United States Department of Agriculture
Forest Service

Mississippi Meadows
Accident Investigation
Factual Report

Prescribed Fire Operational Accident
Chippewa National Forest –Deer River – Marcell Ranger District
Eastern Region
Section 28, T145, R26
Deer River, Minnesota

Accident Investigation
Factual Report

Accident: Prescribed Fire Operational Accident

Location: Chippewa National Forest, Deer River-Marcell Ranger District,

Date of Accident: May 5, 2005

Investigation Team Leader: Thomas G. Wagner, Forest Supervisor, White Mountain National Forest

s/ Thomas G. Wagner	*7/1/2005*
Signature	Date

Investigative Team Members:
Type 1 Incident Commander/WO, Fire and Aviation Management
Type 1 Safety Officer/Regional Fire Operations Safety Program Manager
Writer/Editor, Regional Public and Government Affairs Assistant

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I. Executive Summary

On May 9, 2005, the Regional Forester Randy Moore dispatched an investigative team to the Chippewa National Forest to investigate an accident that had occurred during a prescribed burn on May 5, 2005. He made this decision after the Chippewa National Forest Supervisor provided him with additional information on the circumstances of the accident and the extent of the employee's injuries.

A written delegation of authority was given to Team Leader Thomas G. Wagner (White Mountain National Forest) to conduct the investigation along with three team members: a Type 1 Incident Commander, a Type 1 Safety Officer, and a Writer/Editor. The team was instructed to complete the Factual Report and the Management Evaluation Report within 45 days of the delegation consistent with guidelines provided in the Forest Service Investigation Guide.

On May 12, 2005, after visiting the accident site and conducting interviews with involved employees involved with the prescribed burn, the team determined that the accident met the National Wildfire Coordination Group (NWCG) definition of an entrapment. A Wildland Fire Entrapment Report was submitted to the National Interagency Coordination Center by Team Leader, Tom Wagner. Due to the decision that an entrapment occurred, the Washington Office and Eastern Regional Office further discussed the level of review. The Washington Office delegated the review of the accident to the Regional Forester, and the review team continued their investigation.

II. Accident Narrative

The Mississippi Meadows Prescribed Fire was implemented as part of the East Side Wet Meadow Project. The environmental assessment that covered this project was approved by the District Ranger in January 2002. The objective of the project was to improve wildlife habitat within the meadows, specifically, for several sensitive bird species. Approximately 20 percent of the National Forest acres outlined in the decision had been treated since the Environmental Assessment was completed. The annual window for treating additional acres in 2005 was drawing to a close since supporting documents indicated that burning after May 7th may result in adverse ecological effects.

The Mississippi Meadows Burn Plan was prepared on April 20, 2005 and was subsequently reviewed by the District Fire Management Officer. A second level review was performed by the Forest Fuels Specialist. The burn plan was signed and approved by the District Ranger on April 25, 2005. The District Ranger received a Delegation of Authority to sign burn plans from the Forest Supervisor on April 13, 2005.

Unit 8 which was northwest of Unit 11 had been successfully burned earlier in the 2005 spring burning season.

On the morning of May 5, 2005, crews assembled for a briefing at 0630 at the Deer River Ranger Station for the planned ignition of Units 11 and 12 **(Map 1).** Approximately 20 people who were scheduled to participate in the burn attended the briefing. The briefing was conducted by Burn Boss and the Burn Boss Trainee. The briefing covered:

- objectives of the burn
- planned operations
- safety items
- contingency plans
- organizational structure
- medical emergency procedures
- weather and fire behavior

There was a written Incident Action Plan prepared for the burn and it was noted at the briefing that it did not contain a Medical Unit Plan. Discussion of medical procedures in the briefing highlighted that there was an EMT and two first responders on the burn.

