United States
Department of
Agriculture

Forest
Service

**Southwestern
Region**

Nuttall Complex Fire Shelter Deployment Review

*Factual Report and
Management Evaluation Report*

December 6, 2004

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USDA Forest Service

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(Source: Jayson Coil)

Photographs of Helispot 4 20-22
(Source: Jim Derrick)

Executive Summary

In the dangerous business of wildland fire suppression, we call on fireline leaders to make the challenging decisions of providing for employee safety while taking appropriate suppression actions. The Nuttall Fire Shelter investigation finds that the firefighters relied on their experience and training to make good decisions.

Strategy and tactics were guided by careful application of LCES (Lookouts, Communications, Escape Routes, and Safety Zones). While participants all felt they underestimated the potential fire behavior and had no way of anticipating a critical medical emergency, quality situational awareness and commitment to standard mitigations led to a positive outcome. The mitigations proved resilient. This was a big event—to the agency, to the firefighting community, and particularly to individuals involved. It is an opportunity to study and learn from a critical situation.

This report will describe and document the relevant facts and recommend actions. These findings are largely positive and complimentary. The recommendations are neither career-ending nor policy-changing; however, particular findings will be of interest at all levels of the wildfire organization. This Investigation Team used the After Action Review / Lessons Learned format for interviews.

The Nuttall Fire on the Safford Ranger District of the Coronado National Forest in Arizona was ignited by lightning on June 26, 2004 and escaped initial attack. A Southwest Area Incident Management Type 1 team assumed command on June 27, 2004. An indirect strategy along suitable ridges commenced, with a Firing Group assigned to “bring the black” with the control line construction. Bringing the black is a standard fire suppression technique that provides firefighters a nearby safety zone in the recently burned, hence fuel-free, blackened area.

Firing operations on the evening of July 1 had the burnout “around the corner,” off the main Mt. Graham ridge, and one-half mile north down the Clark Peak Trail secondary ridge. A five-acre slop-over became the first tactical priority for the morning of July 2, and, as possible, the burnout was to continue another one-quarter mile to a rocky outcropping at H-4 (Helispot 4).

The first resources to reach the slop-over chose to suspend operations until appropriate mitigations could be established. Once they were established and additional resources assigned, the slop-over was quickly lined and a hoselay was installed all the way down Division E to H-4 and around the slop-over. The safety zone identified at H-4 was improved. Changes in the air mass and fire behavior were monitored and communicated. When the fire became active and made a run toward Division E, the preferred plan of evacuating the entire area was compromised by two factors: the arrival of resources not of the same fitness level as the firefighters the escape route was planned for, and a medical emergency experienced by one of the firefighters.

A side-bar situation involved helitack resources deployed to manage helispots. Standard mitigations (LCES) were not identified and discussed before exiting the helicopter. To the credit of the H-6 firefighters, they immediately equated their state of affairs to the Cramer tragedy and radioed for corrective measures. The IMT (Incident Management Team) was responsive, and the situation was resolved before there were any negative consequences or close calls.

This is rugged country and demanding firefighting—a classic example of down-the-ridge suppression. Interviews indicate the team carefully planned and executed the operation. The on-site supervision was qualified, dedicated, and engaged. All crews were Type 1 and expertly led. Individuals to the squad level were willing to voice their concerns and, when appropriate, halt

operations. Before redeploying, next level supervision personally inspected the site, often with open dialogue with peers and supervisors. There was a consistent pattern of reassessment, and, as necessary, additional crews were reassigned to safely accomplish the objectives or withdrawn from the area.

Notwithstanding these positive comments, there are issues and situations that led to a close call.

The close call involves firefighters needing to retreat to the previously identified safety zone at H-4 and choosing to deploy shelters there. The firefighting culture dictates that a fire shelter will not be necessary in a true safety zone. Fire shelters were deployed on the Nuttall Fire, but not to protect from radiant thermal burns; in fact, the worst of the heat had already passed. Supervisors gave the 'shelter up' order to provide a more comfortable environment and in response to a high level of discomfort (acrid smoke and fear) in support staff on site.

There were no serious injuries; however, most individuals reported headaches and coughing from a day to several days afterward. Numerous CA-1 forms (Notice of Traumatic Injury) were filed for smoke inhalation. Some reported that this was typical of smoke conditions on other fires or prescribed fire, and others said this was the worst smoke exposure they had ever encountered. Generally, most agreed that the duration of the exposure was longer.

Related to the emotional discomfort experienced by support personnel, line overhead did an exemplary job of coaching, guiding and reassuring throughout.

As twelve people were engaged at H-4, one and ¾ hotshot crews (IHCs) had a situation of their own at the aspen grove. Originally planning an orderly retreat up the escape route to the vehicles, a medical emergency caused them to use a considered, but not well-communicated, refuge in an under-burned aspen grove where the crown was still present.

After the fact, crews and the IMT sponsored AARs (After Action Reviews), and CISDs (Critical Incident Stress Debriefings). The AAR document from the IMT was detailed and demonstrates a proactive, open effort to learn from this event. When it was discovered that a few individuals were missed, an additional AAR was scheduled; however, all agree it would have been better for those individuals to have participated with the main group.

Lessons to be Learned

From an Incident Management Team perspective, we need to look at the structure presented within the IAP (Incident Action Plan). The Division E Supervisor was responsible for a specific section of line, and the Firing Group Supervisor was responsible for suppression resources who would be working within various Divisions. Nowhere in the IAP was it clear that the Firing Group would be subordinate to the Division Supervisor while on that Division. There were no issues regarding authority; in fact, it appears that personnel were cooperative and supportive. The issue emerged when the medical personnel assigned to Division E were directed by the Division E Supervisor to H-4, which was currently being managed by the Firing Group Supervisor. The Firing Group Supervisor, who had previously prevented Firing Group medical personnel from venturing too far down the mountain, was surprised by the arrival of the Division E medical team, who were not of the same fitness or experience caliber as the Type 1 resources at H-4. This is a subtle point, but it altered the mitigation options for the Firing Group. "The door closed" for a swift retreat uphill to the vehicles. While there is no authority issue, one peer made an unannounced decision that affected another peer. The most important point is positive; note how carefully the Firing Group Supervisor monitored and managed escape route elements.

Another organizational disconnect occurred between the Operations group and their subordinate Air Operations. In an attempt to service the suppression effort, helitack personnel were deployed

by helicopter to H-4 and farther down the ridge to H-6. These were not ordered or approved by the line operations staff, and escape routes and safety zones were not pre-identified. Several people pointed out the similarity with the Cramer tragedy. When the situation came to their attention, the Operations section quickly gave the order to retrieve the individuals, but only H-6 was actually recovered. H-4 was deemed to be too smoky, and the helitack personnel were managed by line overhead at H-4. The evacuation of H-6 affected helicopter availability to better reconnoiter the main fire.

Another concern for all of us, from entry-level firefighters to those who supervise fire program managers, is the changing fuel and fire behavior conditions. Highly experienced and qualified firefighters, supervisors, safety officers and others were surprised by the intensity of the fire behavior. The fire went from benign on the safe side of the trigger point (Nuttall Creek), to extreme and across the fire line ridge in a matter of minutes. The strength of LCES carried the day, and the focus and professionalism of players created a work site where more extreme fire behavior would not have significantly changed the outcome. While this fire was managed by high level and experienced individuals, the lessons are for all firefighters, particularly initial and extended attack, while working in similar terrain. For example, the slop-over on Division E could have been an initial attack fire staffed by local resources. The 1200-acre Nuttall fire could have been an undetected lightning strike in the canyon below. The mitigations are the same.

An issue identified by several individuals, from the Forest Supervisor down through line overhead to the line-digging firefighter, was the stigma associated with deploying a fire shelter. As mentioned above, deploying a fire shelter presumes something was done wrong, that the 10-and-18 have been compromised, and that an investigation will follow. This appears to cause reluctance to use the shelter. Earlier deployment in this case would have prevented pulmonary distress. In general, not deploying a shelter early enough has been a pattern on tragedy fires, and the negative implication of triggering an investigation may cause people to resist a proactive maneuver.

An interesting discussion involves the aspen grove. Recognized during slop-over suppression activities, the aspen was never identified as a primary safety zone because no one could accurately predict whether the aspen crown would eventually carry the fire. It was discussed and considered as a backup, but this was not well communicated with the troops. Forces not involved with H-4 intended to get completely off the ridge, up the shortcut trail, and out to the vehicles. When the trainee crew boss developed emergency medical problems, the aspen grove was successfully pressed into service. The decision to use the aspen grove was made by IHC#1 Asst., IHC#2 Superintendent, and the Firing Group Supervisor, who had personally checked the option of leading the crew back to H-4. The aspen grove served them well because it was previously under-burned, the crown was still green, and there was no fuel bed immediately below. This demonstrates the resiliency of the safety awareness on site.

Positives:

The previous night's burnout operation did not achieve the depth or complete combustion hoped for. Without a good clean burn, the blackened area was not a safety zone supporting suppression line construction. To the credit of all involved, this was recognized, discussed, and mitigated on the morning of July 2 by identifying, communicating, and improving the safety zone at H-4.

Similarly, the escape route was identified, timed, and communicated. When individuals unable to meet the time factor arrived, the plan was adapted using the previously identified safety zone at H-4. This shows close management of critical safety mitigations.

Commitment to fundamentals, respectful communications, strong leadership, smooth shelter deployment, use of After Action Reviews, and people speaking up are all examples of positive culture change.

All on-scene participants received an invaluable lesson in firefighter safety. While LCES was dominant and carefully managed, the implications of committing firefighters to a safety zone are now more real to them. Future decisions by these individuals will be tempered by this experience.

Factual Report

Investigation Process

A deployment investigation team was assembled to examine the Southwest Area Incident Management Team's After Action Review and to gather further facts and evidence related to the fire shelter deployments. This second review was initiated by the Washington Office of the Forest Service through the Southwestern Regional Office. A delegation of authority was received on July 12, 2004.

The team assembled in Tucson, Arizona, for a briefing with the Coronado National Forest Supervisor on July 15, 2004.

