MARBLE FIRE

FIRE SHELTER DEPLOYMENT

UTE MOUNTAIN AGENCY

TOWAOC, COLORADO

BUREAU OF INDIAN AFFAIRS, SOUTHWEST REGION

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EXECUTIVE SUMMARY

The summer of 2002 in the Rocky Mountain Geographic Area has experienced extreme fire danger indices, which explains the large number of fire starts and multiple large fires. The delayed onset of monsoonal moisture has extended the drought period and fires have continued to start easily, and quickly build momentum and burn intensely. High winds have critically influenced fires causing them to burn with extreme behavior and produce long fire runs in a single burn period.

Lightning started two fires on Marble Mountain the afternoon of July 14, 2002, and two initial attack modules of three firefighters each were formed to suppress both fires. The fires were in a remote location with steep slopes, dense vegetation, and no roads. Firefighters were flown by helicopter (4EC) beginning at 1930 hours to an unimproved helispot on the north shoulder of Marble Mountain. The first load of firefighters (East Marble IC+2) walked downslope to the East Marble Fire. Estimated at ¼ acre, it was burning in fine fuels on a small ridge that eventually led to slopes of 50-60%. The second group of firefighters (North Marble IC +2) walked about .3 miles cross slope to the North Marble Fire which was 2-3 short trees burning in a talus slope. Sketchy radio communications plagued the two initial attack modules throughout the evening and night. They were unable to contact Durango Dispatch, Ute Mountain Fire Base, or each other.

Both initial attack modules were inserted by 2000 hours; by 2100 hours winds began to increase at a steady pace. Eye level winds estimated at 30-40 mph were also channeled up McElmo Canyon caused the East Marble Fire to burn quickly to the top of the shoulder ridge. Exposed to the high winds, the fire burned rapidly across the upper slopes of Marble Mountain and caused firefighters at the North Marble Fire to deploy fire shelters in a rockslide at about 2130 hours.

These firefighters remained in their fire shelters for about 1-½ hours, enduring high heat, smoke, and embers entering their fire shelters from underneath. All 3 firefighters deployed fire shelters as they had been instructed during training and annual refreshers. Conditions during the deployment were expected as it had been described and simulated during their annual safety refresher. Judging from the lack of noise from the fire, and heat dissipation, North Marble IC was the first to leave his fire shelter. They remained on location through the night and were flown from the original helispot about 0800 on July 15th.

Firefighters at the East Marble Fire were preparing to enter the black at about 2130 hours when information of fire status broadcast by HEGM, located in the valley convinced them to walk out. They discarded their line gear, and with fire shelters in hand walked down and out of the canyon to McElmo Canyon Road by 0006 hours on July 15th.

None of the firefighters suffered burns or other physical injuries. All six firefighters attended a Critical Incident Debriefing the evening of July 16, 2002.

The Serious Accident Investigation Team was briefed at 1300 hours on July 16, 2002 at the Ute Mountain Ute Agency Headquarters in Towaoc, CO. The investigation team has conducted this investigation as outlined in DOI 485 DM Chapter 7. Findings in this report are based on interviews with key Bureau of Indian Affairs employees, and interagency personnel from the Durango Interagency Dispatch Center; on-site observations; and technical analyses of environmental factors including weather, climate and fire behavior. Involved personnel protective equipment was examined on-site.

INCIDENT OVERVIEW

On July 14, 2002, in response to reported lightning fires in the Marble Mountain area helicopter 4EC delivers 3 firefighters (IC + 2) to an unimproved helispot on a shoulder ridge below Marble Mountain summit at 1930 hours. Within 15 minutes they arrive at their fire, named East Marble Fire, and report to Durango Dispatch (DGO) it is about .25 acre and request bucket drops for support. Aerial support was not available due to another Helitack operation at this location, and a reconnaissance of another fire with potential high risk in Mesa Verde National Park.

At about 2000 hours 3 additional firefighters (2nd IC + 2) were delivered to the same helispot to initial attack a second fire, located approximately .3 miles away in slide rock, and named North Marble Fire. After landing and off loading firefighters and cargo, IC briefs his crew on the direction of travel they will take to reach the North Marble Fire. During his brief air reconnaissance he noted his fire was surrounded by rocks and posed no apparent difficulties and offered a good safe zone. He also noted that IC would have more problems because the East marble Fire was on steep slopes with continuous fuels.

The Helicopter Manager (HEMG) calls Durango Interagency Dispatch (DGO) with a fire size-up for the North Marble Fire and departs for Mesa Verde National Park. At 2056 hours 4EC returns from the reconnaissance enroute to the Cortez airport, and reports to DGO that the East Marble Fire is becoming active. By 2100 hours, North Marble IC and firefighters reached the North Marble Fire after laboring through dense Gambel Oak, and steep slopes with loose footing and rolling rocks.

During the next half hour, North Marble IC establishes a camp spot for the night since his fire poses no threat of escape, and fire area is relatively steep, they will work until the fire is secure and then sleep. He tries to contact DGO, and Ute Mountain Fire Management but cannot.

Poor radio communications in this area is well known, and after the Pony and Bircher Fires in CY 2000, the Bureau of Indian Affairs, Branch of Forestry tried to get an additional repeater installed. Since this did not occur, additional time was spent by both Incident Commanders using simplex and repeater frequencies trying to find locations where their radios would connect with DGO or Ute Mountain Agency.

By 2130 hours two firefighters notice a red glow showing over the ridge to their east, and as they begin to move downslope toward their fire they see flames coming over the ridge from the East Marble Fire. Winds had increased to 35-45 mph from the southeast, blowing directly

toward them. They watched active crown fire moving cross-slope towards them, as they become surrounded with prolific spotting, and a dense ember shower.

About 2145 hours, North Marble IC directs his crew to a deployment location in the slide rock and orders them to enter their fire shelters. During the next 1.5 hours they experience high heat inside their shelters with smoke and embers entering through the bottom where they could not get a good seal between their shelters and the rocks. They judged the passage of fire fronts across the top by the red glow inside the shelters, and the extreme noise of the fire. They withstood 2 fire passages across the slope above them, and a 3rd from below as the fire was pushed downslope by winds and then the fire ran upslope channeled by a step draw on their immediate east side.

These firefighters experienced turbulent winds during the fire shelter deployment that collapsed and tugged at the shelter. No major holes or tears developed, but they were able to see the bright red and orange color changes as the fires passed by them. The third heat wave affected their position with convective heat. The lowest firefighter on the slope related that his fire shelter was pushed against his leg, and it was very hot. He reached down with a gloved hand and pushed the shelter out and away from him. All three firefighters credit their training and realistic deployment simulations with their easily achieved deployments.

Concerned there was no radio contact with the 2 initial attack crews, the Assistant Fire Management Officer for Ute Mountain Reservation, traveled into the valley area and made contact with them on the radio using the agency simplex channel. He found they had no injuries, and instructed them to remain on site through the night, and they would be extricated by helicopter in the morning.

The East Marble Fire became active on the steep slopes burning in fine continuous fuels. East Marble IC had determined they would be safe staying at the fire site. He was concerned he could not reach anyone by radio, and made a couple trips to the shoulder ridge attempting to call out. By 2130 hours the East Marble Fire had grown to an estimated 25+ acres and was moving quickly toward the ridge. On-site winds were estimated at 25-30 mph. The strong winds quickly pushed the fire up to and over the ridge. IC directed his crew to brush out the heel of this fire to enlarge their buffered zone at the bottom. His plan was to go into the black and wait out the fire run.

HEMG (T), located in the valley, contacted them on the agency simplex channel and described the fire situation from his vantage point. He recommended they leave and exit out the canyon bottom. East Marble IC instructed his crew to leave all their gear and bring fire shelters. They left the East Marble Fire about 2200 hours and fought their way through Gamble Oak and brush reaching McElmo Canyon Road about 0006 hours on July 15, 2002.

IC and crew spent the night at their camp spot and returned to the initial attack helispot and returned to the Cortez Airport by 0830 on July 15, 2002.