Crews traveled to the burn project area via boat or vehicle **(Photo 1)**. Weather was taken at approximately 0830 and a spot forecast was requested from dispatch. The first spot weather forecast was received at approximately 0900. The weather predictions were all within the parameters of the burn plan except the smoke dispersal mixing height, which was classified as "poor". This prediction was inconsistent with the general forecast for the day which called for "excellent" smoke dispersal. A decision was made to wait another hour and call for a new spot forecast for an 1100 ignition time. Due to the potential for a later ignition time, the Burn Boss decided to burn only Unit 11 and not Unit 12. In addition, he decided not to burn a small portion of the upper part of Unit 11 by using a wet line on the top of the unit **(Map 2)**. This additional delay was also used to further brief personnel on the safety and other operational concerns.

The spot forecast was received around 1100. The smoke dispersion had increased to "good" but wind speeds were predicted winds at 12 to 21 mph which was above burn plan parameters. The Trainee Burn Boss called the Eastern Area Coordination Center (EACC) Predictive Services to discuss the forecast. The Meteorologist stated that smoke dispersal would be "good" by afternoon and that winds should be "moderate" at 8 to 12mph. Additional discussion with the National Weather Service forecaster in Duluth, Minnesota through MIFC dispatch occurred and they indicated with new information winds were not expected to exceed 10 mph. Crews waited another 30 minutes and observed that the winds did not exceed 6 mph. A light rain occurred on the burn unit. The Burn Boss decided to begin a test fire around 1200 **(Photos 2, 3)**.

The test fire exhibited acceptable fire behavior with backing flame lengths of 1 to 2 feet. A decision was made to proceed with the burn and the ignition and holding forces were split **(Map 2)**. One group moved down river to the south and one group moved upriver to the northwest. Lighting was done right along the west side of the river allowing the fire to back into the meadow. Things proceeded smoothly for a little more than an hour. Personnel were deployed to begin the wet line on the top of Unit 11 before the igniters reached the area. Problems developed with keeping the pump running and firing was

suspended until this line could be fully developed. Additional holding resources began to move to this area to assist with getting the wet line in place. This caused much of the northern part of the ignition line on the unburned side of the river to not have personnel in place looking for spots fires.

At approximately 1335, the Holding Squad Boss called in the first spot. Personnel moved from the area around the wet line to Spot 1 **(Photo 5)**. Crews worked Spot 1 with handtools and bladder bags **(Photo 6, 7)**. The pump was disconnected from the wet line operation and moved to Spot 1. Once again there were problems with the pump but the spot was contained by crews. The Burn Boss sent personnel back to the south to watch for more spots across the river **(Photo 8)**.

At 1345, the Holding Squad Boss reported a second spot fire. Spot 2 was reported to be one-tenth of an acre in size and moving quickly to the Northeast **(Photo 9)**. The Burn Boss and holding crew members repositioned to the second spot leaving two people to continue to work on Spot 1. The pump was repositioned and again there were problems getting the pump operating. Crews begin to deploy the remaining hose left in the boat along the right (southeastern) flank of the spot 2. One crew member had difficulty connecting hose couplings. The Burn Boss removed his gloves to assist with this effort.

The Burn Boss instructed the Holding Boss to scout the right (East) flank of the fire to determine the direction of the flame front and ordered the remainder of the crews to anchor at the heel of the fire and begin flanking operations. The Burn Boss then walked out along the left (west) flank of the Spot 2 to determine if the fire was heading into some old wet oxbows further in the meadow which the Burn Boss believed would give the crews a chance to contain the fire. At approximately 1400 hours as he walked up the left flank approximately 200 to 300 feet from the river, the fire turned toward him and became a head fire moving in a more northwesterly direction. The Burn Boss moved away from the fire and attempted to loop back toward the safety zone at the river. After moving about 100 feet, the Burn Boss recognized the fire was gaining on him. Smoke impaired his vision of the escape route and safety zones. In addition, he had moved into an area, in which, rougher hummock-like grass made travel difficult **(Photo 10)**.

