate confusion and competing regulations, restriction and intent for the same piece of ground.
- The location of the East Fork Salvage Timber Sale, directly north of the Pole Creek project. It was a highly valued by the local community and therefore was a value of considerable concern for the forest and fire leadership.
- Do to the circuitous and prolonged nature of project planning and approval, project layout was replete with artifacts which were the legacy of multiple actors and intents. "If I had my choice I would lay out the planning area differently so it would give us flexibility."(Forest Fuels FMO)
- An environment of multiple and often conflicting demands (preseason training/certification versus prescribed fire resource needs) in combination with a culture of doing more with less.

Staffing Levels for the Burn

From the outset, the burn plan was written with lots of latitude with regard choices of staffing levels and organizational structure considered acceptable to meet objectives. As a result it was difficult to discern which complexity level best fit the burn enacted (See Appendix 1). At low complexity levels it called for three people, and at the highest level of complexity it called for fifteen plus a Holding Boss. Regardless, when the neighboring zone's Module arrived on Sunday there were twelve personnel and a Holding Boss was never assigned. Importantly, the staffing levels were not considered to be deficient[16], however staffing was inconsistent with the plan and this was reported by some of the resources. It is worthy of mention here, because it opens inquiry into prescribed and wildland fire community assumptions and priorities regarding staffing.

Conditions that may have influenced the staffing levels:

- There was, in this case as well as multiple other prescribed fire FLAs[17], a priority placed on pre-season training and certifications. In this case, by Monday the burn had lost an estimated 25% of resources to attend scheduled training or certification. Refresher training and any additional training are required to be red carded for the upcoming season and for career advancement. Training coincides with the spring burn season and often results in conflict, requiring the prescribed fire resources to adapt accordingly.

[16] For the firing operations and spotting distances expected, and for the most part experienced, minimum staffing levels were appropriate. They did however leave little room for miscommunications and surprise.

[17] The FLA team reviewed similar FLAs to understand how the decisions, actions and events discussed in this FLA fit into the wider discussion.

- A general assumption in the broader prescribed and wildland fire community that planned ignitions are staffed at the minimum level required, whereas unplanned ignitions are responded to by the number and type of resourced needed to accomplish the mission. Typically we build a larger contingency of available resources when responding to unplanned ignitions. This was vividly apparent throughout this event, concluding with respondents feeling a sense of relief after the declaration because they could finally order what they needed. Artifacts of this general assumption are seen in the prioritization policy referred to by GACC, in the funding allocations to fuels vs suppression budgets, pay structures, e.g. hazard pay for wildland fire but not prescribed fire, and in our language regarding planned and unplanned ignitions, e.g. we "fight wildland fire" and "implement prescribed fire".

Different Perceptions of Firing Patterns

This contributed to Firing Team 2's ultimate ignition pattern, which was inconsistent with the intent of the Burn Boss, producing fire behavior beyond what was intended[18]. Miscommunication is mentioned in most FLAs and is a ubiquitous and stubborn performance issue.

Conditions that may have influenced this difference in perception were:

- Firing Team 2 was unfamiliar with the project, unit and terrain.
- The ignition pattern earlier that day began at the bottom, which seemed odd to some of the burners at the time but was appropriate for the conditions and met objectives. This burn pattern was influenced by the success experienced the previous day.
- The objective was to create stand replacing fire. The difference in perception was a difference in how much of the stand to replace at one time; how much fire was appropriate for the conditions.
- The local unit typically did not utilize Incident Action Plans (IAP) as a means of communication. This was not the case for some of the resources and for some of the FLA team members. There is no mandate to use them but because norms are location specific, this form of communication may be relied on by some resources and not others. IAPs are another means to form a common operating picture.

Perceived Reluctance Unless Declared Wildfire

[18] It is important to note here that neither the FLA team nor those involved with this event believed the spots resulting from the ignition of this unit were responsible for the wildfire declaration. By Tuesday when the wind event came through, these spots were contained, controlled and practically out. The spots were influential in taking focus away from the burn unit for a day and a half.

A clear and robust perception exited among the management (fire, Forest and burn management) of an apparent reluctance to assign the resources requested if the burn was not declared a wildfire. This perception of "reluctance" came from 2 sources; the Forest and the EGBCC/Teton Dispatch and influenced the decision to declare the burn a wildfire.