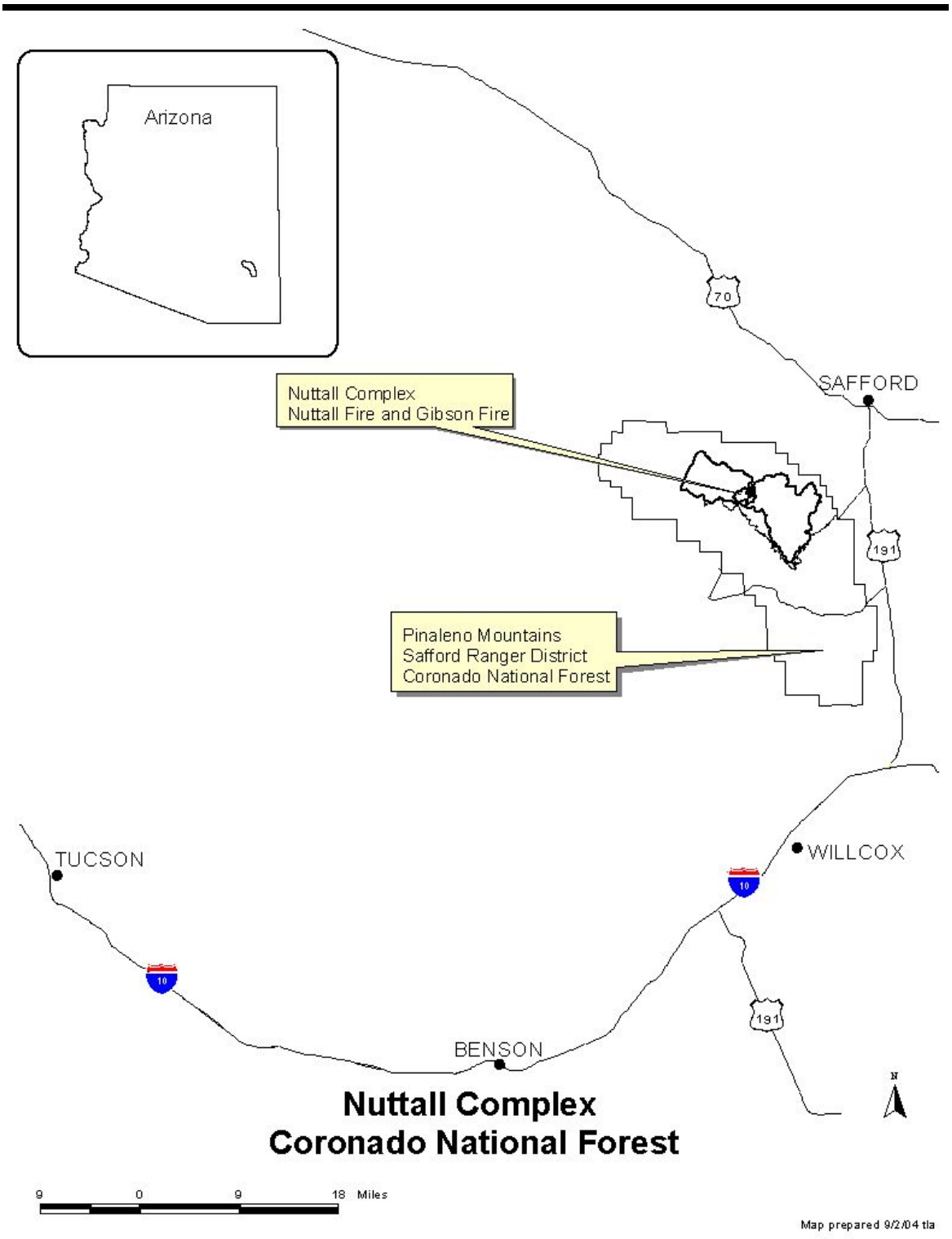
The investigation team members were:

- Bob Castañeda, Team Leader (Kootenai NF Supervisor)
- Paul Chamberlin, Chief Investigator (Missoula, Northern Rockies Fire Operations Safety Specialist)
- Linda Murphy, Safety Manager (Coconino NF Safety Manager)
- David Provencio, Fire Technical Specialist (R-4 Fire Operation Specialist)
- Mary Anna Wheat, primary Documentation Specialist (Coronado NF Recreation)
- Andrea Campbell, secondary Documentation Specialist (Coronado NF NEPA Coordinator)
- Randy Meyer, National Federation of Federal Employees Representative
- Alan Belauskas, Investigation Trainee (Coronado NF Safety & Health Officer)
- Roxane Raley, Purchasing (Coronado NF EMP Resource Assistant)
- Hwayoung Kim, Trainee (Vice-President, R-3 Nat'l Federation of Federal Employees)

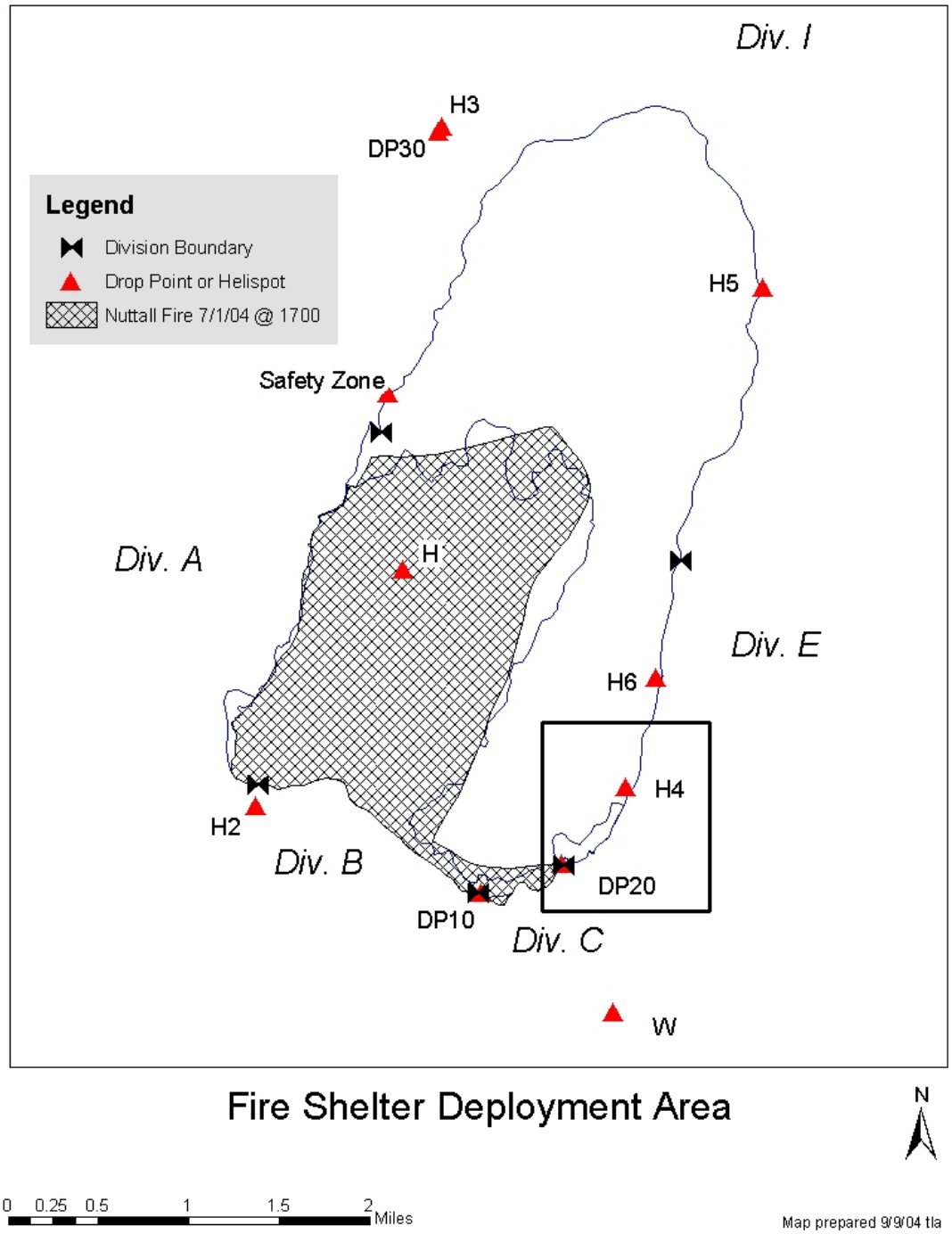
On July 16, the team provided a 24-hour briefing memo to the Regional Forester through the Regional Safety & Health Manager and began interviewing involved personnel by telephone.

The investigation team interviewed, or reviewed witness statements provided by, individuals assigned to the fire who were directly or indirectly involved with the shelter deployment.