The Burn Boss realized there was little chance of moving away from the approaching flame front. He turned around and saw an area of flame that was approximately 3 to 4 feet in height. He held his breath, covered his face, and moved through the flame front back into the black.

The Burn Boss indicated he had not put his gloves back on after working on the hose and pump. The Burn Boss stated he knew he was sustaining some burns and continued to move back toward the heel of the fire. There were no other personnel on the fire who knew the Burn Boss had been cut off from his escape route. He proceeded to the river and put water on his hands and face. He instructed the Trainee Burn Boss to order aircraft to help keep the fire within the contingency lines in the trees to the east. He then informed the Burn Boss Trainee he was heading down river to get to the truck.

The Burn Boss ultimately returned to the bridge location along the highway, and began to order additional resources to keep the fire within the eastern containment lines. He met with the Assistant District Ranger at the bridge who was providing public information on the highway. At 1655 the fire was declared a wildfire and crews initiated the evacuation and structure protection of structures in the Ball Club area. At 1600 the Forest Fire Staff and Forest Fuels Specialist arrived on scene and assisted with ordering additional resources. At 1800, a Type 2 Incident Management Team and a relief Type 3 IC was ordered. A short time later, the Forest Supervisor arrived at the bridge. At 1955, command was transferred to the new Type 3 IC. The Burn Boss returned to the District Office to assist with the preparation of the Wild Fire Situational Analysis (WFSA). At 2100 the Burn Boss left the office for the emergency room in Deer River.

III. Findings

Finding #1 - Employees on the fire met agency requirements for training and red card qualifications. These included the Annual Fireline Safety Refresher and work capacity test.

Fi*nding #2* - The injured party met work-rest guidelines.

Finding #3 - The injured party served in three capacities on the day of the burn: Burn Boss, Fire Management Officer, and acting District Ranger.

Finding #4 - The District Ranger had written delegation of authority to sign the burn plan from the Forest Supervisor, and met the required core competencies for knowledge and experience.

Finding #5 - The Forest Supervisor met the required core competencies for knowledge and experience to delegate authority on this prescribed burn rated at a moderate level.

Find*ing #6* - The District Ranger reviewed and signed the Go/No-Go checklist on May 4, 2005.

Finding #7 -Safety briefings were held at the Deer River District Office the morning of the burn. Additional safety discussions occurred at the prescribed burn site.

Finding #8 - Employees on the prescribed burn were instructed on escape routes and safety zones.

Finding #9 - Safety procedures and hazard abatement actions were followed except in two specific instances: the injured party allowed his escape route to be compromised, and the injured party was not wearing safety gloves while scouting the second spot fire.

Finding #10 - The injured party did not seek medical attention until seven hours after sustaining first and second degree burns to the face and hands.

Finding #11 - An Incident Action Plan (IAP) was used on the prescribed fire; however it did not include a medical unit plan. Medical evacuation procedures were discussed at the briefing, but on-site medical personnel were not designated by name or location.

Finding #12 - The burn plan met the parameters of regional guidance except that on-site weather forecasts were not taken every 30 minutes.

Finding #13 - All personnel maintained good communication throughout the entire incident.

Finding #14 - The overriding concern of the injured party to observe and contain the second spot fire resulted in a momentary lapse of attention to personal safety.

Finding #15 - The overall number of personnel on the fire exceeded what was called for in the burn plan, but approximately fifty percent of the personnel had limited fire fighting experience.

Finding #16 - The prescribed fire operation had one pump which did not perform adequately. No contingency pumps were identified or available on the fire, although twelve pumps in the district warehouse were available for use in the district.

Finding #17 - The Burn Plan identified an additional three person handcrew, an engine, and a Forest Service Beaver aircraft as contingency resources. The aircraft listed was a considerable distance from the burn to be considered as a viable contingency resource.