1. Conditions that may have influenced the perception of the Forest's "reluctance" :
    - The impact to the fuels budget
        - The Forest FMO/Duty Officer on Sunday night was concerned about the impact to the fuels budget. On Sunday evening and again on Monday morning, the Forest FMO/Duty Officer discussed with the Burn Boss the feasibility of reducing the number of crews ordered.
        - It wasn't until late Monday morning that after discussion with the Forest AFMO, the Forest FMO felt confident that the orders placed would not significantly affect the fuels budget.
2. Conditions that may have influenced the perception of the Coordination Center Dispatch's "reluctance" :
    - The necessity of ordering Forest Service crews only, if not declared a wildfire, because the management code issues related to transfer of funds to another agency (fuels dollars were agency specific to the Forest Service).
    - The prioritization of wildland fire over prescribed fire in the assignment of resources.
    - The reduction of information resolution as it passes through intermediaries (the telephone game). The initial message from the Coordination Center to Dispatch was the above two points and the assurance that the chance of losing the crews was small given the current resource availability. This message loses resolution in a second conversation between Dispatch and the Coordination Center to clarify, "A wildfire would take precedence, if we declare a wildfire, we can keep them. No resource shortage. Wanted to make sure sent FS crews since it is on fuels dollars." This information is then passed onto the fire and it is interpreted as "a reluctance to provide resources if it wasn't declared a wildfire."

- Individually these influences are insignificant, but in their combination they are exponentially more influential to the outcome[19].

Delays in Decision Making

On Monday, the Agency Administrator suspended ignition operations due to Sunday evening's prescribed fire activity. By the time the decision was made on Tuesday at 1600, the fire had already spotted across the planning area boundary to the North.

[19] This is an example of nonlinear interactions, which is a defining character of complex systems. A series of conditions will be present without having a significant impact to the system then at some point they can align in surprising and hard to predict ways to have exponentially greater influence (McDaniel, 2003).

- The District Ranger (who would typically be the Agency Administrator for such a burn) was not yet qualified as an Agency Administrator; the qualified Agency administrator was the Deputy Forest Supervisor, based three hours away. This made timely decisions about what to do with the open piece of line on Unit 2 difficult.

Cold Front Not Recognized

A cold front passage was predicted by the weather service, but was not recognized and/or factored into decision making. Wind associated with this cold front was believed to have caused a group of trees at the bottom of the open piece of line to torch, spotting outside the unit and initiating the run that lead to the declaration.

Conditions that may have influenced resources not recognizing the cold front:

- The burn organization appeared to have associated the wind event with the predicted thunderstorm activity and associated outflow winds and not with the passing cold front. So when the thunderstorms did not develop the threat of wind was perceived to have been reduced as well.
    - Spot weather forecast for the morning of June 9th first mentions the possibility of high winds associated with something other than thunderstorm activity, stating" …an approaching weather system on Tuesday will result in warmer and windy conditions with lower min RH's and isolated gusty thunderstorms."
    - A spot weather for evening of June 9th indicated, "Slightly warmer and lower afternoon RH are expected Tuesday…with breezy to windy west to southwest wind…ahead of storm system moving into the Northern Rockies. Isolated shower and thunderstorms will be possible Tuesday afternoon and evening ahead of and along a pacific cold front that is expected to push east across the fire site Tuesday night…"
    - The Tuesday June 10th morning spot weather states, "The combination of an approaching cold front and several disturbances in the area will result in developing showers and thunderstorms later this morning and especially this afternoon. The main threat from these storms will be lightning and very strong outflow winds, which could exceed 50 Mph in the area. Even outside of afternoon storms it will become windy this afternoon."
- There was a consensus across all resources that a cold front had not been predicted. This is similar to the first bullet but goes deeper to suggest that beyond not associating the wind event with the cold front it was never acknowledged by burn resources to be in the forecasts.
- Weather forecasts had been inaccurate previous days on wind direction and speed. Ultimately, the assumption of the inaccuracy of the previous forecasts influenced the reading of future forecasts. Despite this, burn overhead did not provide feedback to the weather service about the inaccuracies.

- The weather service was not compelled to provide unsolicited weather updates to the burn because in their perception the burn had been lit on Saturday, June 7 (4 days prior), they felt it was "old" and were not watching it for weather changes like they normally would for an "active" prescribed fire or wildfire with ongoing operations. This didn't influence the accuracy of the forecasts but may it have influenced how close they were watching changes in weather over the fire and the need to provide unsolicited weather updates.