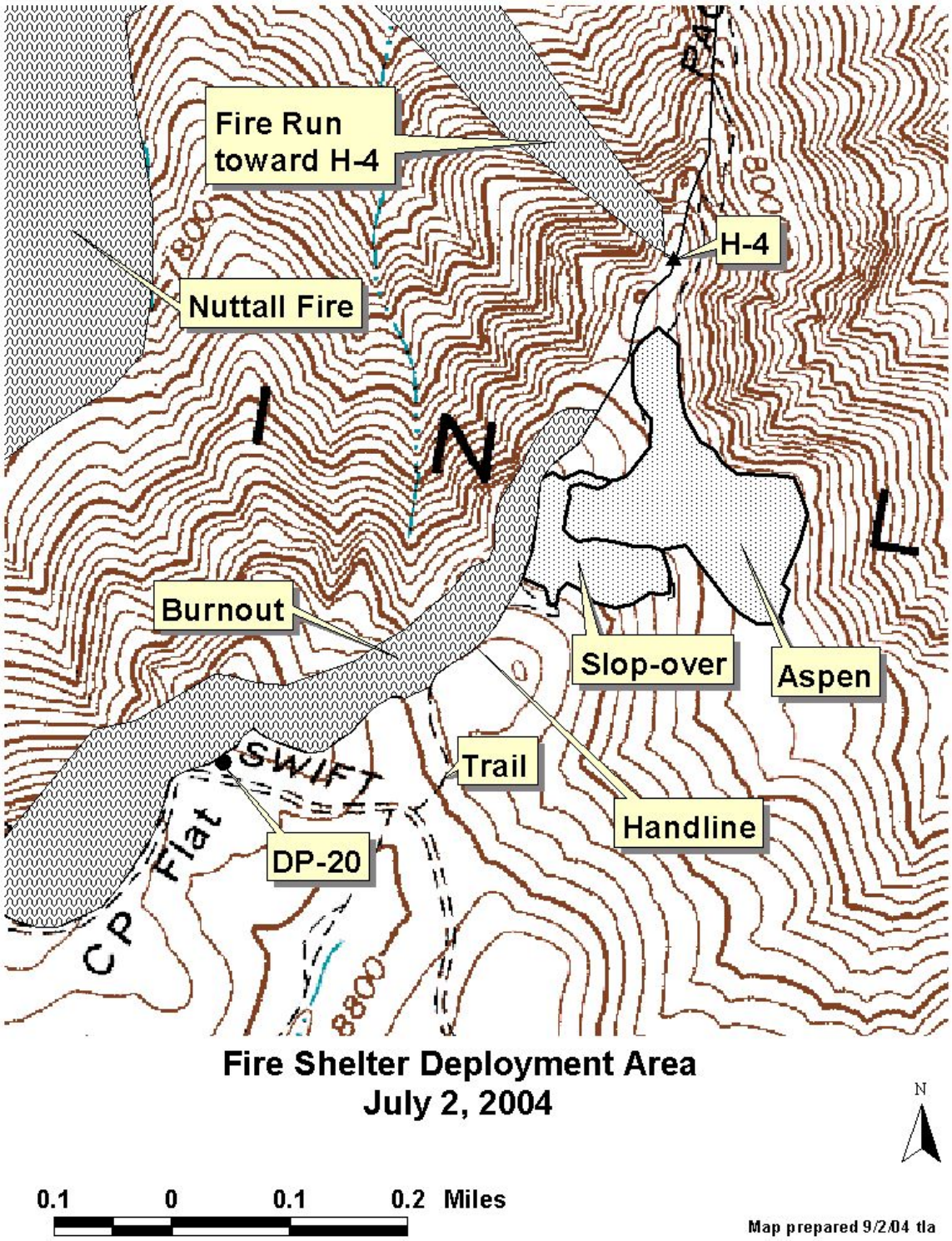
On July 17, the team visited the deployment site with personnel who were assigned to the Nuttall Complex at the time of deployment.



Map 1. General Location of Nuttall Complex



Map 2. Deployment area in Division E on Nuttall Fire (See Map 3 for detailed view of area shown in box above.)



Map 3. Detailed view of fire shelter deployment area in Division E (Fire and burnout perimeters are approximate.)

Incident Chronology

All times are approximate and based on witness interviews and daily logs. The numbers assigned to crews, squads and individuals are for this report and do not reflect actual crew designations.

On the morning of July 2, 2004, the Division E Supervisor was briefed on a five-acre slop-over discovered by the infrared flights. Three hotshot crews (IHCs), a Safety Officer, and two EMTs (Emergency Medical Technicians) were assigned to the Firing Group and working on Division E. The Division E Supervisor and Division E EMTs were also present, and another hotshot crew and portions of the Structure Protection Group were temporarily reassigned to Division E to assist in lining the slop-over and installing a hoselay.

July 2, 2004:

0600—IHC #1 is in service at Columbine spike camp.

0630—IHC #1 arrives at the "shortcut" parking area.

0635—IHC #1 Asst. walks down to scout the slop-over from the previous night's burnout.

0700—IHC #1 Asst. walks to the knob above H-4 to check out the slop-over. He identifies the knob as a good lookout (LO) point. He updates Air Attack on his size-up of the slop-over and requests two additional crews and heavy helicopters for work on the slop-over. IHC #1 Squad Bosses advise IHC #1 Asst. that they are not comfortable with coming down to the knob. They assess the previous night's burnout as being inadequate as a safety zone. They cite the lack of adequate escape routes and safety zones in the immediate area of the slop-over. These Squad Bosses return their crew to the "shortcut" parking area.

0745—IHC #1 Superintendent arrives at the "shortcut" parking area.

0750—IHC #1 Asst. returns to the "shortcut" parking area.

0810—

- IHC #1 Superintendent, IHC #1 Asst., and IHC #1 Crew Boss Trainee go to the slop-over area for further size-up. They scout the top end with IHC #4 overhead. H-4 is inspected as a safety zone. IHC #4 determines that they are comfortable with anchoring in at the Main Hand-Line (MHL) and cutting a line around the top toward the bottom.
- At DP-20, recognizing a relative fitness issue, the Firing Group Supervisor directs Firing Group EMTs to stay close to DP-20. (Time is an estimate.)

0825—Firing Group Supervisor arrives. IHC #1 Superintendent goes to the knob as LO. The crew comes down to the aspen grove to begin building line around the bottom of the slop-over with IHC #2. IHC #2 Superintendent moves to the knob as LO.

0830—IHCs #1, #2, and #4 begin building line around the slop-over.

1015—IHC #3 bumps around the bottom and begins hand-line up west flank toward IHC #4.

1030—Tie in bottom of Slop-over Hand Line (SHL). IHCs #1 and #2 begin improving and securing bottom of SHL.

1120—IHC #1 eats lunch.

1200—Fire behavior increases in Nuttall Canyon. IHC #1 Squad #1 arrives at buggies, eats lunch, and gathers firing equipment for a firing operation on MHL.

1210—IHC #1 Asst. is at the LO position above the saddle on south side.

1215—

- IHC #1 burns an indirect piece of SHL in the aspen grove.
- IHC #1 Squad #1 arrives at the knob with burning equipment and ties in with IHC #1 Superintendent. Column leans to the east toward MHL.

1220—IHC #1 Superintendent requests a saw team to H-4 to start preparing the helispot for burnout.

1230—IHC #1 Asst. reports a downhill crown fire approximately 200-300 yards long. Downhill run places the fire on the east side of Nuttall Canyon. IHC #1 Superintendent moves to the H-4 LO position to see directly below H-4 and the knob.

1240—

- Division E Supervisor directs Division E EMTs to accompany himself and Safety Officer down to H-4. (Time is an estimate.)
- Structure protection resources, deployed to install hoselay, have left the area. (Time is an estimate.)

1250—IHC #1 saw team arrives at H-4 to improve the helispot for burning. IHC #1 Superintendent calls Firing Group Supervisor and advises that H-4 needs to be fired on the west side above Nuttall Canyon. Firing begins shortly after the communication.

1300—IHC #1 Squad Boss #1 arrives at H-4.

1310-1315—

- IHC #1 requests to burn MHL. IHC #1 Superintendent calls IHC #4 to confirm their escape route.
- Safety Officer, two Division E EMTs, Division E Supervisor, and IHC #5 Superintendent arrive at H-4 from the knob. Firing Group Supervisor orders IHC #4 out to the “shortcut” parking area and contacts IHC #3 with the same order. He also recognizes the escape route timing issues presented by Div E EMTs.
- IHC #1 Squad #1 begins lighting off of helispot. The IHC #1 saw team begins clearing heavy fuels from H-4. IHC #3 Superintendent begins a hike out from the knob. IHC #1 Asst. advises IHC #1 Superintendent that the crew is ready to burn MHL. IHC #1 Superintendent calls and advises not to burn and for the crew to escape directly to H-4. IHC #1 moves into the saddle and on the south slope of the knob toward H-4. IHC #2 is on the slope south of the saddle moving into the saddle. The fire run tops the knob and cuts IHC #1 off from H-4 on the slope above the saddle.
- IHC #1 Superintendent starts on the trail around back of the knob to the saddle and calls IHC #1 Asst. to go to the trail. IHC #1 Asst. replies that he does not know where the trail is, and the crew is headed up. Firing Group Supervisor departs H-4 on the trail to the aspen grove to look for IHC #2.

1320—Firing Group Supervisor arrives at the aspen grove. IHC #1 reverses tool order through the saddle toward the SHL. IHC #1 Asst. tells the crew to drop gear if necessary. IHC #1 Crewmember #2 leads crew into aspen grove to SHL.

- IHC #1 Superintendent arrives in the saddle. He tells IHC #1 Asst. to continue to the aspen grove. IHC #1 Superintendent returns to the trail and meets Firing Group Supervisor en route to the aspen grove to find IHC #2. IHC #1 Superintendent notes a half-dozen spots around the trail between the saddle and trail.
- IHC #1 Squad Boss #2 informs IHC #1 Superintendent that the crew is hiking to the top. The route is SHL through the aspen grove to the "shortcut" parking area.
- IHC #1 Crew Boss Trainee begins to deteriorate physically.
- IHC #2 crewmembers carry IHC #1 Crew Boss Trainee into aspen grove.
- Fire whirl crosses H-4.
- Crew EMTs from IHCs #1 and #2 begin to assess and treat IHC #1 Crew Boss Trainee.
- H-4 personnel begin preparing deployment site on helispot.

1325—H-4 personnel deploy shelters to escape smoke and ember wash. Personnel are in shelters approximately fifteen minutes. Eleven of the twelve personnel at the site deploy. IHC #1 Superintendent notifies Air Attack that eleven personnel at H-4 have deployed shelters for environmental (smoke and embers) safety.

1330— Firing Group Supervisor checks route back to H-4, and, after deciding it is not safe enough, instructs crews to proceed to the aspen. IHCs #1 and #2 begin preparing Deployment Zone (DZ) in aspen grove.

1340—IHC #2 Superintendent begins directing air drops around DZ. IHC #1 Asst. begins burnout around DZ at the lower end of the aspen grove (the upper end was already blackened by the slop-over fire). Firing Group Supervisor arrives in aspen grove from H-4 and contacts Operations to advise of the situation. IHC #3 Superintendent arrives in the aspen grove.

1400—H-4 personnel fold shelters and move approximately 30 feet to sling site and fresh air. Personnel use cubies to extinguish the sling load.

1430—H-4 personnel secure the deployment site for investigation. IHC #1 Superintendent notifies Safety Officer at DP-20 of the deployment. Firing Group Supervisor walks to H-4 on MHL and returns on MHL to the aspen grove with Division E EMTs. IHC #4 Superintendent and saw team arrive at the aspen grove after cutting trail down from the top. IHC #1 Asst. walks the trail to the east of MHL to H-4 and ties in with IHC #1 Superintendent.