A Serious Accident Investigation Team was formed on July 15th, traveled and arrived at Ute Mountain Agency on July 16th. The Team was briefed and given a delegation of authority to conduct the investigation.

INVESTIGATION PROCESS

The Bureau of Indian Affairs through the National Fire and Aviation Office in Boise, Idaho initiated the investigation of the Marble Mountain fire shelter deployment.

The Serious Accident Investigation Team (SAIT) received a Delegation of Authority on July 16, 2002, from the Regional Director of the Southwest Region.

1. Team members were notified on July 15, 2002, and traveled to Towaoc and Cortez, Colorado the following day arriving at different times. Two team members received the initial briefing on July 16th.

2. The team used procedures outlined in DOI 485 DM, Accident Investigation.

3. The team visited and examined and photographed the site on the morning of July 17, 2002. Following this the team set up facilities and discussed procedures and assignments.

4. The team interviewed the 6 initial attack firefighters, 4EC HEMG, AFMO Ute Mountain Agency, Superintendent Ute Mountain Agency, Natural Resources Director Ute Mountain Agency, Center Manager Durango Interagency Dispatch Center, and Helicopter Manager-Bureau of Indian Affairs.

5. July 17, 2002 delivered the 24 and 72-hour report.

6. The team developed the draft report on July 18 and 19, 2002, and briefed the BIA Agency Superintendent, Natural Resources Officer, and Assistant Fire Management Officer at 0700 hours on July 18, 2002. Team members traveled to their duty stations also on the 18th.

FINDINGS AND RECOMMENDATIONS

Fire Behavior and Environmental Factors

Findings:

1. Record high fire danger indices with a sudden wind event led to significant fire behavior creating a life-threatening situation.

2. Steep terrain with loose rock limited firefighter mobility and supported rapid fire spread.

3. Relative humidities exhibited an atypical diurnal pattern that contributed to creating the significant fire behavior.

4. Tactical decisions for the North Marble Fire were based on the rock scree safety zone at that location. Fire behavior created at the East Marble Fire proved this safety zone was marginally effective.

Recommendations:

1. Ensure a more focused use of National Fire Danger Rating System data to describe fire season situations as it relates to actual and expected fire behavior.
    a. Confirm NFDRS data is accurate – validate with field measurements.
    b. Use Fire Behavior Service Centers for all agencies supported at the geographic area, or zone levels.
    c. Incorporate local NFDRS interpretations.
    d. Use NFDRS Pocket Cards as visual aids for crew briefings with explanations of the indices compared to known fire behavior.
    e. Locate and review the Bircher Fire (CY 2000) paper by Gene Rogers relating to relative humidity and expected fire behavior.

2. Local fire managers must stay engaged and communicate daily fire weather data (Remote Area Weather Stations, National Weather Service, Private Weather Service Companies).
    a. Daily checks of weather relationships throughout the burning periods allows better management decisions during stress periods.
    b. Daily fire behavior predictions based on recently archived weather data allows for better decisions when fuels, weather, topography, and time changes are in play.

3. Use the Risk Management Process found in the NWCG publication, Incident Response Pocket Guide, NFES #1077, to help pre-identify mitigations to risks imposed by steep rocky terrain, poor firefighter mobility, and firefighter inability to realize effective safety zone size. Other tools available to assist with better situational awareness and decision processes are:
    a. LCES Workshop (NWCG endorsed).
    b. Entrapment Avoidance, It's Your Call (USFS March 2002).

c. BLM Annual Refresher Videos.

4. All fire managers need a heightened awareness of potential fire behavior influences and associated risks due to adjacent fires and potentially undetected fires.
    a. Fire behavior experienced during statistically average years cannot be relied upon for guidance during extreme droughts as currently experienced in the Rocky Mountain, Great Basin, and Southwest Geographic Areas this year (CY2002).

Management Factors

Findings:

1. Firefighters were committed to fires during the twilight period when aviation support, firefighter mobility, and need for increased situational awareness becomes a limiting factor.

2. Guidance from the Ute Mountain Agency Fire Management Plan was not considered in the decision to staff these fires.

3. Previously identified radio communications problems have not been mitigated.

4. The Ute Mountain Agency Fire Management Officer was allowed off reservation for a fire assignment and was not available for management oversight. Given the extreme fire danger indices management oversight is critical.

5. Fire training and position qualifications database (SACS) has not been kept current to meet BIA policy. When management allowed unqualified firefighters to staff these fires, they placed them at risk. According to employee files, none of the firefighters were qualified for any of the positions they were assigned.

6. Localized fire weather data was not available because the recently purchased Remote Area Weather Station has not been installed. A spot weather forecast had not been requested.

7. Recent training for shelter deployment was accurate and designed to reinforce acceptable behaviors. It likely mitigated a more serious and undesirable outcome.

Recommendations:

1. Fire managers are encouraged to use existing guidance to help with decisions during potentially high-risk situations. The Ute Mountain Fire Management Plan specifically identifies indirect actions to deal with fires where communications, fire fighter mobility, lookouts, and safety zone access are insufficient. Using late evening conditions, steep and rocky terrain, and drought year fire behavior, the Risk Management Process

(NWCG) can guide fire managers to decisions that mitigate firefighter risk and detail alternative actions. Examples of alternative actions are:

a. Do not staff fires until daylight, using the extra time to plan additional support actions if necessary.
b. Do not staff fires until daylight. Use the remaining flight time to drop water on critical fires to hold through the night.
c. Recognize how to mitigate the poor communications, using either alternative in the Marble Mountain area and implement a plan for the next day.

2. Poor radio communications has been known locally for a long time. During the Pony and Bircher Fires during CY 2000 this situation was identified during these incidents and the BIA pursued mitigations through the Southwest Regional Office. As yet nothing has been accomplished. Durango Interagency Dispatch Center has a recently completed radio propagation study that technically identifies communication dead areas.
    a. The BIA can use the radio propagation study, as well as recommendations from the Pony and Bircher Fires to again approach BIA Facilities Management to install additional radio repeaters.
    b. Local fire managers need to describe possible mitigations for poor communications until technical assistance provides necessary communication links. This fire shelter deployment investigation identified distractive behaviors by incident commanders because radio communications were poor and inconsistent. Realizing this deficiency has existed for a long time, our fear is that firefighters will readily accept this risk.

3. Fire management oversight is a critical part of incident suppression when unusual circumstances occur. The extreme drought in the Four Corners area is a good example of the need for management decisions to intervene when standard operating procedures are inadequate. It becomes necessary for the Ute Mountain Agency to understand where this oversight will come from.

    Although the Ute Mountain Fire Management Plan provided some guidance it is not detailed enough to present a decision tree for every circumstance that happens.
    a. The Fire Management Officer must be certain those left in charge are comfortable with their decision-making responsibilities by preparing everyone with the same information and direction.
    b. Address all known hazard areas using the Fire Management Plan Decision Table, the Risk Management Process, and Job Hazard Analysis techniques so everyone has the same understanding of mitigations and appropriate policies.
    c. Continue Ute Mountain Agency, Line Officer involvement with developing policy direction, and daily operations involvement.
    d. Make certain these management actions are understood and supported through Durango Interagency Dispatch Center prior to every fire season.

4. The BIA training and qualifications database, located in the Department of Interior SACS program is integral to tracking employee development, and assuring we are all meeting

training and experience standards. It is imperative Ute Mountain Agency allows time and effort to complete all records for all firefighters employed by Fire Management on the reservation. Firefighter assignments must be made using their documented qualifications as the basis for filling positions.

Based on prevailing circumstances, if the Risk Management Process had been used prior to staffing these fires, the results would have indicated a fire complexity level equal to a Type 4 fire, rather than Type 5. Agency and Regional fire managers must comply with BIA qualifications and certification standards and make fire assignments based on personnel qualifications equal to the complexity level.

5. Ute Mountain Agency needs to install the recently purchased remote weather station for immediate use. This would provide more accurate real time weather data as well as initiating archived data for use in the future.

    a. A spot weather forecast was not requested for Marble Mountain. Although spot forecasts sometimes do not reflect much change from the general forecast, requesting one does help firefighters focus attention on the weather. In this case it would have reaffirmed thunderstorm activity above 7,000 feet through 2200 hours.