Lessons Learned and Recommendations

Restricted Operating Environment, Prior to Ignition

Dialogue was limited in this regard; many of the conditions that restricted the operating environment and created an error-intolerant system were beyond the scope of those present in the room. The one topic that was discussed was the position of the northern boundary and its influence on making the project more challenging to implement. From this there was intent to make future plans less challenging to implement. This is our recommendation as well, but this intent should go well beyond the individual who is tasked to write the burn plan. There are places all the way through the hierarchy of the Forest and beyond that should be asking themselves the same question, "Someone may have to put fire on the ground at some point and in order to make this plan a success, how do **I** provide the most favorable operating environment (i.e. including error tolerance) for them before they start to burn?

Recommendation Discussion Question

How will I create the most favorable operating environment into this plan for the person who has to implement it?

Staffing Levels for the Burn

Staffing levels were adequate for the burn as planned, more resources would have increased the error tolerance of the operation, but decisions to increase the number of resources are countered by cost, culture and logistical concerns. Increasing the number of resources is not a decision made in isolation, there are tradeoffs. The recommendation would be to define the basis for arguments against having lots of resources on hand. From this begin to openly question the cultural assumptions about appropriate levels of staffing. Why do we always shoot for just enough in prescribed fire; is it just about money? Are there types of burns that would warrant the assignment of a Type 2 helicopter and/or a hotshot crew?

Recommendation Discussion Question

What aspects of staffing levels on prescribed burns are the result of "that just the way we do it around here" or cultural assumptions? Can we question those assumptions and build more error tolerance for our burns?

Perceived Reluctance Unless Declared Wildfire/ Different Perceptions of Firing Patterns

Although these decisions, actions, events were very different looking they were, at their roots, miscommunications and as such we will treat them together in this section. In the dialogue participants reflected on missed opportunities to use active listening and feedback techniques like asking receiver to repeat back messages/instructions for clarification, and when unsure or uncomfortable about instructions or intent, to speak up with necessary feedback. We concur that participants should work on these and other techniques to improve communication performance[20]. However, in addition, leadership should develop plans and practices based on the premise that communication will be inherently flawed, i.e. full of errors. Implementation of this concept will be context specific and specific to the individual or group, but it has to be based in the assumption that the intent has been missed and a desire to understand the sender's intent.

Recommendation Discussion Question

With the assumption that communication is inherently flawed, what are some practices we can try that will help us perform better *and* build room for the inevitable communication errors that will exist?

Cold Front Not Recognized

Why didn't they pick up on the cold front?

Participants in the facilitated dialogue believed a likely reason for missing the approach of a cold front was in the previous days' spot weather inaccuracies. They discussed ways to prevent this in the future. Foremost amongst the suggestions was to provide feedback to the weather service about the inaccuracies; this was an important discussion topic and will be discussed on its own in the next section. Additionally, participants discussed the following: timing the spot weather requests so spot weather observations could be more "real time", utilizing local Remote Automated Weather Stations (RAWS), even suggesting that there be one placed on every burn. Unfortunately, while these suggestions are good, they do not address the fact that the cold front was correctly predicted more than a day prior to its arrival. It had been mentioned in Monday afternoon's spot weather and again in more detail in the Tuesday mornings spot weather. The fact that multiple people read the spot weather forecasts and still missed the mention an approaching cold front challenges our assumption that we can accurately and objectively perceive our environment. While there is little doubt that the participants will look more thoroughly through spot weather forecasts from now on (thus plugging this specific hole in the Swiss cheese), it doesn't fix the "problem" because it assumes that we can train ourselves to continually perceive our

[20] In fact the FLA team discussed these same things in our interactions with each other and the participants.

environment more accurately and objectively to meet an ever more complex environment. The following short

video is appropriate here to dispel such illusions[21]:

Figure 8: This is a link to the YouTube video detailing how we perceive our environment.

The lesson is that our operational environment is highly complex and our ability to maintain an accurate, objective perception of our environment has limitations. Our recommendation is to acknowledge the complexity of our environment and the limitation of our abilities and to use this information to build room for the inevitable error to exist without consequence. This could take the form of consciously practicing consistent feedback in order to develop a shared mental model of operations and the environment.

Recommendation Discussion Question

How "good" is your Situational Awareness? How can you allow for the inevitable missing information or misperception of the environment?