Finding #18 - Initial weather predictions delayed the burn due to concerns of smoke dispersal and wind speed. Additional conversations with the National Weather Services (NWS), Eastern Area Coordination Center (EACC) predictive services, Minnesota Interagency Fire Center (MIFC) dispatch, and further on-site weather readings resulted in the decision to proceed with the burn.

Finding #19 - The prescribed burn was within weather parameters during the entire ignition process.

Finding #20 - There were minor changes in weather throughout the day relative to cloud cover and wind direction and speed.

Finding #21 - The area in which the entrapment occurred was characterized by matted sedge meadow, bogs, and uneven hummocky surfaces that made traversing the area difficult (Photo 10) & **(Photo 13).**

Finding #22 - Parts of the burn area contained some patches of willow and cane grass (fuel model 5) that burned at a higher intensity with greater spotting potential. Fuel model 5 is abundant in the area where the two spot fires occurred **(Photo 5).**

Finding #23 - Four of the 18 watch-out situations influenced or contributed to the entrapment:

- (#11) Unburned fuel between you and the fire
- (#15) Wind increases and/or changes direction
- (#16) Getting frequent spot fires across line
- (#17) Terrain (hummocky patches) and fuels make escape to safety zones difficult

Finding #24 - The injured party compromised one of the 10 standard fire orders:

- (#4) Identify escape routes and safety zones and make them known.

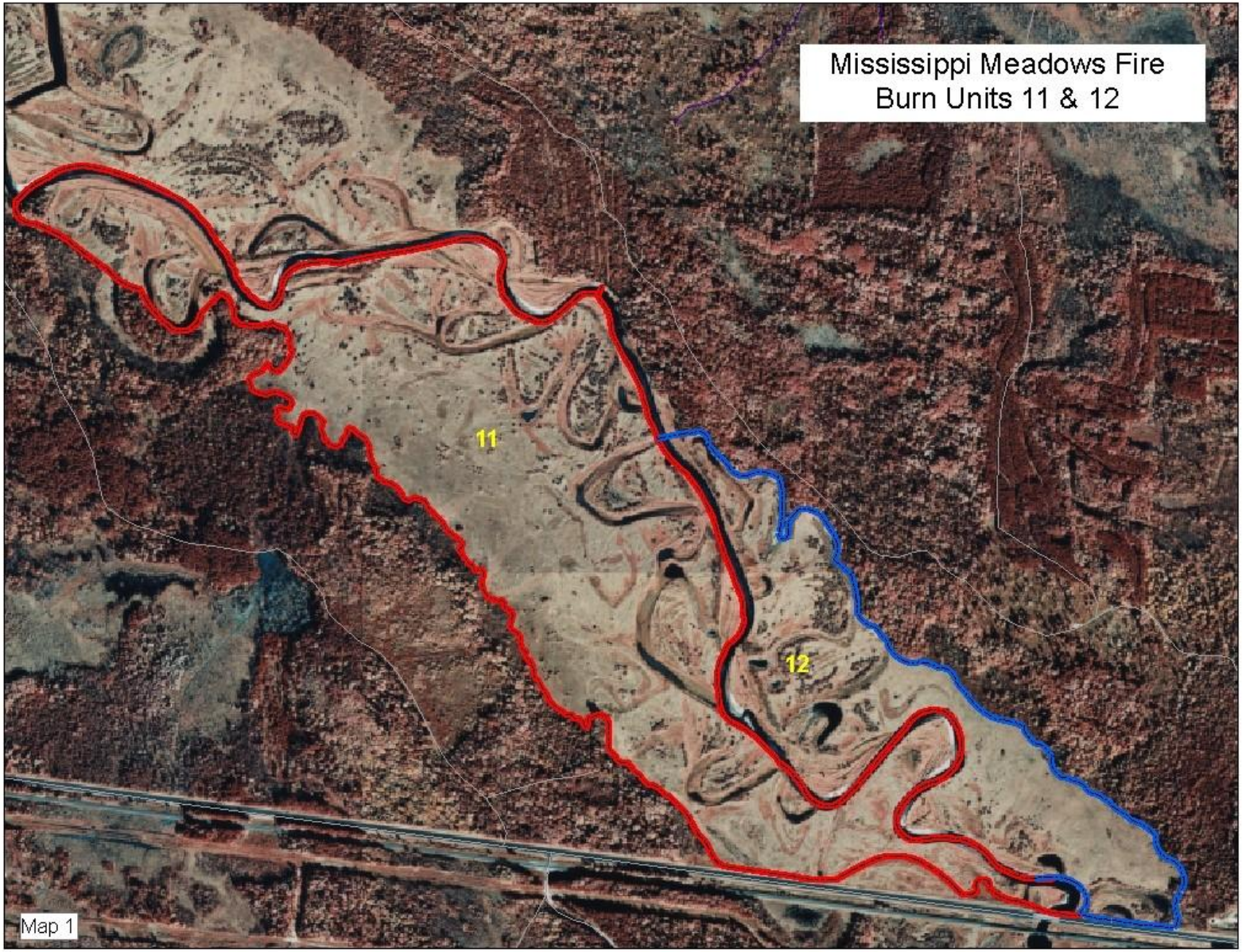
The injured party's escape routes back to the safety zones (the river and the black) were momentarily compromised.