1530—Division E EMTs arrive in the aspen grove to start treating IHC #1 Crew Boss Trainee. IVs and oxygen are administered.

1610—Trail is opened up between aspen grove and H-4 by saw teams from IHCs #2 and #4.

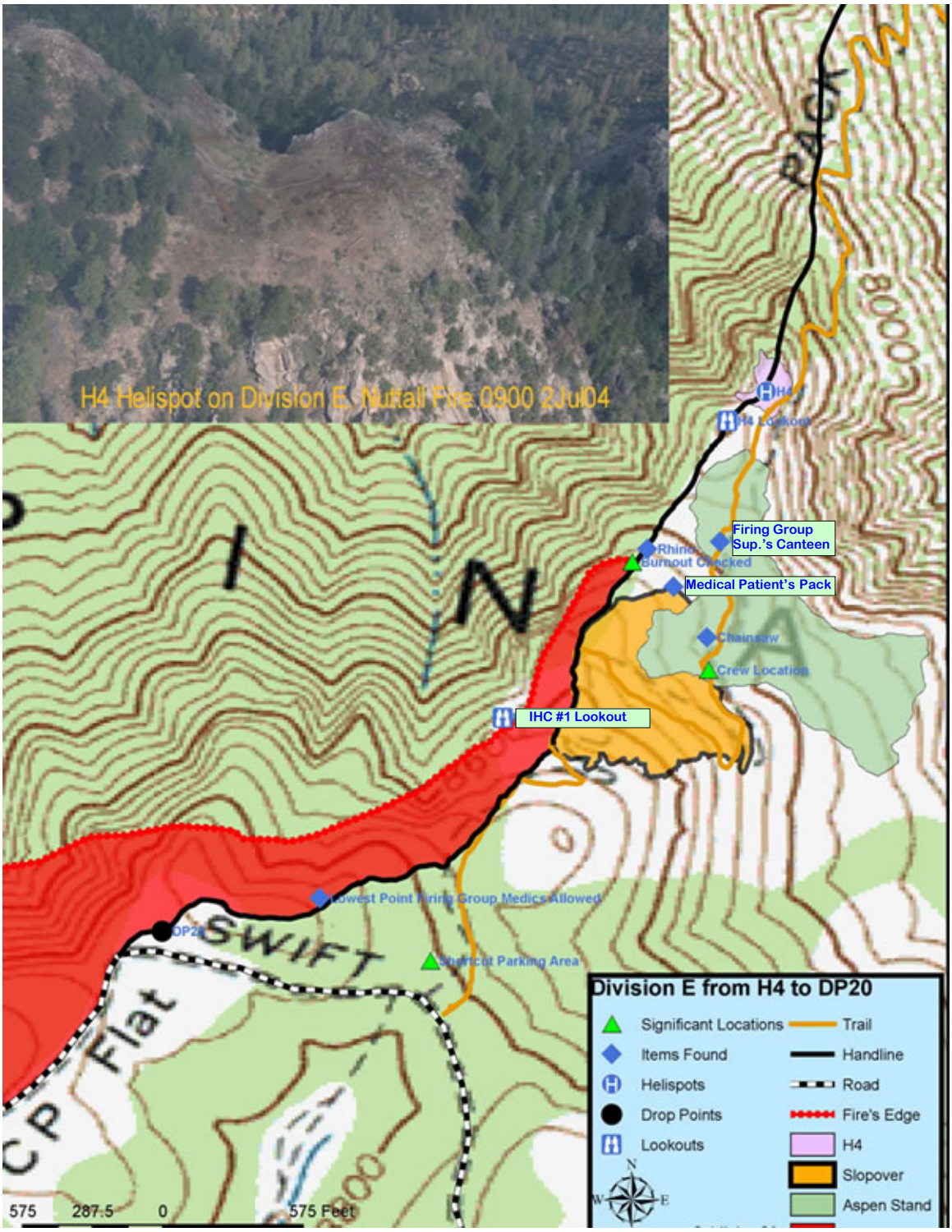
1630—H-4 personnel arrive at the aspen grove. IHC #1 Crew Boss Trainee is attached to a backboard and is prepared for extraction.

1645—All personnel leave the aspen grove.

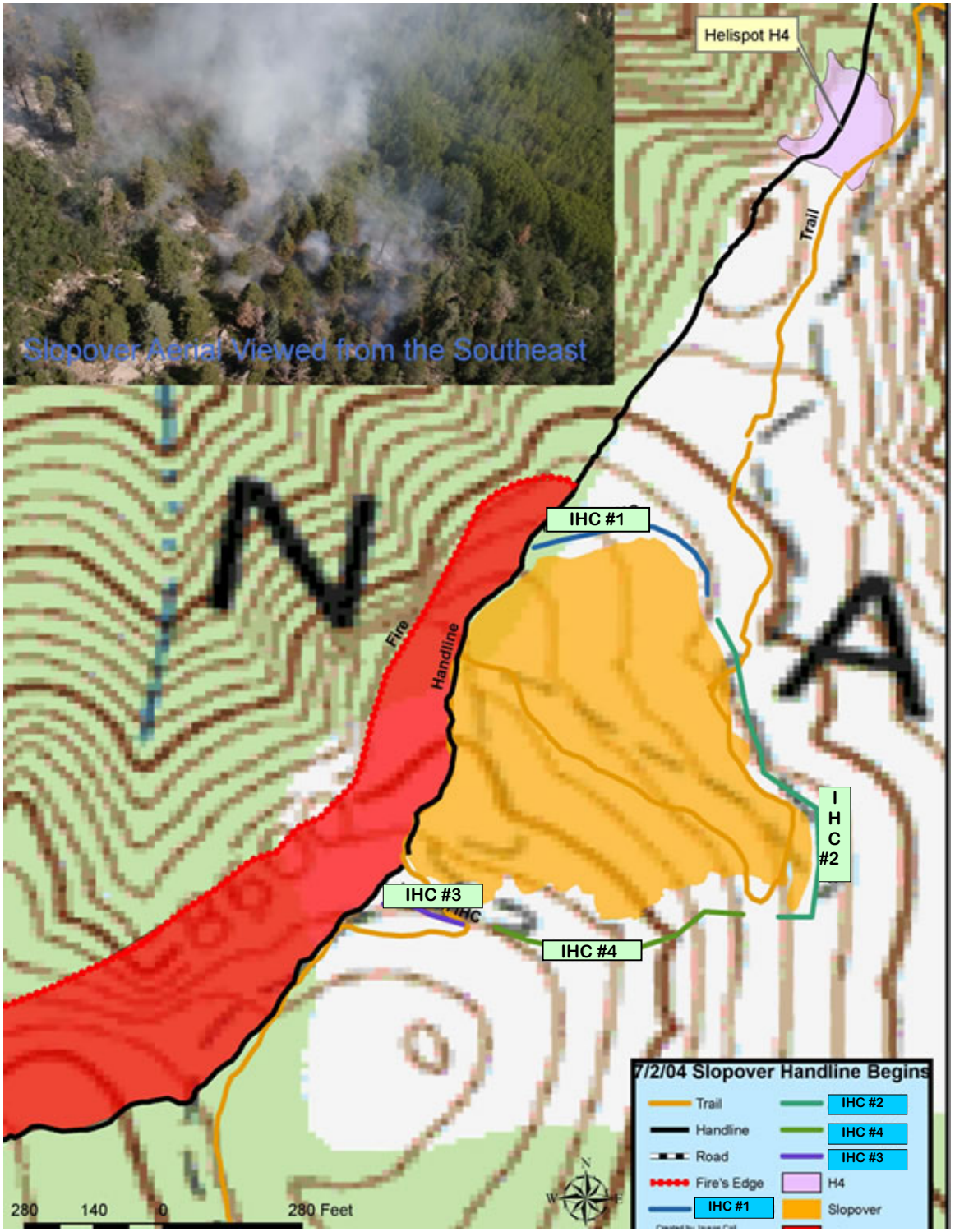
1730 plus—All personnel from H-4 and the aspen grove arrive at the "shortcut" parking area. IHC #1 has a brief meeting about the personal condition of each individual. The crew begins making phone calls to family. Division and Firing Group overhead meet to update Operations and confirm meetings with Team overhead. Crews are notified of hotel rooms and general arrangements.

2000—IHC #1 Superintendent and Asst. meet briefly with IC and Operations to plan meetings for the next morning.