Relationship with the Weather Service

This is a great example of the potential for relationships to play a significant role in building error tolerance and resilience. During the facilitated dialogue the burn overhead were asked why they didn't provide feedback to the weather service regarding the inaccurate forecasts mentioned above. They suggested it was due to a lack of time, but it was likely more than that. As it was, they understood the weather forecasts were not completely accurate but did provide enough accuracy for the burn to remain in prescription. It didn't prevent things from moving forward, therefore there was little motivation to provide feedback. If on the other hand there was a relationship built between the two entities then there may be an additional motivation; you would know the people you were talking to and want them to be successful too. In a relationship, you want to be successful and you want the other entity in that relationship to be successful as well. The recommendation therefore would be

[21] If you are reading this in paper form, search YouTube for "Brain Tricks-This is How Your Brain Works, by AsapSCIENCE" https://www.youtube.com/watch?v=JiTz2i4VHFw

to take a field trip to the weather service office and spend a day with them, go out to lunch get to know them as people.

This works for the weather service as well. Their perception was that the burn was days old and not active. A tighter relationship might encourage extra communication between the entities, just because the relationship is important and someone you know is out on the line.

Recommendation Discussion Question

How can we build relationships and share information to increase the tolerance of our systems and mitigate the effect of errors and surprises?

Conclusion

One of the first questions asked during the facilitated dialogue was about its format. The agency administrator asked where the "causal factors" were. He knew it wasn't quite what he was after because he was well aware that FLAs do not assign causal factors, but he felt something was missing, as there was no clearly defined reason why this event happened. What he and possibly you (the reader) found was a detailed narrative and a series of decisions, actions and related events, with influencing conditions. At first blush this format is less than satisfying. How can we expect to learn, to fix the stuff we did wrong, if there isn't a clear understanding of what caused the unintended event? This is a fair criticism, but in truth there was no "clear cause" to reference in this unintended outcome.

This event was richly complex; in the narrowest of perspectives it took place over four days, but in reality the conditions that influenced this outcome are rooted a great distance in time and space from this event. The fear is that in acknowledging a greater breadth of complexity the relevant lessons closest to those involved will be lost. The FLA team believes this is false and we point to the facilitated dialogue as evidence. The group was able to pinpoint opportunities for individuals or groups to increase their capacity to perform (to do better next time), while at the same time acknowledge the influence of conditions beyond the immediate scope of the event. It is the recognition of both that ultimately results in a more favorable operating environment for future operations.

Contributors

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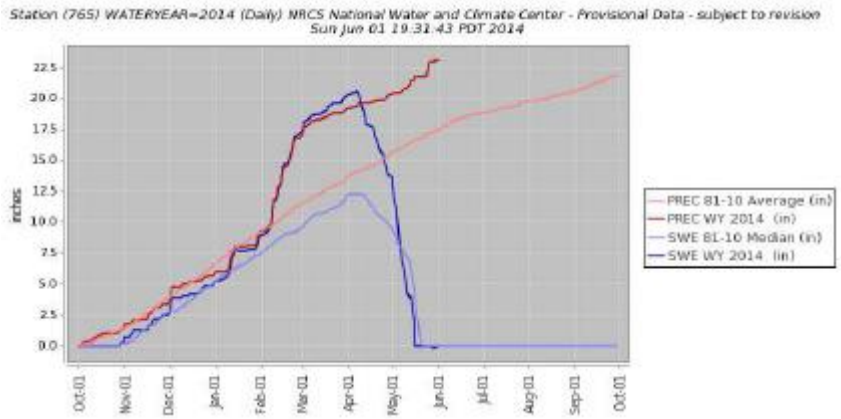
Appendices

Appendix 1: The Prescribed Fire Review

From the Interagency Prescribed Fire Planning and Implementation Procedures Guide, the need to review the following five questions was necessitated.

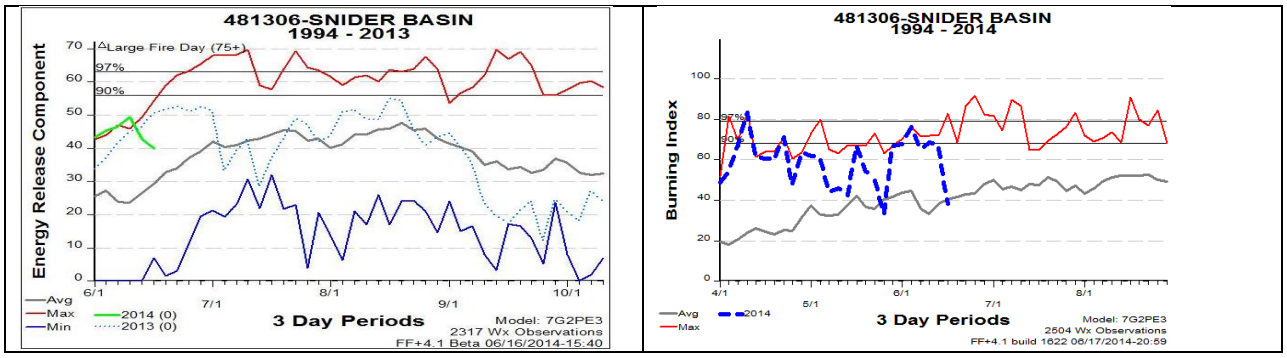
<u>An analysis of the seasonal severity, weather events, and on-site conditions leading up to the wildfire declaration.</u>