6. The management emphasis placed on basic survival training proved successful during this assignment and should be continued with the same enthusiasm and realism provided during the spring of CY 2002.

Other Findings

Findings:

1. There are roles and responsibilities regarding use and membership of a centralized dispatch center that are not well defined. Conflicting opinions regarding standard operating procedures, resource allocations, and priority setting need to be addressed and resolved.

2. The NWCG Risk Management Process is published only as part of the Incident Response Pocket Guide and as part of the Risk Management Lesson in S-339, Division/Group Supervisor.

Recommendations:

1. Ute Mountain and Southern Ute Mountain Agencies need to assert their dispatch priorities so they can be well understood and incorporated into a dispatch agreement and plan that is acceptable to all members of the Durango Interagency Dispatch Center. The Southwest Regional Office, BIA, should also be a party to these discussions to assure BIA policy is aligned with reservation and interagency oversight of dispatch center operations, as well as use of the Southwest Region, BIA helicopter.

2. It is also essential the interagency community (BIA and cooperators) discuss fire suppression priorities relative to firefighter safety. Specifically, when initial attack becomes the #1 priority nationally and in the geographic area, it is imperative that we identify when rapid initial attack is contributing risk to firefighter safety. Initial attack is not the governing priority, firefighter safety is. Such is the case here, when the agency has direction to modify their approach to initial attack using the Ute Mountain Fire Management Plan. Additionally, use of interagency resources should be used to support high-risk initial attack operations as agreed upon through a centralized dispatch agreement that has been mutually accepted.

3. NWCG course revisions need to include the Risk Management Process (RMP) and detailed lessons on how to use it. Practical applications of the RMP need to be included in pre-season refreshers and included in formal and informal instruction in all Operations and Command positions to the ICT5 level.

Commendations:

Findings:

1. East Marble Incident Commander provided effective leadership prior to and during a life-threatening situation.

2. North Marble Incident Commander applied proper escape route procedures by ordering firefighters to abandon gear on-site except the fire shelter during their escape route use.

3. Fire Management Officer provided leadership and oversight for preseason refresher and basic training that was effective. This was apparent in light of the decision processes by both initial attack incident commanders and actions of the firefighters.

4. Ute Mountain Agency Superintendent is actively involved with Fire Management operations.

5. Ute Mountain Agency, Fire Management Officer is providing leadership to change Fire Management's training and qualifications system to become nationally compliant.

6. Ute Mountain Assistant Fire Management Officer took positive actions to mitigate the lack of communications with firefighters on Marble Mountain during the fire shelter deployment.

7. Despite incomplete radio transmissions, individual continued to broadcast fire status updates to crews on Marble Mountain. This information was received by IC and used as situational awareness to make further decisions.

APPENDIX 1 – FIRE BEHAVIOR ANALYSIS

Marble Fire Behavior Analysis for Sunday July 14, 2002 Ute Mountain Agency

Fuels

Fuels in the fire area consisted of open Pinyon-Juniper with scattered sagebrush, grass and oak brush, Fuel Model 6 best fit these fuels. Fuel Model 2 represents the other fuel model within the basin, open Ponderosa Pine with scattered sagebrush, grass and pockets of tall thick oak brush.

Fuel moistures were estimated from the Chapin Remote Automatic Weather Station (RAWS). This site is located at 7050 feet elevation in the Mesa Verde National Park, approximately 15 miles southeast of the deployment site. The primary carrier of the fire was the Pinyon-Juniper fuel on the slopes and the grass and brush in the open Ponderosa Pine stand. Low relative humidities were recorded in the evening hours and staying in the low teens well into the night and early morning hours, contributing to the low fine fuel moisture values of 2-3%. The live woody fuel moisture values from the Chapin RAWS were in 54% range. This is a low reading that can lead to extreme fire behavior in brush fuel types.

The fire danger indices for the Chapin RAWS site for this time period exceeded the 90th percentile Energy Release Component (ERC) and had been setting records for several weeks indicating the severity of the season.

Weather

The Grand Junction, Colorado National Weather Service (NWS) Office issued a morning forecast on Sunday July 14, 2002 for hot and dry weather conditions to continue with low relative humidities and widely scattered thunderstorms over the mountains after 1300 hours, including zone 207, the area of the East and North Marble Fires. A Haines index of 6 was also forecast.

At 1140 hours the National Weather Service issued a Red Flag Warning for zones 205 and 207 from 1300 to 2200 hours for widely scattered mainly dry thunderstorms above 7000 feet. These storms have the potential to produce strong gusty outwash winds to 40 mph, and strong downslope winds under storm cells. “In addition… the hot temperatures… low relative humidities…and Haines indices of 6… will cause extreme fire behavior.” At 1500 hours the NWS afternoon forecast continued the Red Flag Warning for dry thunderstorms, at 2049 the Red Flag warning was allowed to expire at 2200.

Initial attack personnel reported winds at 4-6 mph out of the Northeast during the initial size-up at 1923 hours. The IA crew on the North Marble Fire reported the winds picking up at 2100 hours to 15-20 mph and at 2134 hours 35-45 mph winds out of the Northwest with embers flying past them. The Chapin RAWS site reported 20-foot wind gust of 16 to 52 mph between 1900 and 2400 hours, with steady winds of 5-15 mph. No crewmember interviewed noticed any thunderstorm development in the area during the initial attack process, however a picture taken

by one of the North Marble Fire crew shows cirrus clouds to the Northwest of the Helispot. This may indicate storm cell energy collapse from a previous thunderstorm. No on site weather readings were taken during the incident even though some crewmembers were carrying belt weather kits. No spot weather forecast was requested for this incident.

The Chapin RAWS located in the Mesa Verde National Park recorded the following weather conditions for July 14, 2002.

Time	Temperature ºF	Relative Humidity	Average Wind Speed MPH	Direction	Peak Gust
1800	89	14	5	179	12
1900	91	13	6	223	16
2000	93	12	7	198	15
2100	92	12	6	239	12
2200	80	20	6	103	20
2300	80	19	3	78	12
0000	68	43	16	6	52
0100	75	23	12	67	25