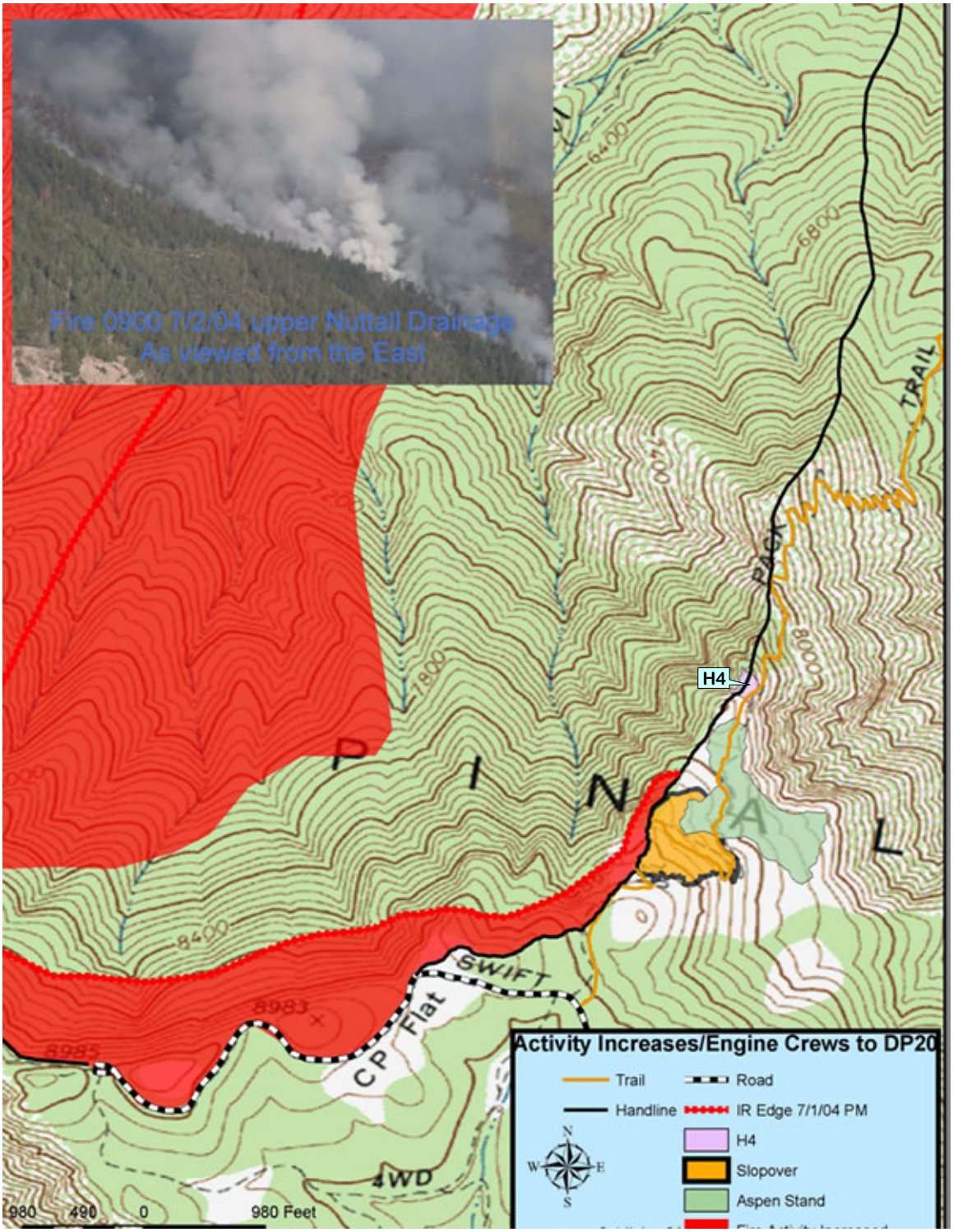
Incident Progression Maps



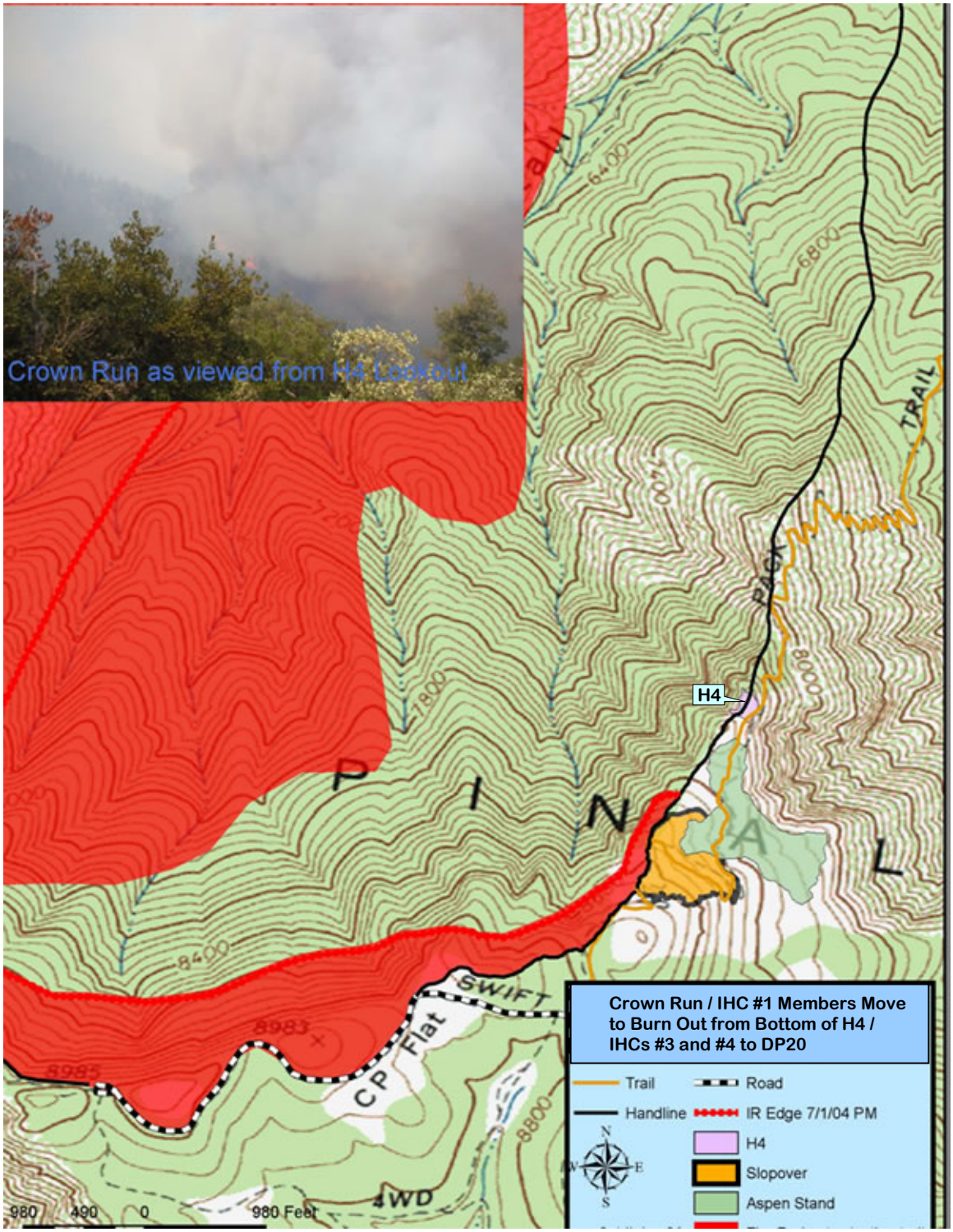
Progression Map 1. Division E from Helispot 4 to Drop Point 20



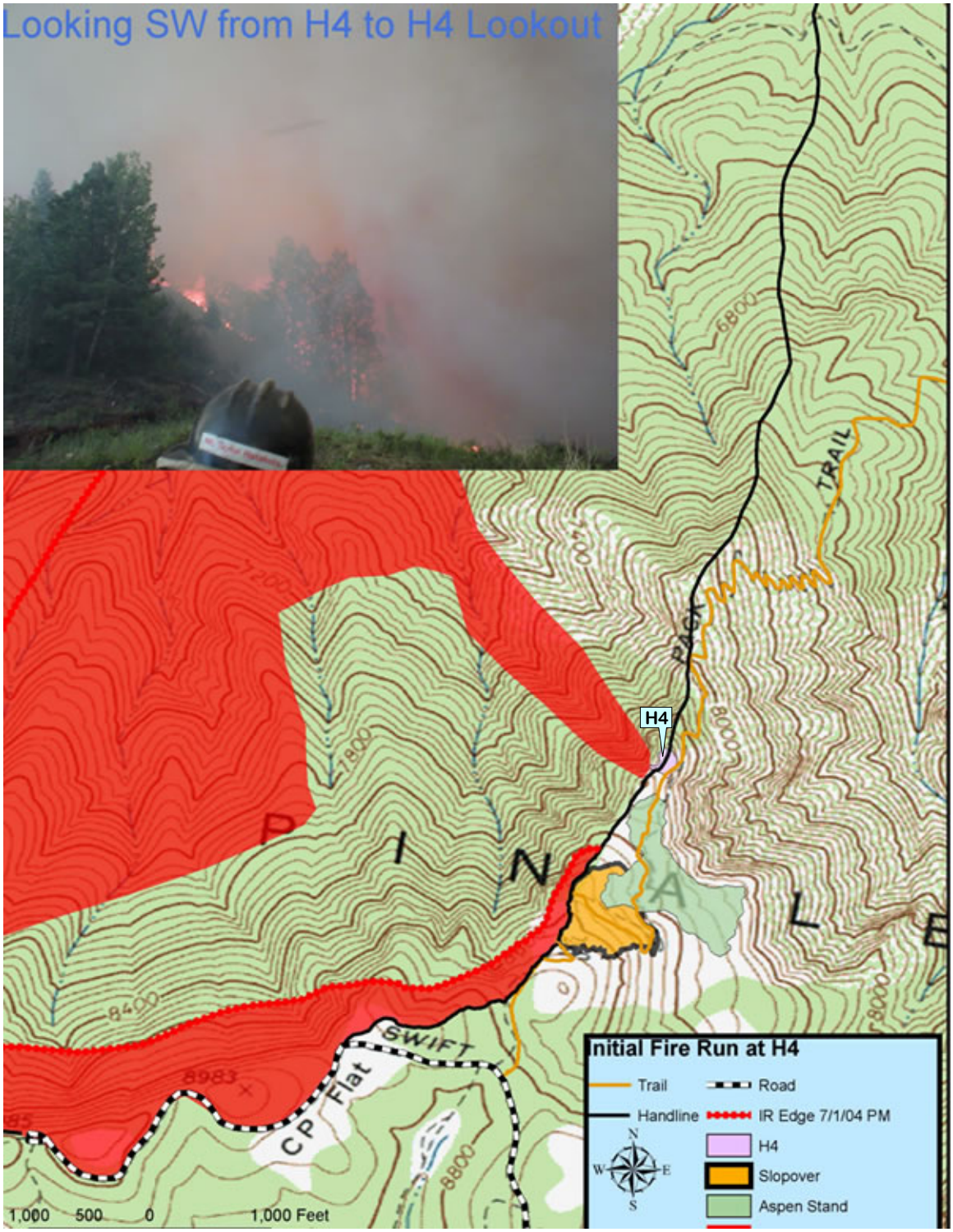
Progression Map 2. Crew Locations on Slop-over