In general, the Teton Interagency Fire Zone experienced a relatively wet winter season with above-normal precipitation. In fact, this past winter's snow-water equivalency has eliminated the drought status of the 2013 season. May was warmer and drier than average which resulted in the rapid depletion of the snow pack and relatively quick drying of the larger dead fuels.

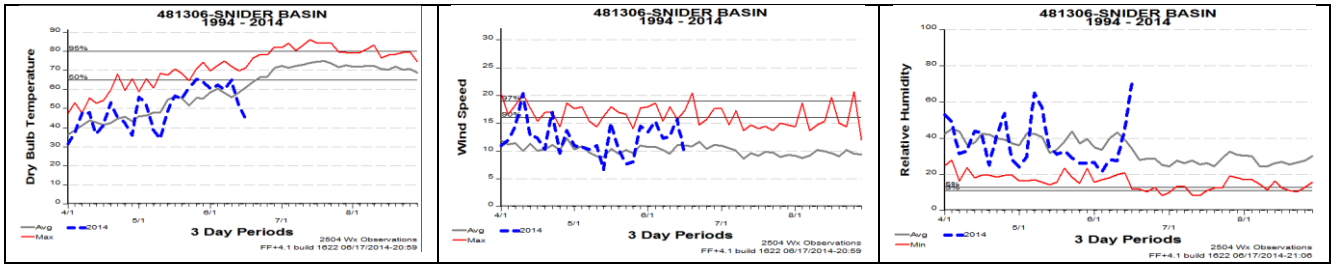


Snider Snotel Site

The energy release component chart below represents the rapid drying of fuels once the snow cover left the prescribed fire area. District personnel reported that the majority of the snow had only left the burn units within the two weeks preceding ignition operations on June 7th. When the unit was burned (June 7th-8th) there were still pockets of snow on the some of the more protected north and east slopes within the project area. Of note in the chart below, is the current year's line (green) which represents a record setting reading for this time of year when these units were ignited. The burning index was also quite high during the ignition phase of the operation as the reading was at or near the 90th percentile.



Weather during this event up to the declaration of escape can be characterized by relatively warm and dry conditions with a series of weather systems passing over the project area. These associated systems brought both increased winds and some convective development on both Sunday and Tuesday (June 7th and 10th) which were the days when significant fire spotting occurred. Winds at the Snider RAWS station, located approximately 20 miles to the NNW, were relatively strong each afternoon during the peak fire activity hours (1500-1800). These winds averaged around 25 mph from Saturday through Monday (June 7th-9th). On Tuesday afternoon (June 10th) as a cold front passed over the project area, winds increased to approximately 35 mph during the period the fire spotted outside the project area and the fire was declared a wildfire. The Haines index during the 4 days leading up to the conversion to a wildland fire were Saturday (4), Sunday (4), Monday (3) changing to (5) in the evening and on Tuesday (5).



Fuels were sampled on site 10 days previous to the unit's ignition date (May 27th) and again after the fire was declared a wildfire (June 13th). The second sample was taken off site to the north of the project site. All readings were compatible as required within the burn plan for a spring burn implementation.

5/27/2014		**6/13/2014**	
White Bark pine	104%	Lodgepole pine	125%

Subalpine fir	114%	Sage	190%
Sage	258%		
1000 hr	27%		

An analysis of the prescribed fire plan for consistency with agency policy and guidance related to prescribe fire planning and implementation:

A review of the Pole Creek Prescribed Fire Plan was conducted and found that all elements were consistent with agency policy and guidance as outlined in the Interagency Prescribed Fire Planning and Implementation Procedures Guide (November 2013). However, it is unclear if the amendment to the burn plan signed on 5/9/2014 was a Moderate or Low complexity level. The burn plan was signed by both the preparer and the technical reviewer on 5/7/2014 and approved by the Agency Administrator on 5/9/2014. The burn plan has the current Agency Administrator Pre-Ignition Approval Checklist and Agency Administrator Ignition Authorization (Element 2 and Prescribed Fire Plan Element 2A (PMS 485 11/13)). Both of these were signed by the Burn Boss and Agency Administrator on 4/30/2014 and 5/9/2014 respectively.