IV. Maps, Photos

Maps:

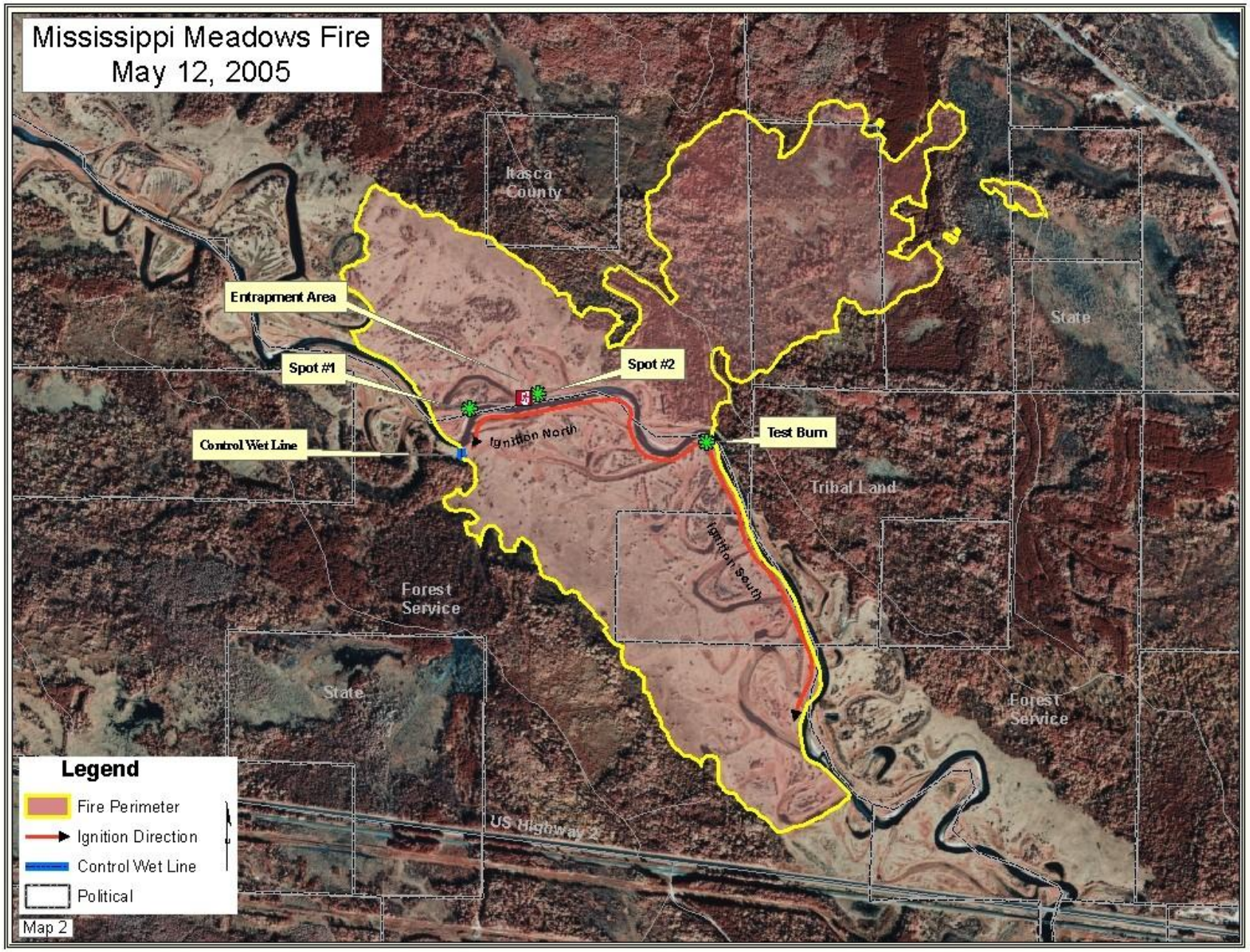
Map 1 – Prescribed Burn Map

(Link back to Document)



Map 2 - Mississippi Meadows Prescribed Fire Accident Map

(Link back to Document)



Photos

Photo #1. Crews Mobilize to Burn

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Photo #2. Test Burn

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Photo #3. Test Burn

Photo #4. Fuel Model 5

Photo #5. Crews Respond to Spot #1

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Photo #6. Spot #1

(Link back to Document)

Photo #7. Spot #1

Photo #8. Looking South – Down river toward Spot #2

(Link back to Document)

Photo #9. Spot #2 Origin (Post Burn)

(Link back to Document)

Photo #10. Hummock Mounds – Difficult Walking (Post Burn)

(Link back to Document)

Photo #11. Spot #2 Looking Northeast (Post Burn)

Photo #12. Spot #2 Looking Southwest (Post Burn)

Photo #13. Entrapment Area (Post Burn)

(Link back to Document)

V. Appendices

Appendix A – Evaluation of 10 Standard Fire Orders
Appendix B – Evaluation of 18 Watch-Out Situations
Appendix C – Evaluation of 5 Common Denominators
Appendix D - Weather Timeline
Appendix E - Supporting Information – File Case Delivered to Regional Forester with Factual Report

Appendix A: 10 Standard Fire Orders

The 10 Standard Fire Orders were evaluated to determine both their application and the key order (s) that was compromised and caused or contributed to the accident.

10 Standard Fire Orders	Did not Contribute (Order was followed)	Influenced	Contributed Significantly (Order was not followed)	Unknown
#1 – Keep informed on fire weather conditions and forecasts.	*X*			
#2 – Know what your fire is doing at all times.	X			
#3 – Base all actions on current and expected behavior of the fire.	X			
#4 – Identify escape routes and safety zones, and make them known.			X	
#5 –Post lookouts when there is possible danger.	X			
#6 – Be alert, Keep calm. Think clearly. Act Decisively.	X			
#7 – Maintain prompt communications with your forces, your supervisor, and adjoining forces.	X			
#8 – Give clear instructions and insure they are understood.	X			
#9 – Maintain control of your forces at all times.	X			
10 – Fight fire aggressively having provided for safety first.	X			

Appendix B: 18 Watch out Situations

The 18 Watch-Out Situations were evaluated in terms of their application and contribution to the Mississippi Meadows Accident.