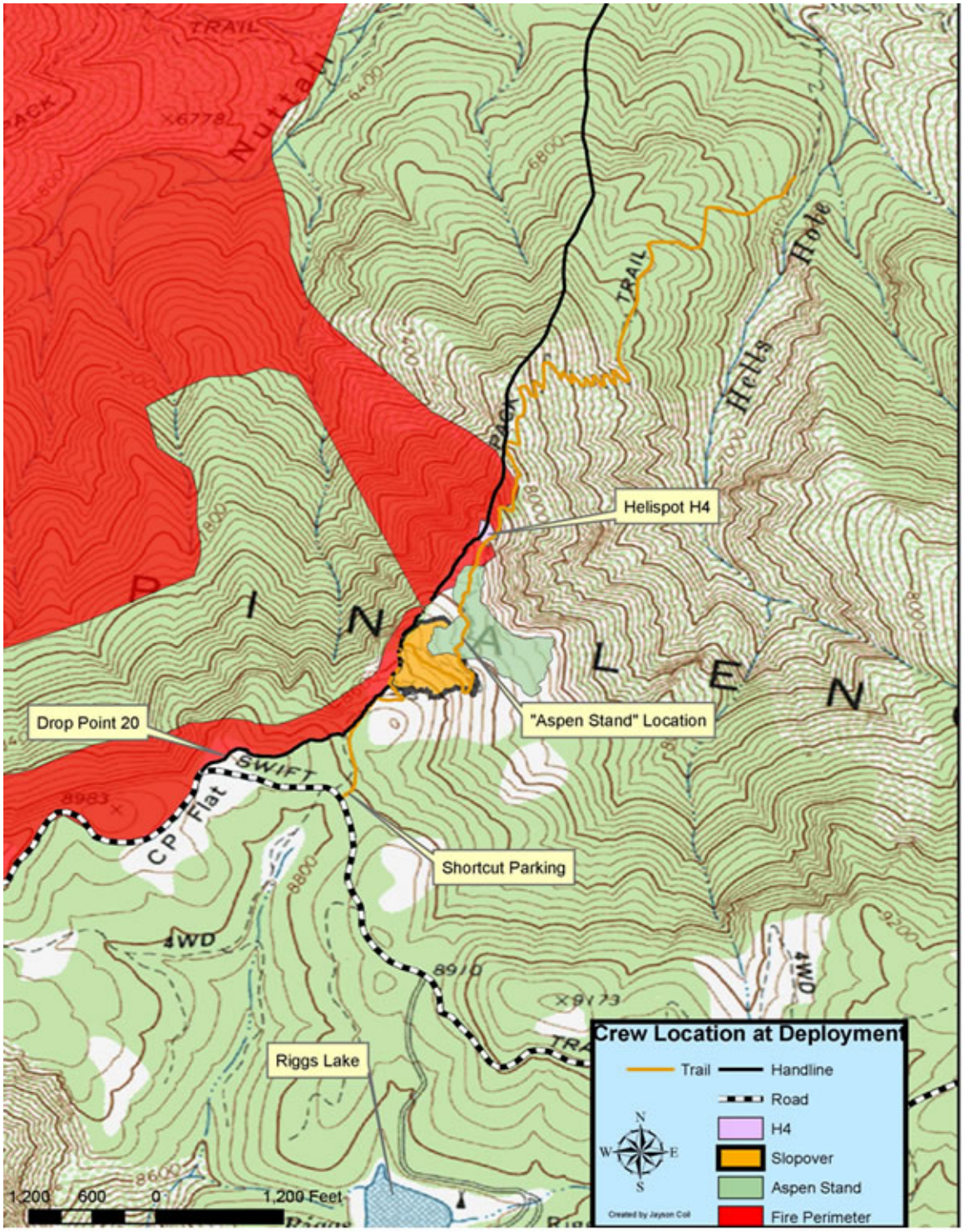
Progression Map 3. Increase in Fire Activity



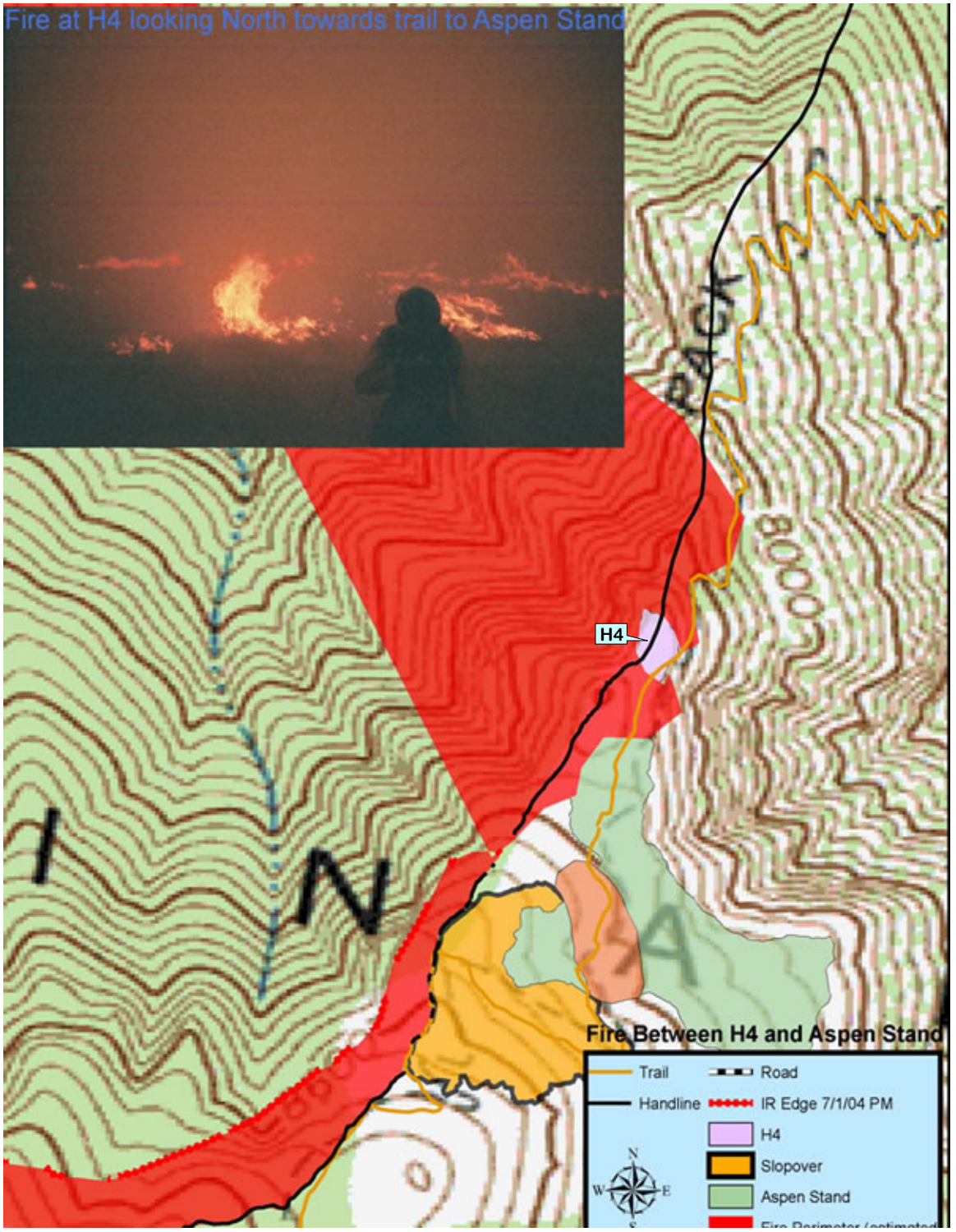
Progression Map 4. Crown Run and Movement of IHCs #1, #3, and #4



Progression Map 5. Initial Run of Nuttall Fire toward Helispot 4



Progression Map 6. Locations of Helispot 4, aspen grove, shortcut parking, and Drop Point 20



Progression Map 7. Fire between Helispot 4 and aspen grove

Helispot 4

Helispot 4

Helispot 4 after deployment

Findings

The investigation team used a matrix to determine the degree to which various elements contributed to the decision to deploy fire shelters. It is important to remember that this is not a tragedy, and the decision to deploy is a positive decision. Further discussion relating to the investigation team's conclusions may be found in the narrative following the matrix.

The team used the elements to describe the positive and negative conditions and events leading to the deployment decision.

Deployment Investigation Elements

	Did not contribute	Influenced	Significant contribution
Fire Behavior			
Fuels			X
Weather			X
Topography			X
Predicted *vs.* observed	X		
Other (drought)		X	
Environmental Factors			
Smoke, temperature, embers			X
Slope			X
Visibility		X	
Incident Management			
Incident objectives	X		
Strategy	X		
Tactics		X	
Safety briefings/major concerns			X
Instructions given			X
Control Mechanisms			
Span of control		X	
Communications		X	
Ongoing evaluations			X
Ten Standard Fire Orders/18 Watchout Situations, and LCES			X
Personnel Profiles of Those Involved			
Training/qualifications/physical fitness			X
Length of operational period/fatigue	X		
Attitudes			X
Leadership			X
Experience levels			X
Equipment			
Availability	X		
Performance/non-performance	X		
Used for intended purpose		X	
Other			

Fire Behavior—

- Fuels: The crews were experienced in fighting fires in these fuel types. Fire behavior was monitored by lookouts and supervisors; however, fire severity conditions were underestimated.

- Weather: Weather was hot and dry. Firefighters used the Haines Index to understand the potential for increased wildfire growth. The Haines Index at the time was 5, transitioning to 6, or moderate transitioning to high potential for increased fire activity.

- Topography: Steep and rocky terrain contributed to the increase in fire behavior.

- Predicted *vs*. observed fire behavior: The fire behavior discussion in the IAP says that the "fire behavior has been less than expected" in the higher elevation mixed conifers and says to "expect the same activity today…" While the discussion includes slope and wind alignment, the prediction of three to five chains per hour was exceeded. The decision to deploy was related to smoke and control of the personnel, and not to heat from the fire's run.

- Other (Drought): The ongoing drought conditions contributed to increased tree mortality from insect infestation. The increase in dead fuels influenced fire behavior but was not a significant contributor to the decision to deploy.

Environmental Factors—

- Smoke, temperature, embers: The deteriorating air quality, primarily due to smoke and embers, was a significant factor in the deployment. Radiant heat, which had passed by the time of deployment, was not the primary concern of the firefighters.

- Slope: The steep slopes and rocky terrain greatly reduced the options for escape routes and safety zones.