There was also an amendment to this burn plan issued in the spring of 2014. This amendment provides for winter/early spring tree welling and spring burning/black lining to provide a larger buffer along the north, northwest and northeast sides of the burn unit. The complexity level of this amendment is listed as both Moderate, and in the body of the write up, as Low. If the intent of the Low rating was to downgrade the complexity of the burn, then an additional complexity rating should have been completed and included as part of the burn plan. This amendment was authored by the RXB2, reviewed by the West Zone FMO and approved by the Agency Administrator. All signatures were present and the document was signed by 5/9/2014.

***Note(s):**

-Primary burn blocks within the project boundary would be good to identify and describe. A large project area not having specific burn blocks mapped can create confusion and difficulty in describing site specific information. These should be attached to the burn plan and easily referenced by others not on site.
-Complexity Analysis determination is open for interpretation, but on projects that rely upon stand replacement fire behavior to accomplish objectives, the potential for escape, active fire behavior and complex organizations are all elevated.

An analysis of prescribed fire implementation for consistency with the prescription, actions, and procedures in the prescribed fire plan.

An analysis of the prescribed fire plan for consistency with implementation was conducted and resulted in the following findings.

-Overall the Elements within the burn plan were adhered too. Both weather and fire behavior prescriptions were followed and at no point were they exceeded. Overall the observed weather conditions fell into the low to desired prescription range with the exception of wind speeds which were consistently on the high fire intensity scale. Since spotting was the primary cause of conversion to a wildfire, it should be noted that under the burn plan it allowed for spotting distances of up to .5 miles. BehavePlus showed that under predicted weather forecasts the spotting distances (not withstanding possible thunderstorm outflow winds) would range up to .4 miles, which is still below those allowed in the burn plan.

-Under Element 11 – Organization and Equipment it appears as though the organization may have been understaffed for the assignment in the initial phase of the operation. There is some confusion as to which minimum organization chart the burn organization was following during the first two days of ignitions on Unit #5. There are currently three organization charts; Spring and Fall, Winter/Early Spring and the amended plan's Winter/Spring. The RXB2 stated that they were operating under the amended organization chart as approved on 5/9/2014 which required a minimum of three personnel; he also stated that they had enough personnel on site to burn under the other organization chart(s) as well, which require a minimum staffing level of either 8 or 14/15 depending upon which of the original organization charts in the burn plan he referenced.

A review of both the Winter/Early Spring and the Winter/Spring (amended) burn plans reveals that the intent of these lower complexity organizations was to burn when conditions provided for reduced potential of fire escape. These burn plans refer to "tree welling" and "black lining". There is room to interpret if using these lower complexity plans was appropriate in this case, but the burning conditions were very active with group torching, spotting and the intended operations were not tree welling or black lining. On Saturday and Sunday morning the burning operations involved burning full units and it appears as though utilization of the more complex organization Spring/Fall was in order.

If the prescribed fire organization was utilizing the more complex organization chart in the burn plan, they would have needed a minimum of 14/15 individuals. When Unit #5 was ignited on Saturday and Sunday morning there were a total of 12 individuals present. An assigned Holding Boss would have also been called for under the higher complexity organization and this function was not activated until approximately Monday.

The approving agency administrator's qualifications, experience and involvement.

The Agency Administrator was qualified at the Advanced level and has experience at all levels including suppression and prescribed fire. This Agency Administrator was involved from the approval of the burn plan, amendment to the burn plan, signing the Administrator Pre-Ignition Approval Checklist and Ignition Authorization through the moment the fire was declared a wildland fire.

The qualifications and experience of all key personnel involved:

All key fire personnel were qualified in the positions for which they were assigned according to current IQCS records. All other assigned personnel also appeared to have been qualified in their respective positions.

Assigned Position	Qualified Yes/No	Currency Expiration
Agency Administrator		
RXB2	Yes	9/03/2015
RXB2"T"	Yes	6/06/2017
FIRB (Units 1 and 5)	Yes	8/31/2018
FIRB (Firing Team 1)	Yes	5/09/2019
FIRB (Firing Team 2)	Yes	10/26/2018
Holding Boss, Monday 7/9 (TFLD)	Yes	10/26/2018
Holding Boss "T", Monday 7/9 (TFLD)	Yes	11/08/2015