18 Watch-Out Situations	Did not Contribute (Not applicable and/or was considered if applicable)	Influenced	Contributed Significantly (was applicable and wasn't considered)	Unknown
1 – Fire not scouted and sized up.	X			
2 – In country not seen in daylight.	X			
3 – Safety zones and escape routes not identified.	X		X	
4 – Unfamiliar with weather and local factors influencing fire behavior.	X			
5 – Uninformed on strategy, tactics, and hazards.	X			
6 – Instructions and assignments not clear.	X			
7 – No communication link with crewmembers or supervisor.	X			
8 – Constructing line without safe anchor point.	X			
9 – Building fire line downhill with fire below.	X			
10 – Attempting frontal assault on fire.	X			
11 – Unburned fuel between you and fire.			X	
12 – Cannot see main fire, not in contact with someone who can.	X			
13 – On a hillside where rolling material can ignite fuel below.	X			
14 – Weather becoming hotter and drier.	X			
15 – Wind increases and/or changes direction.			X	
16 – Getting frequent spot fires across line			X	
17 – Terrain and fuels make escape to safety zones difficult.			X	
18 – Taking a nap near fireline.	X			

Appendix C: Five Common Denominators

The Five Common Denominators of Fire Behavior on Tragedy Fires were evaluated in terms of similarity/relation to the Mississippi Meadows Accident.

Common Denominators	Not Similar	Somewhat Similar	Very Similar	Unknown
1. Most incidents happen on smaller fires or isolated portions of larger fires.		X		
2. Most fires are innocent in appearance before the "flare-ups" or "blow-ups." In some cases, tragedies occur in the mop-up stage.	X			
3. Flare-ups generally occur in deceptively light fuels.			X	
4. Fires run uphill surprisingly fast in chimneys, gullies, and on steep slopes.	X			
5. Some suppression tools, such as helicopters or air tankers, can adversely affect fire behavior. The blasts of air from low-flying helicopters and air tankers have been known to cause flare-ups.	X			

Appendix D: Weather Sequence of Events

May 5, 2005

The weather played a significant role in the burning activities conducted on the Mississippi Meadows Unit #1 and Unit #12 prescribed burn.

The Mississippi Meadows Prescribed Burn Plan Prescription is as follows:

NFFL Fuel Model	3, 5
Wind speed /direction	2 - 10 mph eye level @ 90 - 270 degrees
Temperature	25 – 90 degrees
Relative Humidity	25% - 70%
Smoke Dispersion Rating	Fair or better

Sequence of Weather Events

0630 Burn Boss and Burn Boss Trainee conducted a 35 minute briefing for all personnel involved in the operation. This briefing covered the day's forecasted weather as predicted by the National Weather Service (NWS). This forecast predicted:

Maximum temperatures	68 - 73 degrees
Minimum Relative Humidity's	23% - 28%
20 foot winds	5 - 10 south
Smoke Dispersion Index	Excellent
Haines Index	6 or High
General Condition	Chance of showers or thunderstorms

0813 Holding Boss took on site weather and requested a spot weather forecast. Weather elements recorded were:

Dry Bulb Temperature	55 degrees
Wet Bulb Temperature	47 degrees
Relative Humidity	47%
Winds	6 mph south
General Condition	Overcast skies

0840 Spot weather forecast was received from NWS office in Duluth, Minnesota.

Temperature	57 degrees, maximum 72 degrees
Relative Humidity	55%, minimum 28%
Eye Level Winds	7 mph south
20 Foot Winds	Same as eye level
Smoke Dispersion Index	Poor
General Condition	Continued chance of thundershowers

Due to the Smoke Dispersion Rating being out of prescription the Burn Boss decided to wait one hour and call for a new spot forecast, anticipating a favorable change in the rating.