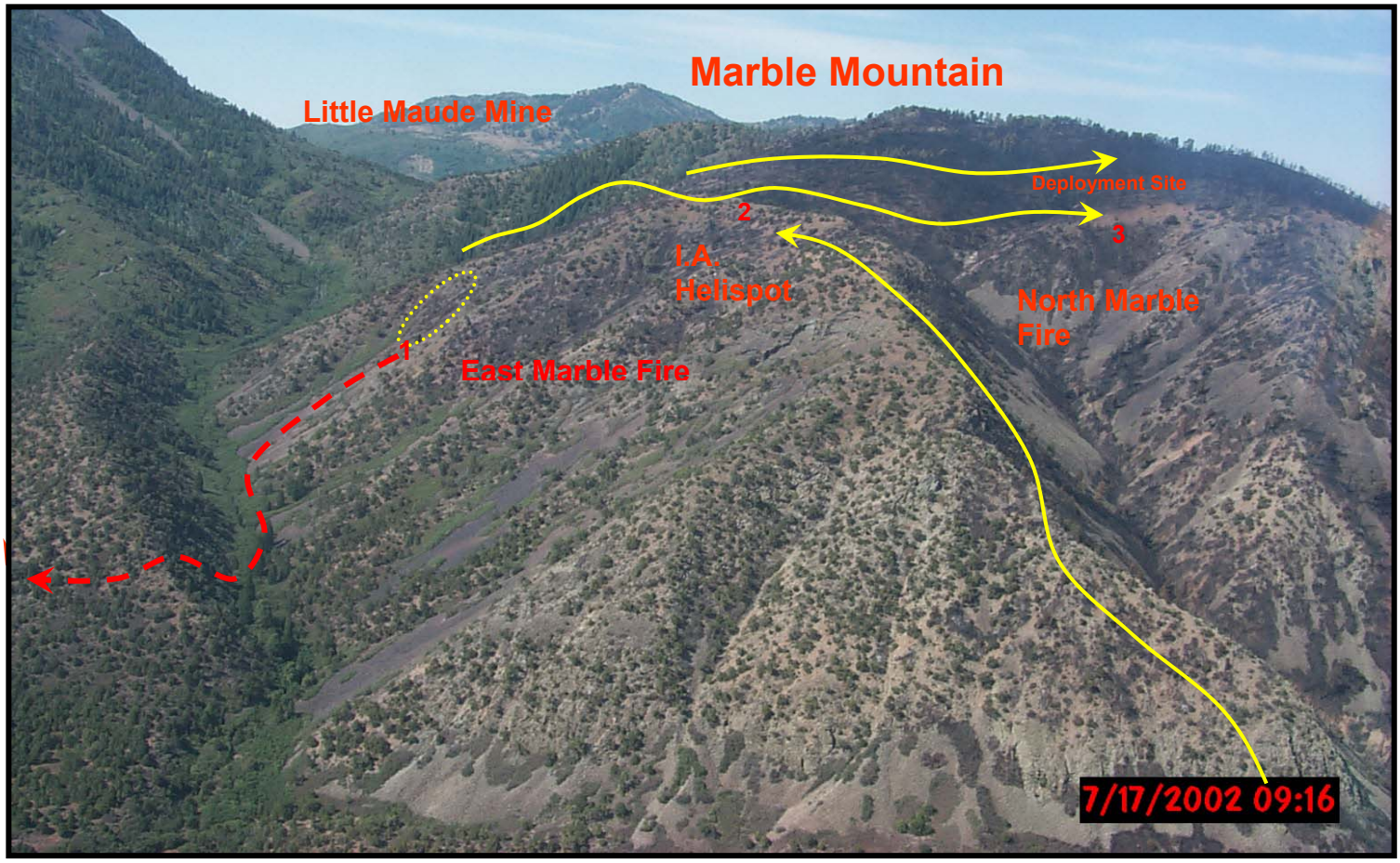
Topography

The topography of the East Marble and North Marble Fires was in mountainous terrain of the Sleeping Ute Mountain Range running North and South to the West of Cortez, Colorado. Elevation relief from McElmo Canyon to the Top of Marble Mountain was 5700 feet to 8572 feet. Slopes at both fire locations ranged from 55 to 60%. There was moderate slope above both fires in the 30 to 35% range.

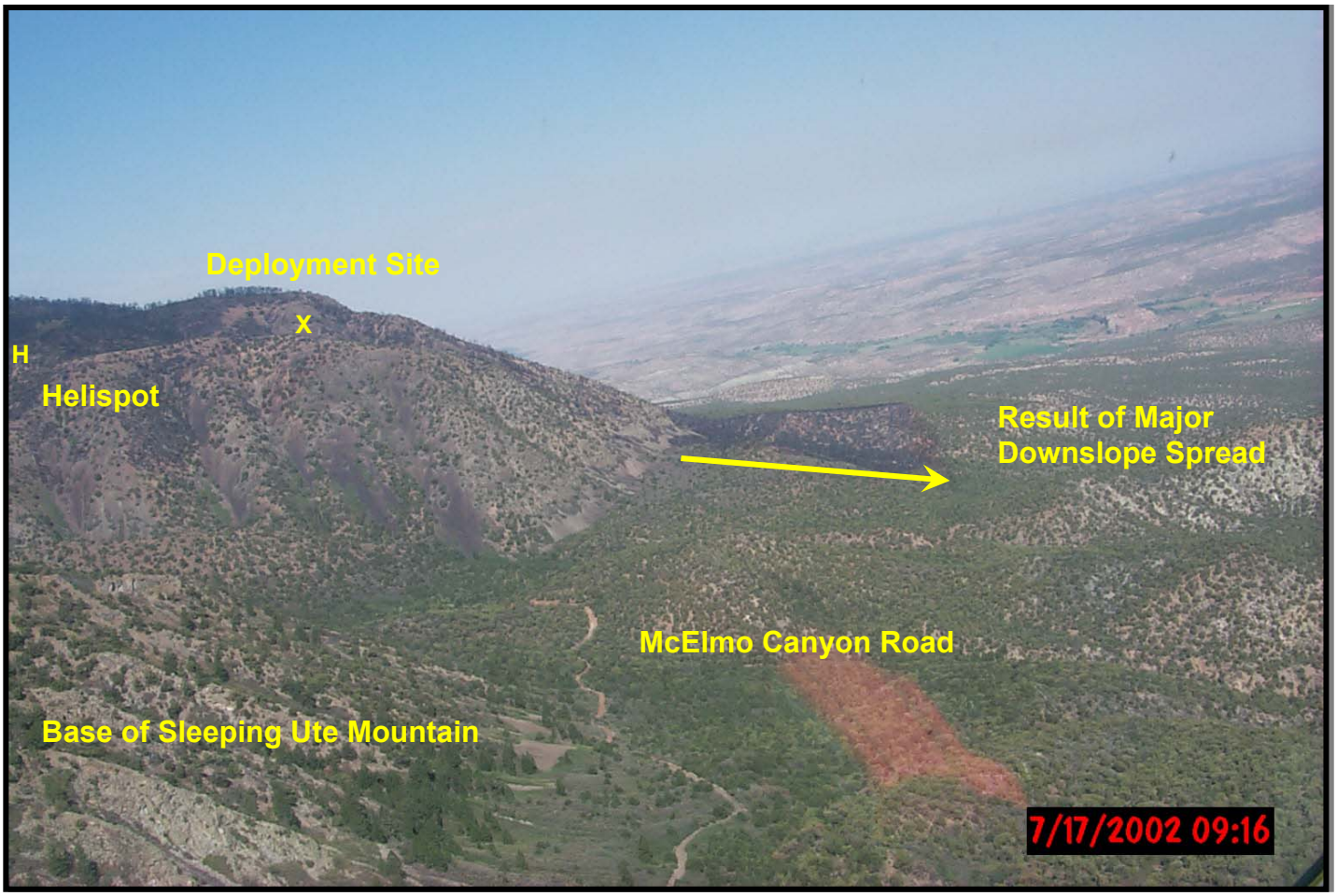
The origin of the East Marble Fire was on a mid slope ridge with an east aspect, elevation 7760 feet. The North Marble Fire origin was mid slope on a Northeast Aspect at 8080 feet elevation. The two fires where 220 feet elevation difference and 2000 feet horizontal separation. A ridge, 8120-foot elevation, near the helispot extending from the summit of Marble Mountain running northeast and southwest separated the two fires and did not allow line of sight.

The North Marble Fire was located on steep rock scree with minimal fuels surrounding it. The East Marble Fire was located in Pinyon Juniper fuels with continuous fuels to the top of the ridge. The area of critical cross slope fire run was in a basin near the top of Marble Mountain with a 35% slope and an east-northeast aspect. The head fire moved cross slope at a 60-degree vector.

The exposed east aspect, steep slopes and narrow canyon facing the strong winds that developed late in the evening are all contributing factors to the extreme fire behavior at the deployment site.



The dotted ellipse approximates development of the East Marble Fire, #1, before strong winds pushed it to the top of the shoulder ridge where the initial attack helispot (#2) is located. From here, the yellow arrows show the path of fire spread to the west, then downslope to the south, and then upslope to affect the firefighters in the deployment site, #3, for a third time. The dashed red line indicates the firefighters from the East Marble Fire walked downslope, across the canyon to the lower slopes of Ute Mountain before reaching McElmo Road. They also witnessed a downslope fire run that affected their previous location at Point #1.



Looking west toward the base of Marble Mountain. A fire scar is evident showing the downslope fire spread that occurred around 2230 hours. McElmo Canyon Road is in the foreground where firefighters from the East Marble Fire were picked-up just after midnight. The relative positions of the deployment site and helispot are shown denoting the direct exposure to strong east winds.