- Visibility: As the fire activity increased in Nuttall Canyon, the smoke restricted full visibility of the fire activity and, therefore, influenced the decision to deploy.

Incident Management—

- Incident objectives: The incident objectives were clear and followed. They did not contribute.

- Strategy: The suppression strategies were followed. They did not contribute.

- Tactics: The need for and placement of EMTs varied. One team was ordered to wait fairly close to DP-20, while the other team was sent down the ridge to H-4. This reveals a seemingly minor communication error, but it affected options later on.

- Safety briefings: This element is rated for significant contribution with positive and negative results. The IHCs had excellent briefings and understood the fire behavior and risks involved. The EMTs were not as prepared. They did not have LCES briefings, nor did they understand the difficulty of carrying heavy packs in steep terrain.

- Instructions given: Overall, the instructions given to crews significantly contributed to the safe outcome of the deployment. Two points are worth noting: 1. The instructions to the EMTs were different and led to one team moving to a location close to DP-20 and the other team

going to H-4. 2. As it was not considered a primary or even secondary safety zone, the use of the aspen grove was not well communicated to all crews.

Control Mechanisms—

- Span of control: Overall, the span of control was adequate and contributed to the safe outcome for firefighters. As noted above in "Instructions given," the instructions to the EMTs came from the Firing Group Supervisor and the Division Group Supervisor. The IAP was not clear as to the hierarchy of supervision between the two.

- Communications: Communications between line personnel were good. Radio discipline and protocols for radio use need improvement. IHCs had their own frequencies, which led to effective group communications.

- Ongoing evaluations: The crews were constantly watching weather conditions and fire behavior, and reviewing and changing tactics and strategies. The crews were experienced, and their situational awareness and decision-making were significant to the safe outcome. The Incident Meteorologist also contributed to the situational awareness.

- Ten Standard Fire Orders/18 Watchout Situations and LCES: The application of all three of these was significant to the safe outcome.

Personnel Profiles of Those Involved—

- Training/qualifications/physical fitness: The IHCs and line supervisors were well qualified for and physically capable of the tasks. The physical fitness of the EMTs, who arrived at a critical moment, was not at the same level as the IHC firefighters the escape route was designed for.

- Length of operational period/fatigue: Work/rest policies were followed.

- Attitudes: Crews were mission-driven and focused on safety.

- Leadership: The Firing Group Supervisor, Division Group Supervisor and IHC superintendents were key in maintaining team unity and keeping everyone informed. IHC #1 Superintendent and Safety Officer were instrumental in keeping the deployed firefighters and EMTs calm. Safety zones and escape routes were carefully monitored. The important lesson is not the fitness of the EMTs; they met all applicable fitness standards. What is important is that the Firing Group Supervisor and others carefully monitored critical escape route elements.

- Experience levels: The experience of the IHCs was good. The inexperience of the EMTs was an element leading to the shelter deployment.

Equipment—

- Availability: Air attack had to share support with the nearby Gibson Fire as well as the Nuttall Fire.

- Performance/non-performance: This element did not apply to the event.

- Used for intended purpose: The deployed shelters were used to shield the firefighters from embers and to provide respiratory protection from the smoke. The shelters were not needed to protect the firefighters from radiant heat.

Management Evaluation Report

Introduction

There were no serious injuries. Early reports, beginning with radio transmissions from the line preceding the deployment, indicated that this was a precautionary use of the fire shelter. This action provided improved breathing air and had a calming effect on firefighters and support personnel. There was some question regarding whether an investigation was warranted, which led to delays in initiating the investigation team. In hindsight, the event provides an outstanding opportunity to study complex suppression strategies, with application all the way back to initial attack firefighters in similar terrain. The event also shook people up emotionally, reinforcing the implications of actually riding out extreme fire behavior in a properly identified safety zone.

This report is not an investigation of an injury or fatality, but instead discusses a carefully managed close call, where the best and most experienced underestimated fire behavior.

Causes and Contributing Factors

A primary or probable cause of a fire shelter deployment is the direct agent that starts or sustains an incident. A contributing factor influences or contributes to the cause of the shelter deployment. The following causes and contributing factors have been built from the findings presented in the factual report.

Probable cause for the close call:

Under-predicting the fire behavior is a big lesson here. Fire behavior predictions were reduced from previous days. Seasoned hotshot superintendents, division and group supervisors, operations section chiefs, and a safety officer all evaluated the assignment and underestimated the fire behavior. For example, a fire run blocked a previously identified escape route from the slop-over fire to the safety zone at H-4, and from H-4 up the ridge and out to the vehicles. This points to the fact that everything we know about fire behavior is based on last year's and earlier years' experience. Changing fuels and continuing drought are making that collective knowledge obsolete.

Probable cause for the success:

No firefighters remained committed without quality safety zones, timed escape routes, adequate communications, and good lookouts. Throughout the operational period, people re-evaluated, considered the capabilities of resources on scene, and discussed new or changing options. They established and monitored trigger points. We do not know what would have happened if the aspen grove secondary safety zone had not been present. It is possible that the ill firefighter and the 1¾ hotshot crews would have exited the area in a heroic charge; however, the plan proved resilient, and the previously discussed aspen proved adequate when pressed into service.

Factors contributing to the close call:

Besides the surprising fire behavior, events making this more complicated include the following:

- A failure of one supervisor to communicate orders that affected another supervisor. This involved a medical team ordered down the ridge to H-4. As the medical personnel were not well conditioned for rugged country, this altered the escape route options.

- A medical emergency during the critical period.

- Standard mitigations (LCES) were not identified for the helitack personnel deployed to H-6 before they exited the helicopter.

Factors contributing to the success:

- LCES was carefully managed. There are several findings reinforcing the fact that firefighters would not have been committed without quality lookouts, communications, escape routes, and safety zones.

- Alternate safety zones were discussed. Recognized as not being "certifiable" due to the inability to accurately predict the aspen crown's resistance to carrying a flame front, a correct last-minute judgment call led to the use of this successful refuge.

- With the superintendent at H-4, the assistant nearby as LO, and the senior firefighter Trainee Crew Boss experiencing a medical emergency, the moments when the plan quickly changed from retreat to the vehicles to taking refuge in the aspen grove and treating the patient, while urgent, remained well supervised and orderly.

- Supervisors ordered and oversaw the improvement of the H-4 safety zone. This appropriate use of discretionary time expanded the safety margin.

- Supervisors recognized and addressed the stressful discomfort experienced by support personnel.

- Changing conditions within the air mass, fuels, and fire behavior were simultaneously being monitored and communicated by lookouts and supervisors on site and by the Incident Meteorologist at the Incident Command Post in Safford.

- H-6 Helitack, Air Attack, and Operations Trainee recognized the lack of standard mitigations and took immediate action to rectify the situation.

- The "Social Engineering" efforts, including the leadership curriculum, entrapment avoidance, and study of standard mitigations, all came together on Nuttall.

Recommendations

This event has proven to be an excellent sand-table exercise, examining how strategy and tactics can be carefully guided by proven mitigations. Initial attack firefighters may at first wonder what a Type 1 incident with a full command and general staff has to do with their lonely ridge-top IA fire; however, a little explanation opens their eyes to the fact that the five-acre slop-over on Nuttall

equates to a typical Type 4 or 5 fire, and the major burning happening across Nuttall Creek is no more dangerous than an undetected lightning fire, or an ember, below them in the canyon. The risks and mitigations are the same.

Incident Management Teams and local fire managers must be careful to avoid situations with overlapping responsibilities. For example, if the IAP specified that the Firing Group Supervisor was to become subordinate to each Division Supervisor as they progressed around the fire, the check-in and briefing process should have led to a consistent plan for medical personnel.

Support Personnel must have standard mitigations identified before deployment. In this case, the aviation staff, particularly helicopter, must be well integrated into the operations planning and ensure safe assignments for all.

Firefighters must be confident in their aggressive, safe firefighting. Distribution of this report, and posting at Lessons Learned, will add a positive fire operations vision, with positive outcome, in firefighters' minds.

Forest officials and seasoned firefighters involved with this incident all made the point that firefighters must not be reluctant to use the fire shelter or be intimidated about using it. They all said that a stigma currently is associated with fire shelter deployment. We must work past that stigma. With rare exception, injuries and fatalities occur when firefighters have delayed in preparing and deploying shelters. The culture claims that serious 10-and-18 or LCES mistakes have been made if anyone needs to use a shelter. This is a case where that is not true.

Mobilization of an appropriate investigation or fact-finding team should be prompt. While there was some question whether a full investigation for a precautionary fire shelter deployment is appropriate, there is no doubt that firefighters went through a distressing event. Choosing noteworthy events for study, regardless of outcome, will add case studies of real fire operations, with both positive and negative elements.

The professional manner in which this difficult operation was managed, and the outstanding performance by individuals during challenging events, suggests that recognition of key players is appropriate.

Appendix A – 10 Standard Fire Orders, 18 Watchout Situations, & LCES

10 Standard Fire Orders

FIRE BEHAVIOR

1. Keep informed on fire weather conditions and forecasts.

Weather conditions were recognized, and forecasts were provided at all briefings.

2. Know what your fire is doing at all times.

Briefings were good, as were communications between divisions, aviation resources and subordinates. Lookouts, who had a view of the fire, the job site, the escape routes and safety zones, kept all personnel informed.

3. Base all actions on current and expected behavior of the fire.

All actions were consistent with forecasted weather and fire behavior.

FIRELINE SAFETY

4. Identify escape routes and safety zones, and make them known.

Safety zones and escape routes were established and known to Division E, Firing Group, and Structure Protection Group personnel.

5. Post lookouts when there is possible danger.

Interviews indicated that at least seven lookouts were established throughout Division E when all resources were assigned.

6. Be alert. Keep calm. Think clearly. Act decisively.

All personnel in leadership positions were alert, calm, thinking clearly and acting decisively. The IHC #1 Superintendent acted decisively when he told the crewmembers to stay calm, stay in the safety zone, and deploy shelters as a precautionary measure.