0900 – 1000 Burn Boss and Burn Boss Trainee discussed concerns with predicted Relative Humidity's and eye level winds resulting from the later ignition times that may occur. With the potential for a later ignition time the decision was made to cancel the plan to burn Unit #12 and to burn only Unit #11. The reason for not burning Unit #12 was to eliminate open wood line in Fuel Model (FM) 8 that would hold fire and as it was ignited. Predicted winds would push fire into the timber which would then need to be mopped up and patrolled.

0933 Holding Boss recorded the following on site weather elements:

Dry Bulb Temperature	61 degrees
Wet Bulb Temperature	52 degrees
Relative Humidity	54%
Winds	6 – 8 mph southwest
General Condition	Overcast skies

1000 Holding Boss recorded the following on site weather elements for a spot weather forecast.

Dry Bulb Temperature	64 degrees
Wet Bulb Temperature	54 degrees
Relative Humidity	52%
Wind	5 - 10 mph south (also recorded as 6 -8 mph)
General Condition	Overcast skies

1013 Holding Boss submitted the 1000 readings to NWS for a spot weather forecast.

1043 Second spot weather forecast received from NWS. The forecast predicted the following:

Temperature	65 degrees, maximum 70 degrees
Relative Humidity	52%, minimum 39%
Eye level winds	12 mph southwest, gusts to 21 mph
20 foot winds	15 mph southwest, gusts to 25 mph
Smoke Dispersion Index	Good
General Condition	Continued chance of thunderstorms

This forecast gave a favorable Smoke Dispersion Index but an unfavorable predicted wind speed.

1055 Burn Boss Trainee contacted the EACC Predictive Services to discuss the discrepancy in NWS spot forecasts. The initial spot forecast at 0840 predicted winds out of the south at 7 mph, while the second spot forecast at 1043 predicted winds out of the southwest at 12 mph with gusts to 21 mph. EACC Predictive Services stated that smoke dispersion should be 'Good' by afternoon and winds should be 8-12 mph out of the southwest by afternoon.

1100 Burn Boss Trainee contacted NWS forecaster through MIFC to discuss the discrepancy in NWS spot forecasts. At this time the NWS forecaster stated "with new information, the winds would probably not get any higher than 10 mph".

1100-1130 Rain wet the prescribed burn area.

1200 Holding Boss recorded the following on site weather elements:

Dry Bulb Temperature	62 degrees
Wet Bulb Temperature	52 degrees
Relative Humidity	50%
Winds	6 – 8 mph southwest

Test fire began and acceptable fire behavior was observed. Proceeded with ignition of prescribed burn and continued for next 60-90 minutes.

1320 Burn Boss Trainee recorded the following on site weather and requested a spot weather forecast.

Dry Bulb Temperature	71 degrees
Wet Bulb Temperature	59 degrees
Relative Humidity	49%
Wind	6 mph south, gusts to10 mph
General Condition	cloudy skies

1335 Spot fire #1 was discovered.

1345 Spot fire #2 was discovered.

1350 Third spot weather forecast received from NWS. The forecast predicted::

Temperature	71 degrees, maximum 72 degrees
Relative Humidity	45%, minimum 39%
Eye level winds	5-10 mph northeast
20 foot winds	same as eye level winds
Smoke Dispersion Index	Good
General Condition	Continued chance of thunderstorms

1605 Chippewa and Superior National Forest Prescribed Fire and Fuel Specialist took weather readings at Mississippi River and Highway 2 bridge site and requested a spot weather forecast from NWS. The elements were:

Dry Bulb Temperature	75 degrees
Wet Bulb Temperature	56 degrees
Relative Humidity	28%
Winds	15 mph west, gusts to 25 mph

1615 Declared prescribed burn a wildfire.

1642 Fourth spot weather forecast received from NWS. The forecast predicted:

Temperature	76 degrees, maximum 77 degrees
Relative Humidity	28%, minimum 28%
Eye level winds	15 mph, becoming northwest, gusts 25 mph
20 foot winds	same as eye level winds
General Condition	Scattered thunderstorms developing