Fire behavior predictions were not made for the initial attack crews on the East and North Marble Fires on July 14, 2002. The fires were lighting caused and in initial attack. Using the nearby Chapin RAWS site, weather forecast, information from the initial attack personnel, and onsite visits, fire behavior predictions were calculated to determine rate of spread and fire intensities for the East Marble Fire.

Behave calculations were made using environmental inputs and data listed below:

Fuel Model	2	NFFL Fuel Model 2 was used to model the fire behavior in the open ponderosa pine stands with scattered oak brush and grass intermixed. These fuels were in the basin near the top of Marble Mountain. (Fire behavior calculations were made from behavior and best confirmed the eyewitness estimation for rate of spread.)
Fuel Model	6	NFFL Fuel Model 6 was used in pinyon-juniper with scattered grass and oak brush on the steep slopes near both fires.
1 Hour Fuels	3 %	Fine fuel moisture was calculated from the Chapin RAWS site temperature and relative humidity.
10 Hour Fuels	3.5%	Value from Chapin RAWS.
100 Hour Fuels	5.7%	Value from Chapin RAWS.
Live Woody FM	56%	Value from Chapin RAWS.
Mid-flame Wind	2-16	Calculated recorded winds at the Chapin RAWS site along with estimated wind speeds from Initial attack personnel.
Slope	35–60%	Slope average at the East Marble Fire origin and slope in the area above the deployment site.

The calculated rate of surface spread (ROS) prior to and during the entrapment ranged from 38 to 112 chains per hour in fuel model 6. From 2130 hours to 2145 hours strong east winds estimated at 30 to 40 mph created spread rates of 250 to 433 chains per hour, or 3 to 5.4 miles per hour cross slope in fuel model 2. At 2145 hr. the fire made a significant downslope run with spread rates between 125 to 195 chains per hour. The East Marble Fire transformed from a low intensity surface fire with a few individual trees torching to a fast moving intermittent crown fire with erratic fire behavior in just a few minutes. The predicted flame lengths for the surface fire during this period ranged from 17 to 21 feet. The spread rates and flame lengths well exceeded any control options.

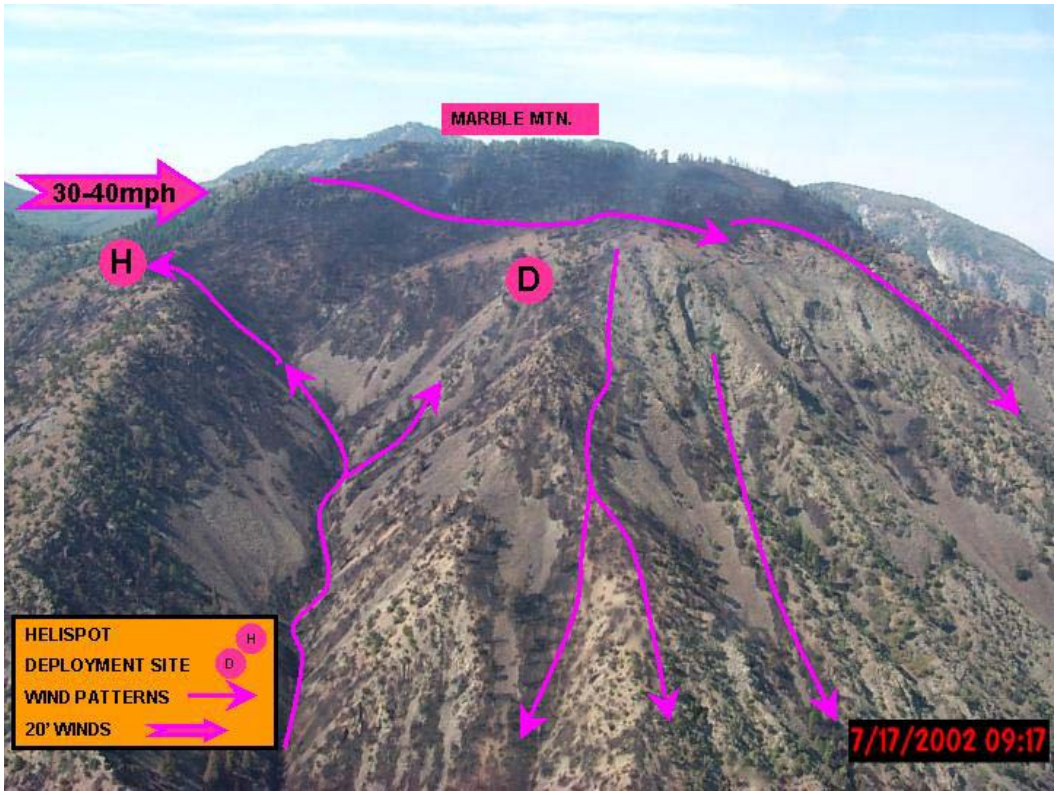
It is important to note that the North Marble Fire was not significantly influenced by the East Marble Fire behavior.

Observed Fire Behavior

The initial size-up of the East Marble Fire reported the fire behavior was creeping with moderate spread potential and at 1 ac in size. The North Marble Fire size-up reported fire behavior as creeping with low spread potential and the size as a spot.

At 2115 hours the wind on the fires had picked up and the East Marble Fire became active with torching and short range spotting upslope. By 2130 hours the North Marble Fire Incident Commander reported seeing a glow coming from over the ridge in the direction of the East Marble Fire. At 2134 hours the IC saw the East Marble Fire crest the ridge and move cross slope towards their position. The IC estimated the fire took 5 minutes to travel from the ridge to the rock scree above their position, a distance of 1700 feet. The winds were estimated to be 35-40 mph at this time from the east. The calculated rate of spread based on this account was between 3 and 3.5 mph. This coincides with BEHAVE surface fire spread rates for a Fuel Model 2.

The North Marble Fire IC reported, “fire all around them” with radiant heat on their southeast side and from above their position on the rock scree and finally convective heat from below them. Radiant heat produced from the initial run drove them into their fire shelters, and the channeling of heat energy in the major draw to their east forced convective heat and winds on them as the fire spread upslope toward the initial attack helispot location.



Wind patterns and fire spread on the evening of July 14, 2002 that contributed to extreme fire behavior and the fire shelter deployment at location D.

APPENDIX 2 – TACTICAL RISK MITIGATIONS – RISK MANAGEMENT PROCESS

This section will examine how the NWCG Risk Management Process (RMP) decision points could have been used as a management and tactical decision tool. There is no way to assure ourselves this process would have been used exactly as displayed here; it does however, demonstrate that useful information was available to make a different decision.

Step 1: Situational Awareness

1. At 1140 hours on July 14th the National Weather Service (NWS) issued a Red Flag Warning for dry thunderstorms above 7000 feet elevation until 2200 hours. Winds capable of reaching 40 mph were predicted. This forecast remained in effect with the NWS 1500 hour afternoon forecast.

2. Initial attack activities had to occur within a 2-hour time frame prior to darkness.

3. The area was remote and steep, and helicopter was the only expedient way to insert firefighters in this time period.

4. Radio repeater coverage was insufficient and this area had a history for poor communications.

5. This area was experiencing extreme drought and extreme fire behavior with high winds as demonstrated by recent fires in the area.

6. East Marble Fire had no identified safety zone or escape routes prior to engaging the fire.

7. North Marble Fire was considered low risk for increased fire activity or escape.

8. Other interagency initial attack fires were occurring at the same time in Mesa Verde National Park, and on the San Juan National Forest.

9. The agency was attempting to meet the #1 geographic area priority of quick initial attack and completing it within a narrow timeframe.

Step 2: Hazard Assessment

1. Ingredients for intense fire behavior (high rates of spread, crowning) existed: steep slopes, high occurrence of fine fuels, high fuel continuity, direct wind channeling from McElmo Creek drainage, strong frontal winds from storm cells, and drought conditions (low fuel moistures, low atmospheric moisture).

2. Poor to non-existent communications with either dispatch office or between fires.

3. Escape route potential is poor from both fires; safety zones are not readily available at East Marble Fire, and not adequate at North Marble for fire intensities produced by the East Marble Fire.