ORGANIZATIONAL CONTROL

7. Maintain prompt communications with your forces, your supervisor and adjoining forces.

According to some of the interviews, there was a need for the hotshot crews to use their own intra-crew communications during the deployment, which mitigated the over-use and out-of-

control radio discipline observed during and just before the deployment. Up to that time, communications with crewmembers, supervisors, and adjoining forces were very good. The IHC #1 Superintendent took leadership and control of those at H-4 during the deployment. The Division E Supervisor, Firing Group Supervisor, and Structure Protection Group Supervisor all agreed to take control in communications for the other incidents within the incident.

One supervisor did not communicate orders that affected another supervisor. This led to the EMTs going to H-4.

8. Give clear instructions and insure they are understood.

There were good communications between the Division E Supervisor, the Structure Protection Group Supervisor, the Firing Group Supervisor, and all crew bosses. Instructions were clear and understood. During interviews and After Action Reviews, some supervisors indicated that they will give instructions more effectively in the future.

9. Maintain control of your forces at all times.

All crews and supervisors maintained good control of their forces.

10. Fight fire aggressively, having provided for safety first.

Fire was being aggressively fought. There is every indication that resources would not have stayed on site if mitigations were not possible.

18 Watchout Situations

1. Fire not scouted and sized up.

Fire was scouted and sized up.

2. In country not seen in daylight.

Resources assigned to Division E had been working for three consecutive day operational periods.

3. Safety zones and escape routes not identified.

Safety zones and escape routes were identified.

4. Unfamiliar with weather and local factors influencing fire behavior.

According to the interviews, briefings provided by the meteorologist and the fire behavior analyst were tracked; however, they under-predicted what actually happened on the ground.

5. Uninformed on strategy, tactics, and hazards.

Interviews indicated strongly that strategy, tactics and hazards were well communicated and in a constant state of re-evaluation. A very few individuals may not have gotten all the information.

6. Instructions and assignments not clear.

Division and group supervisors' communications were often indirect and relayed through the other crew bosses. Follow-up on communications was made to insure that instructions were understood.

7. No communication link with crewmembers or supervisor.

The communications links were there. However, when radio traffic discipline was compromised, the hotshot crews used their own tactical frequencies to mitigate this compromise in Division E.

8. Constructing line without safe anchor point.

Mitigated with escape routes and safety zones. Original mitigation of "bringing black" was recognized as inadequate.

9. Building fireline downhill with fire below.

This was indirect fireline construction, followed by a firing operation. The main fire progression was stationary until the day the weather changed with the Haines Index going to 6, which was a direct cause of the fire run to DP-20 and H-4.

10. Attempting frontal assault on fire.

Not applicable.

11. Unburned fuel between you and fire.

This watchout situation existed, but was mitigated by the identification of safety zones, escape routes, and the creation of further unburned area between the crews and the main fire by the firing operation that had been completed prior to the precautionary deployment.

12. Cannot see main fire; not in contact with someone who can.

According to the interviews, not all personnel could see the main fire, but this was mitigated with a minimum of seven lookouts relaying information to the crews.

13. On a hillside where rolling material can ignite fuel below.

Not applicable. The first strategy and tactic were changed to avoid hillside where rolling material could ignite fuel below.

14. Weather becoming hotter and drier.

The weather changed, and the Haines Index changed from 5 to 6. Personnel recognized a limited chance of success with the tactic of continued burning and relied on mitigation by re-establishing and re-evaluating safety zones, escape routes, strategy and tactics.

15. Wind increases and/or changes direction.

Several interviews indicated that, at the time the main fire crossed the Nuttall Creek trigger point (the confluence of Nuttall Creek and Carter Canyon), or just shortly thereafter, wind changes were observed. The main fire influenced the burnout operation and caused unusually high winds and downhill runs.

16. Getting frequent spot fires across line.

Active fire behavior continued throughout the night before the deployment. That evening, frequent spot fires occurred, causing the slop-over that was discovered on the morning of July 2.

17. Terrain and fuels make escape to safety zones difficult.

Although terrain was steep and rocky, relatively easy access to escape routes and safety zones was established.

18. Taking a nap near fireline.

Not applicable.

LCES Checklist

LCES must be established and known to ALL firefighters BEFORE needed.

---------- Lookout(s) ----------

Experienced/Competent/Trusted	**YES, formal lookouts were posted**
Enough lookouts at good vantage points	**YES, at seven key locations**
Knowledge of crew locations	**YES, crew locations identified**
Knowledge of escape and safety locations	**YES, identified and known**
Knowledge of trigger points	**YES, identified and known**
Map/Weather Kit/Watch/IAP	**YES, all available and used**

---------- Communication(s) ----------

Radio frequencies confirmed	**YES, established and confirmed**
Backup procedures and check-in times established	**YES, established and confirmed**
Provide updates on any situation change	**YES, updates constantly given**
Sound alarm early, not late	**YES, identified with trigger points**

---------- Escape Route(s) ----------

More than one escape route	**YES, more than one established**
Avoid steep uphill escape routes	**YES, well-defined and accessible. One escape route was uphill but timed by line supervisors**
Scouted: Loose soils/Rocks/Vegetation	**YES, well scouted and clean trail**
Timed: Slowest person/Fatigue & Temperature factors	**YES, identified**
Marked: Flagged for day or night (NFES 0566)	**YES, flagged**
Evaluate: Escape time *vs*. Rate of spread	**YES, thought out for *predicted* rate of spread**
Vehicles parked for escape	**YES, in adequate and safe location**

---------- Safety Zone(s) ----------

Survivable without a fire shelter	**YES**
Back into clean burn	**NO, and mitigated by escape routes to vehicles, H-4 and aspen grove**
Natural Features: Rock Areas/Water/Meadows	**YES, planned and used**
Constructed Sites: Clearcuts/Roads/Helispots	**YES, planned and used**
Scouted for size and hazards	**YES, identified**

Upslope?
Downwind? → More heat impact → Larger safety zone
Heavy Fuels?

Escape time and safety zone size requirements will change as fire behavior changes.

Source: Incident Response Pocket Guide, January 2004, p. 6

Appendix B – Fire Behavior Report

NUTTALL COMPLEX
Nuttall Fire – Coronado National Forest, Safford Ranger District
Shelter Deployment Fire Behavior

I am Pat Velasco, the Fire Behavior Analyst on the New Mexico Type II Incident Management Team. This team has been managing the fire since July 14, 2004, to present.

On July 16, 2004, I was asked by Paul Chamberlin, who is leading the Nuttall deployment investigation, to assist as a local Fire Behavior Analyst.

On July 17, 2004, I met with the team and several of the individuals involved in the deployment. We met at Drop Point 20 (DP-20) and proceeded to the deployment.

The following is my Fire Behavior Report.

July 1 and July 2, 2004

Fire Danger: The combination of consistently low relative humidities (11%), low night humidities (low 11%, highest 28%), little recovery from the extended drought (1996 to present), and fuel conditions (extremely low moisture content of both the live and dead fuels) created extraordinary circumstances for Extreme Fire behavior. Fire Behavior Rating for the area was EXTREME; the Energy Release Component ratings at the Columbine station were at the 90th percentile. ERCs (Energy Release Components) region-wide have exceeded the 2002 historic high levels.

Fuels: The drought state of the fuels prevailed. Primary fuels were Fuel Model 10 (Douglas and white fir, Limber pine) and Fuel Model 5, Chaparral (oak, manzanita, silktassel, etc.) I estimate the following live and dead fuel moistures: 1 hr = 2%; 10 hr = 2-3%, 100-hr = 3-4% and 1000 hr = 5-6%; Douglas and white fire and Limber pine in the 80% range; Chaparral models in the 60 to 75% range.

Topography: The deployment area was Helispot-4 (H-4) on a ridge running north and south. Surroundings are best described as follows: The slopes east and west of the deployment ridge were in excess of 75%. The actual deployment site is level to 10% slope. Elevation 8250'.

Weather Summary: Columbine RAWS Unit, July 2, 2004

Time	Wind Speed (mph)	Wind Direction	Air Temperature °F	Relative Humidity (%)
1100	8	SW	65	11
1200	8	SW	66	13
1300	7	SW	67	17
1400	5	SW	68	14
1500	5	SW	70	12

At 1100, the IMET (Incident Meteorologist) read the following update over the radio: "Humidities will be bottoming out the next couple of hours. Higher ridges 9 to 12 percent and lower elevations (below 5500 ft), 5 to 8 percent. Slow rise in humidities between 1300 and 1500, like yesterday. Low to mid-teens during that time, occurring with increase in cloud cover." He also reported at this time that the Haines Index had changed from 5 to 6, VERY HIGH.

Fire Behavior: The fire behavior had been holding west of Nuttall Canyon on an east-facing slope with Moderate fire behavior for two days. The crews had constructed a fire line on the ridge east of Nuttall Canyon, and had burned down the ridge the night before and stopped for the night.

On July 2, the crews discovered slop-overs on the line and were working to contain the slop-overs. On this day, also at approximately 1300, the weather profile began to change, with higher temperatures and lower relative humidities, and the conditions changed to a Super-High Haines Index rating of 6.

When weather conditions began to change, the fire behavior began to react with those conditions. There was an upslope run toward DP-20 within the bowl. At about this time, I believe the fire began to cross Nuttall Canyon onto the opposite slope and began upslope runs toward the ridgeline where the fire line had been constructed.

The change in Haines Index was the catalyst for 'fuel-driven' combined with 'terrain-driven' fire behavior to cause the extreme fire behavior run causing the shelter deployment by crewmembers on H-4 and forced the crews on the line to utilize the "aspen" safety zone.

/s/ Pat Velasco
FBAN (Fire Behavior Analyst), New Mexico Type II Team
7/18/04

Appendix C – List of Interviewees

IHC #1 Superintendent
IHC #1 Squad Boss
IHC #1 Saw Boss #2
IHC #1 Sawyer
IHC #1 Sawyer
IHC #2 Superintendent
IHC #3 Superintendent
IHC #4 Superintendent
Safety Officer
Firing Group Supervisor
Division E Supervisor
Task Force Leader
EMT
Helitack / Helispot Manager
Helitack / Helispot Manager
Helitack Crewmember
Operations Section Chief 1
Operations Section Chief 1
Operations Section Chief 1 Trainee

Appendix D – After Action Review

(See three-ring binder in investigation file.)