4. Confusion with terminology or concepts may have led to misunderstanding that a safety zone is synonymous with a fire shelter deployment site.

5.Lack of management direction regarding priority staffing of initial attack fires during this situation.

6. Firefighter travel is slow and laborious due to steep slopes, loose exposed soil, and loose rocks making escape and routine travel difficult and time consuming.

7. Gamble Oak cover made cross-country travel difficult, and obstructed long-range viewing.

8. Twilight insertion of firefighters limited practical size-up time as helicopter flight time was running out, and there was another mission to conclude before flight time ended for the day at about 2100 hours.

9. Late evening staffing of fires in an area with known poor communications would compound firefighter rescue if injuries occurred prior to daylight on July 15th.

Step 3: Hazard Control

1. During drought conditions, anchor points and/or effective escape routes with known and tested trigger points for escape, or accessible safety zones makes initial attack a safer environment for firefighters.

   Escape routes on either of these fires were undesirable due to steep slopes, unstable footing, and dense unburned Gambel Oak. East Marble Fire had no identified safety zone until the fire escaped initial attack, and the safety zone at North Marble was sufficient only for intensities produced from the North Marble Fire. It was not adequate for intensities produced from the East Marble Fire. <u>These situations could not be mitigated.</u>

2. Daily monitoring of RAWS data for relative humidities and dew points provides updated analysis of weather conditions and fire behavior potential.

Low humidities may have been assumed, however the constant night time low humidities would have indicated a higher potential for burning activity given the Red Flag Warning for dry thunderstorms and associated strong winds.

4. Additional mitigations are necessary to assure communications are established and maintained through initial attack operational periods; options are human radio relay, relay through aircraft (air to ground), and cellular telephones.

Use of the helicopter as an air to ground relay up to 2100 hours could have been used, and the option of establishing a ground contact in McElmo Canyon area was not done until after the entrapment occurred.

5. Initial size-up must include influencing factors for both fires. What are the opportunities and likelihood that one fire could be influenced to affect the other? The NWS had issued a Red Flag Warning for dry thunderstorms in this zone, above 7000 feet elevation, until 2200 hours. The Red Flag Warning needs to be addressed with follow-up actions prior to staffing fires. Examples would be verification with the NWS if Doppler radar indicates local storm cells, a weather watch instituted for the immediate area, and using this information in an existing decision matrix.

Firefighters had heard the Red Flag Warning in the afternoon forecast. However with night conditions a couple hours away, meeting the first priority of initial attack had to be completed quickly. It is difficult to engage a management level decision when there is need for a tactical mission; this is sometimes referred to as a "bias for action" where we conclude an operation is necessary when circumstances indicate it would be best to look at other choices. In this case, the Ute Mountain Fire Management Plan indicated an indirect tactic was preferred and a key decision maker was on another assignment.

6. Some statements were made in reference to deploying fire shelters in a safety zone.

The existing definition for a safety zone in the NWCG Glossary is convoluted and does not portray any standards or proper use. It would be more effective to conform to the definition offered in the Entrapment Avoidance CD referenced earlier in this report.

7. Night operations in remote locations have not been identified through a job hazard analysis and staffing these fires was not considered exceptionally hazardous.

There were more analytical deterrents to staffing these fires than supporting it. In view of poor access, poor communications, steep heavily vegetated terrain, and Red Flag Warning for dry thunderstorms, LCES mitigations are necessary to maintain a safe work environment. The possibility of physical injury in this area is high, and the crews did a good job of on-site mitigations for traveling across this steep terrain. However there was no alternative that would support a night medivac, or provide intermediate or advanced level of patient care if needed.

Step 4: Decision Point:

Are controls in place for identified hazards? *No – reassess situation.*

Are selected tactics based on expected fire behavior? *No – reassess situation.*

Have instructions been given and understood? *Yes – firefighters were confident in their assignment, and did not feel lacking for information. However the absence of reliable communications did provide major distractions to incident commanders, and dispatchers. A second answer to this question based on assumptions that this action will be routine in a drought-influenced area is No – reassess the situation.*

Step 5: Evaluate:

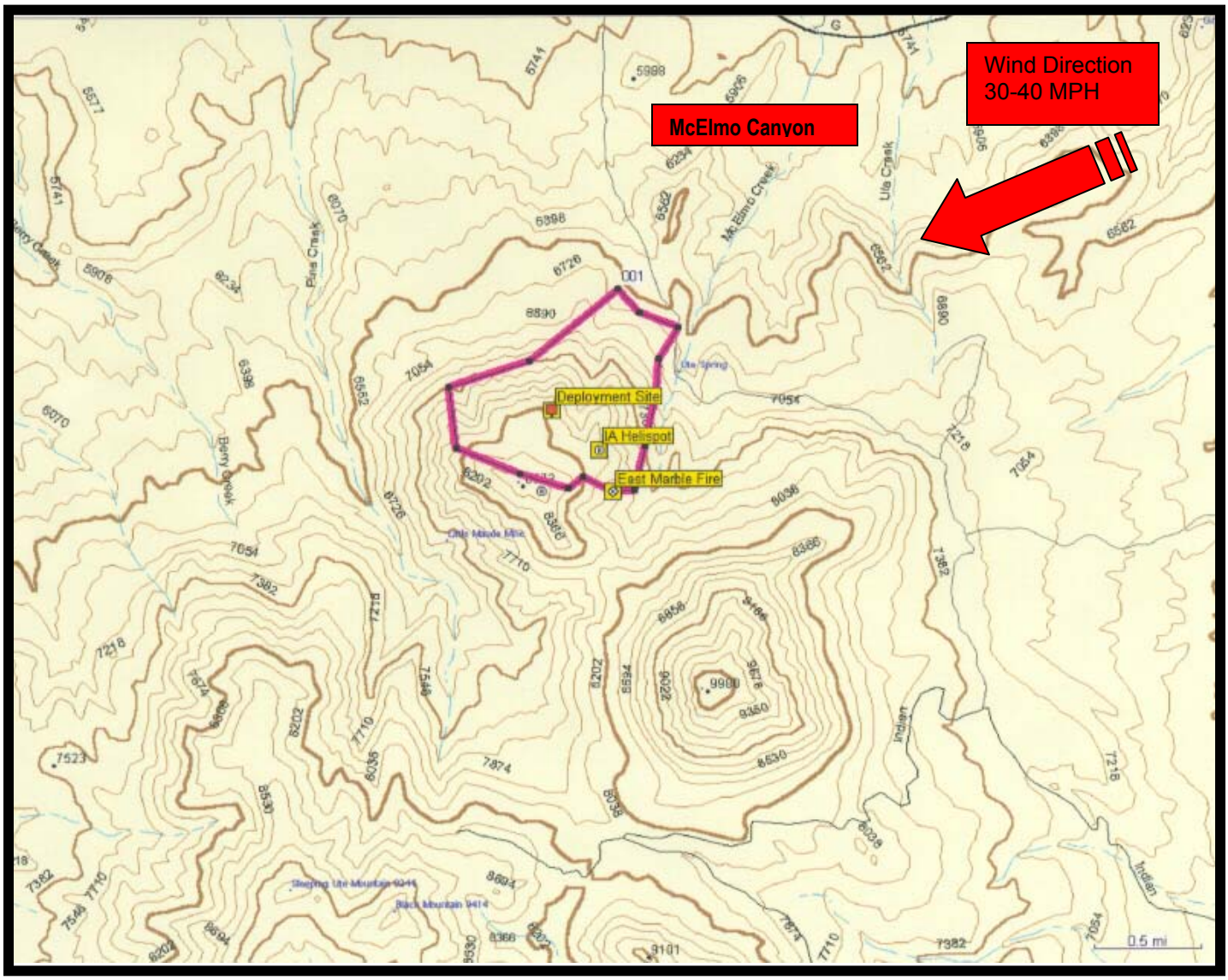
Based on Steps 1-3 and Decision Point checks, the Risk Management Process directs a reassessment of the situation. In this case, risk is not rated as high or low, but the overwhelming conditions of uncertainty are liberally applied because of fire weather, fuels, and topography; this assignment involved all elements of the fire environment, which presented unmitigated risks.

APPENDIX 3 - AREA MAP OF MARBLE MOUNTAIN

MARBLE MOUNTAIN AREA MAP

Cortez, CO is about 46 miles west of Durango, CO. Marble Mountain is about 12 air miles southwest of Cortez, and less than 9 air miles due west of the Cortez Airport.

APPENDIX 4 - MAP OF FIRES AND DEPLOYMENT SITE



EAST MARBLE FIRE & FIRE SHELTER DEPLOYMENT LOCATIONS MAP

The purple line indicates Marble Mtn. Fire perimeter as of July 15, 2002 at 1330 hours. The locations of the East Marble Fire, the initial attack helispot, and the deployment site are indicated. The North marble Fire site was located downslope from the deployment site about 200 yards to the northeast.. Map labeling would totally cover that location for mapping purposes. Strong winds were easterly and were channeled upslope through McElmo Creek (Canyon).

APPENDIX 5– QUALIFICATIONS AND CURRENCY

Fire Management at the Ute Mountain Ute Agency has been proactive towards achieving Bureau of Indian Affairs, and NWCG Currency and Qualification standards.

Interviews with Fire staff, and a review of training files, indicate all the firefighters involved with the East and West Marble fire had attended an annual firefighter safety refresher course, and all had passed the Work Capacity Test this spring. A review of time sheets showed all involved firefighters were within the 14 and 1 day off schedule, and none had excessive shift lengths during the past pay period.

In addition, FMO made a point of personally conducting the annual refresher training to assure a quality presentation, and to get to know the local GS and AD firefighters. Comments from the involved firefighters credit this training as an important factor in preventing a more tragic outcome. Fire shelter training included fans, and multiple deployments (six times).

Ute Mountain Ute Fire Management has not been as successful in updating firefighter qualification records, or able to provide ready access to these records. It appears there were no training records available two years ago, and vigorous attention has been focused on this problem. Agency direction dictated all non-SACS red-cards are to be destroyed, and only Boise produced red-cards will be used. Locally produced red-cards were dutifully shredded, but so far, with agency-wide computer system shutdown being a factor, appropriate red-cards have not been 100% reissued.

In addition, a portion of the red-card files was off site with the FMO on a crew dispatch.

The accompanying matrix was developed by piecing together the available information. For the most part, firefighters were qualified for their red-card rating. The exception was with the two ICT5s, and the lack of 310-1 mandated S-133 (Look Up, Look Around). For one of the IC's, single resource Engine Boss requires S-290 (Intermediate Fire Behavior).

It does not appear these shortcomings were revealed in performance issues, with the exception of 1) a generally low quality fireline briefing that should have included fundamental LCES mitigations, and 2) it was not understood by all firefighters that safety zones are areas where all involved can comfortably ride out a fire blow-up, without the need of a fire shelter.

TRAINING & QUALIFICATIONS

NAME	HIGHEST QUALIFIED POSITION	POSITON ON FIRE	LAST DAY OFF	DATE OF ANNUAL REFRESHER	WCT	RED CARD QUAL.	S130 S190	S230	S231	S212	S131	S133	S290
	GS-Helitack	ICT5	7/13	4/06/02	4/06/02	FFT1 ENGB	X	2/02	2/02	6/01	6/01	X	X
	AD-FFT2	FFT2	7/07	6/01/02	6/5/02	X	6/00	X	X	X	X	X	X
	AD-FFT2	FFT2	7/07	7/03/02	7/03/02	X	3/01	X	X	X	X	X	X
	AD-FFT2	ICT5	7/10	5/15/02	4/24/02	FFT1 FALB	5/00	X	X	6/01	6/01	X	X
	AD-FFT2	FFT2	7/05	6/12/02	6/12/02	X	5/02	X	X	X	X	X	X
	AD-FFT2	FFT2	7/05	X	X	X	X	X	X	X	X	X	X

X - No Records Available

APPENDIX 6– CHRONOLOGY OF EVENTS

MARBLE MTN. FIRE ENTRAPMENT **SEQUENCE OF EVENTS JULY 14-15, 2002**		
DATE	**TIME**	EVENT
July 14	1920	North Marble Fire IC and crew receive dispatch orders and prepare to spike out the night.
July 14	1923	Initial fire size-up reported by helicopter 4EC to Durango Dispatch (DRO) of East Marble Fire, headed back to base to pickup personnel. Reports IC has communications.
July 14	1930	IC + 2 arrive at helispot on Marble Mountain.
July 14	1945	IC and crew arrive at the East Marble Fire and estimate size at ¼ acre. IC and crew depart Towaoc for helispot on Marble Mountain.
July 14	1950	IC contacts DRO with size-up and requests bucket drop.
July 14	2000	IC + 2 arrive at helispot on Marble Mountain (4EC). They walk west toward the North Marble Fire; fire is visible from the helispot. IC and crew digging fireline as East Marble Fire increases burning intensity.
July 14	2030	East Marble Fire exceeds 1 acre in size.
July 14	2033	4EC going to base, eta 15 min.
July 14	2030+	East Marble IC makes repeated trips to helispot ridge attempting to contact DRO to report East Marble Fire activity.
July 14	2046	4EC had contact with IC on Goodman repeater.
July 14	2053	4EC arrives at Cortex Airport.
July 14	2056	Returning from fire reconnaissance 4EC reports to DRO the East Marble fire is getting active. Reports they may need retardant tomorrow, contact through the night.
July 14	2100	IC and crew arrive at North Marble Fire. The fire is characterized as 2-3 trees with very low spread potential. IC could not establish radio contact with DRO or Ute Mountain Base. IC and crew walk upslope to establish a camp for the night due to low fire spread potential. He notes winds are increasing, 15-20 mph. Firefighters at East Marble also note winds increasing, IC climbs to higher ground to establish communications with DRO, no contact.
July 14	2110	IC climbs uphill to a flat spot and locates a camp for the night since spread potential for their fire was considered very low. Firefighters at East Marble begin to enlarge their “safety zone” at the heel of the fire; East Marble Fire is very active now. IC tries going to higher ground again to make radio contact, no contact.
July 14	2130	North Marble fire crew locates a campsite about 200 yards upslope from North Marble Fire. The crew notices a red glow over the horizon to the southeast coming from the East Marble Fire. IC could hear two firefighters, but could not transmit. Baker requested IC click his microphone twice if everything is ok. Reports of fire progress are given to them and they are advised to walk out the bottom.
July 14	2131	DRO attempts to contact IC, no contact.

July 14	2134	North Marble IC starts to take crew downslope to the North Marble Fire when they saw flames coming over the ridge from the East Marble Fire. IC estimates winds had increased to 35-40 mph from the northwest, and blowing directly at them. Tries to contact DRO without success.
July 14	2140	IC observes extreme fire behavior with spotting and rapid fire spread coming towards them.
July 14	2145	IC directs his crew to move down downslope and deploy their shelters on a rock outcropping.
July 14	2200	Broadcasts are made to IC using the Agency simplex channel. He relays what he sees from the valley, and recommends they leave the fire and walk out the bottom. IC using this information knows the fire is moving northwest, and they will escape going east, down canyon.
July 14	2209	DRO receives a broken transmission from IC.
July 14	2214	Fire staff trying to reach IC on Hermano repeater.
July 14	2219	DRO receives unreadable transmission from IC.
July 14	2221	E4051 calls FF, they are coming down Whiskey Road, getting windy, heading back to base, no contact with IC.
July 14	2222	DRO receives a broken transmission from IC.
July 14	2225	DRO receives a transmission the fire is going into McElmo Canyon.
July 14	2226	The fire has gone down into McElmo Canyon on west side.
July 14	2228	DRO attempts to contact IC, no contact.
July 14	2234	E4051 located above Horseshoe Lake, no contact with either IC.
July 14	2238	DGO receives call from E-4051 the fire is running downhill on the west side.
July 14	2248	East Marble IC and crew having walked crosscountry onto Ute Mountain is finally able to contact and inform they were walking out. They had no idea what was going on at North Marble Fire.
July 14	2251	AFMO calls DRO and informs them IC and crew are walking out to McElmo Road, NE of fire; fire is heading west toward the N Marble fire, estimate 20 acres.
July 14	2255	DRO receives a call from WT16; the fire is over the ridge, down Marble Mtn. on west side and going up the next hill.
July 14	2258	North Marble IC calls and informs him the fire overran them, they had to deploy fire shelters on a rockslide; fire all around them, they are in the black and ok. Advises not to move.
July 14	2145-2310	IC and both crewmembers remain in their fire shelters. IC is able to contact DRO for a few seconds and notify them the East Marble Fire had blown up and shelters had been deployed, transmission and reception scratchy.
July 14	2315	IC and crewmembers exit fire shelters. They survived the burnover without injury but had experienced heavy smoke and some embers while inside their fire shelters. They observed the fire had severely burned the landscape in all directions around their deployment area. Radio contact is established with AFMO. IC verifies no injuries. AFMO instructs them to stay there for the remainder of the night and they will be picked up by helicopter in the morning.
July 14	2330	IC and crew remained in the rock slide and watched fire burning around them.

July 15	0006	IC and crewmembers are picked up on the McElmo Canyon road.
July 15	0145	IC and crew move from deployment area to flat camp spot as the fire behavior had dramatically decreased activity.
July 15	0730	IC and crewmembers arrive at the initial attack helispot.
July 15	0830	Helicopter 4EC pick up IC and crewmembers and transport them to the Cortez airport.

APPENDIX 7 – PICTURES

PICTURE 1. APPROACHING MARBLE MTN. FROM THE EAST

PICTURE 2. DRIFT SMOKE FROM NORTH MARBLE I.A. FIRE

PICTURE 3. NORTH MARBLE FIRE FROM HELISPOT

PICTURE 4. DEPLOYING FIRE SHELTERS

PICTURE 5. EMBER SHOWER

PICTURE 6. COMING OUT OF FIRE SHELTERS

PICTURE7. NORTH MARBLE FIRE FROM HELIS POT

PICTURE8. NORTH MARBLE FIRE AREA FROM HELIS POT

PICTURE 9. COMPOSITE PICTURE FROM HELISPOT TOWARD NORTH MARBLE FIRE LOCATION

PICTURE 10. FROM DEPLOYMENT SITE EAST TO HELIS POT

PICTURE 11. AERIAL VIEW OF HELIBPOT AND DEPLOYMENT SITE

PICTURE 12. NORTH MARBLE DEPLOYMENT SITE

PICTURE 13. DRAW EAST OF DEPLOYMENT SITE

PICTURE 14. EAST MARBLE FIRE FROM HELISPOT RIDGE

PICTURE 15. FROM EAST MARBLE FIRE LOOKING UPSLOPE

PICTURE 16. EAST MARBLE FIRE LINE GEAR & CHAINSAW

PICTURE 17. EAST MARBLE FIRE VIEW OF ESCAPE ROUTE

APPENDIX 8-UTE MOUNTAIN FIRE PLAN APPROPRIATE RESPONSE TABLE

APPROPRIATE MANAGEMENT RESPONSE TABLE 3

AMR # 1 -SUPPRESSION ACTIONS "TRIGGER POINTS" FOR TACTICAL OPTIONS				
CRITERIA	**ELEMENT**	**THRESHOLD**	**TACTIC**	**TACTIC**
			DIRECT OR PARALLEL ATTACK	**INDIRECT ATTACK**
SAFETY	**Safety Zones and Escape Routes**	**Fuels and topography limit safety zones and escape routes near fire perimeter.**		**x**
	Lookouts and Communications	**Insufficient warning/reaction time for forces working near fire perimeter**		**x**
	Hazards	**Snags, power lines, dumps, pipelines, oil & gas sites, or other hazards in/near fire perimeter**		√
Fire Behavior	**Flame Length**	**< 6 ft**	√	
		>8ft		**x**
	Fire Spread	**Ground and/or surface fire**		
		Frequent or long-range spotting		√
		Erratic fire behavior or aerial (crown) Fire		**x**
Topo-graphy	**Slope**	**< 15%**	√	
		> 30%		**x**
	Relief	**Chute, chimney, or box canyon**		**x**
Fuels	**Ignition Potential**	**Flashy fuels or incomplete burn with possibility of reburn in islands or overstory (the "black" is not safe)**		√
	Fuel Moisture	**Low fuel moisture is resulting in rapid rates of spread and/or high fire intensity**		√
WEATHER	**Wind**	**Sustained winds >**		
	Relative Humidity	**< 20%**		√
	Red Flag	**Red Flag Alert or Warning**		√
IC's DISCRETION	**All Elements Combined**	**Direct/parallel attack safe and efficient**		
		Risks posed by direct/parallel attack not commensurate with benefits or values being protected		**x**
√ = Management Action suggested (consider other elements) x = Management Action required (based on this element alone)				

APPENDIX 9– SERIOUS ACCIDENT INVESTIGATION TEAM
MARBLE MOUNTAIN FIRE SHELTER DEPLOYMENT
JULY 14, 2002

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APPENDIX 10 – 72 HOUR BRIEF

Marble Fire Deployment Investigation

72 Hour Brief

On July 14, 2002 two lightning-caused fires were detected on Marble Mountain on the Ute Mountain Ute Indian Reservation in Southern Colorado. These fires were initial attacked by two 3-person modules from the Bureau of Indian Affairs. They were inserted by helicopter on a mid-slope helispot between 1930 and 2000 hours, and the helicopter departed the area for another assignment. The fires were designated as the “North Marble” and “East Marble” fires.

Radio communications both to Durango Dispatch and between the fires was poor to non-existent. The fires were about 2100 feet apart, and separated by a steep ridge. At 2130 hours, the firefighters on the “North Marble” fire noticed a glow on the horizon coming from the “East Marble” fire. By 2134 hours, the winds had rapidly increased to 35-45 mph, and were blowing burning embers from the “East Marble” fire past the 3 firefighters on the “North Marble” fire.

When the fire crested the ridge between the two fires, the Incident Commander on the “North Marble” directed his crewmembers to move to a rock scree slope that was designated as their Safety Zone, and to deploy their fire shelters. They entered the shelters at approximately 2145 hours, and remained in them until about 2330 hours. After they emerged from their shelters, they stayed on the site overnight because of the steep rocky terrain and the darkness. None of the 3 firefighters were injured, and their fire shelters performed as designed. The firefighters were evacuated by helicopter on the next morning. The 3 person I.A. module that had been working on the “East Marble” fire observed the escalating fire behavior conditions on their fire, and hiked out to a safety zone; they did not deploy fire shelters.

Lessons for the Field

Based upon the preliminary findings by the Investigation Team, the following Lessons Learned should be transmitted to all wildland firefighters for the remainder of the 2002 Fire Season:

1. Incident Commander of the North Marble fire identified safety zones from the helicopter before committing to the fire.
2. Fire Shelter training works! Based on interviews with the individuals that deployed, their refresher fire shelter deployment training was a good representation of the conditions they faced in an actual deployment event. The winds were strong, and required that they hold down the shelters; the noise was loud, not unlike a nearby train; the red/orange glow could be seen through the pinholes in the shelters; and holding down the edges of the shelters restricted the entry of heat and gases.
3. Deployment on a rock scree slope proved successful, as shown in “Your Fire Shelter – 2001 Edition”, but requires special efforts to get a good seal to prevent heat and gases from entering. Firefighters in a deployment situation should consider rock scree slopes only as a last resort deployment area if other options are available.

4. In areas of known radio communications problems, mitigation measures must be identified before firefighters are assigned to the area.
5. Strong leadership was an important factor in the safe and successful deployment: directions were clearly given, and were understood and followed.

The report of the Interagency Marble Fire Deployment Investigation Team will be issued within 45 days.

_____
John Waconda
BIA- SW Regional Forester

APPENDIX 11 – DELEGATION OF AUTHORITY