VIRGINIA LAKE FIRE ENTRAPMENT

August 13, 2001

U.S. Department of the Interior
Colville Indian Reservation, Washington

VIRGINA LAKE WILDLAND FIRE ENTRAPMENT INVESTIGATION TEAM

Roy Doore, Team Leader
Bureau of Indian Affairs, Blackfeet Agency
Browning, MT

Benjamin R. Chio, Safety/Health Officer
Division of Safety & Risk Management
Albuquerque, NM

Carl Gossard, Chief Accident Investigator
National Interagency Fire Center
Boise, ID

Jim Steele, Fire Behavior Analyst
Bureau of Indian Affairs
Missoula, MT

Del Ostenberg, BIA Fire Mgmt. Team Liaison
Bureau of Indian Affairs
Nespelem, WA

Douglas Maryott, Operations Specialist
U.S. Forest Service
Coeur d'Alene River Ranger District
Coeur d'Alene, ID

Investigative Support

Linda Nee, Documentation
Bureau of Indian Affairs
Forestry, Administration
Nespelem, Washington

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Early on the morning of August 13, 2001 a thunderstorm passed over the western portion of the Colville Reservation. It ignited several fires. The suppression organization began initial attack on the fires beginning at around 5:00 A.M.. Darrell Dick and Richard Epperson initially responded to Fire #122, which was located near the mission turnoff.

Dick was informed that he would be responsible for several fires located in the same general area. About mid morning, the Goose Lake Fire (#123) began to get active. Allen Antoine was the Incident Commander (IC) on this fire. Dick assisted Antoine in getting additional resources to this fire.

At around 10 A.M. several different people, including helicopter 69PF, the Goose Lake IC, and several members of the District 8 Volunteer fire department, noticed a smoke column over Soap Lake or Cameron Lake. District 8 sent Kirk Kramer out with his dozer to begin working on this fire. This fire was named the Virginia Lake Fire (#132).

Around midday Dick was sent from fire 122 to fire 132 to be IC. When Dick arrived on the fire he tied in with Ken Kramer(District 8) who had already started the dozer with Kirk Kramer and Brian Featherly south along the east side of the fire and then west on the McMurray road to establish a fireline. After discussing the situation with Kramer, Dick decided to send Epperson and Christie down the other flank (north and then west) to flank that side of the fire. Pib Morris (local rancher) was sent with them as a guide. They were to be supported by a FMC which would burnout the line.

Between 3:45 and 4:15 P.M. a thunderstorm passed over the fire intensifying fire activity and the fire began pushing the NE flank. This is the time that Epperson and Christie retreated to the safety zone, cleared a spot to mineral soil with the dozer, and entered their shelters. Pib Morris left the area on his 4 wheeler to find his grandchildren. Jon Batten in helicopter 69PF heard Epperson's radio call that they were trapped and getting ready to deploy their shelters. Batten remained over the blowup the entire time that Epperson and Christie were in their shelters talking to them on the radio. He also had two SEATs orbiting ready to drop retardant if they had a chance.

During this time, Epperson indicated that he had been burned. Jon landed, got off the helicopter, and put Cody Belkoff (EMT) on the helicopter to assist Epperson and Christie after the fire passed over the safety zone. Almost immediately after Belkoff got into the air on 69PF the smoke cleared enough in the safety zone for the helicopter to land, pick up Epperson and Christie and fly them out.

As the Epperson-Christie entrapment was occurring, the District 8 dozer was finishing the fire line on the McMurray Road and had turned around to widen the line to two blade widths. They proceeded up the McMurray road and upon getting to the McMurray homestead, noticed that the fire was immediately to their north and approaching fast. This was sometime between 5 and 6 P.M. They cleared a 5 blade wide area in the meadow they were in and parked the dozer in the

middle of this area. They watched the fire for about five minutes, noticing several embers igniting fires in the meadow around them. They were in front of the dozer blade; their fire shelters were on the dozer tracks. They reported that all of a sudden the entire meadow erupted in fire and they only had time to get under the dozer. They threw dirt on each other as embers landed on them. They were under the dozer for about 30 minutes as the fire burned past them. There was a period of about 2 minutes when they reported there was no air to breath.

Epperson and Christie were both treated and released at the local hospital. They each had mild smoke inhalation and Epperson had a small burn on his hand that needed no additional treatment. Kramer and Featherly did not seek any medical attention.

The Serious Accident Investigation Team was briefed at 2200 hours on August 14, 2001 at the Mt. Tolman Fire Center. 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 personnel and members of the District 8 Volunteer Fire Department; on-site observations; and technical analyses of factors including weather, climate and fire behavior. Involved personal protective equipment has been sent to the Missoula Technology and Development Center for further analysis.

INCIDENT OVERVIEW – GENERAL

The weather pattern on the Colville Indian Reservation on August 12, 2001 was hot, dry, and included gusty winds. The fire situation included a Red Flag Warning for dry lightning in the early evening, and the Agency had kept fire crews later than usual. The forecasted lightning didn't develop, however, so the Agency released the crews at 2100.

In the early morning hours of August 13, another storm cell moved through the Reservation, and the Agency documented over 50 lightning strikes. After the storm cell moved through the area, reports started coming in, indicating that approximately 20 fires had occurred from the storm. Out of these small fires, the first report of a larger fire was in the Mission Road area. The second large fire reported was at the Goose Lake area, and the third large fire was in the Virginia Lake area.

All through the morning new fires were being reported and resources were reallocated to deal with the new fire reports. Both Darrel Dick and Richard Epperson were working on fire number 122 until about noon. Kramer and Featherly were sent to the area between 0930 and 1000. They began taking action from the loop road (suppression of what became fire #132) sometime after this. Darrel Dick arrived at fire number 132 at approximately 1300 hours, met with Kramer and Featherly and determined their plan of action (blade dozer line to the McMurray road and then clear the road down to the Soap Lake Road). Dick then briefed Epperson to construct line with the dozer down to Highway 97.

INCIDENT OVERVIEW – PART A – VIRGINIA LAKE
Richard Epperson and John Christie

At approximately 1330, August 13, 2001, Richard Epperson (Line Scout) and John Christie (dozer operator) begin fire line construction toward Highway 97 after getting a briefing from Darrel Dick, ICT3 assigned to the fire (Pib Morris, a resident of the area, accompanied the dozer to function as guide). They began line construction on the east side of the fire following a jeep trail to the north and west. Dick instructed Epperson to "go slow and double up on the dozer line", and to make sure he was in the right area. He instructed him to stay 300 to 400 feet from the east side of the fire to allow it to back to the line. Dick showed Epperson some potential safety zones on a map, which Dick had seen during his flight in Helicopter 69PF.

At 1414, Dispatch called Dick and he relayed that Epperson was leading the D-6 dozer to construct line.

At 1515, ICT3 Dick called Dispatch to report that Fire #132 is lost on the northeast side; they are pulling back to the main Cameron Lake Road.

At 1519, Dick reported to Dispatch that the threat is east to the main Cameron Lake Road (Cameron Lake Road is due east of the fire). If the fire crosses this road, there may be houses in danger within ¾ to 1 mile away.

At approximately 1550, Epperson and Christie decided to abandon line construction and head for an old lakebed.

At approximately 1552, Epperson requested a SEAT drop to cool down a flare-up so they could get the dozer past it. They then proceeded to the meadow that the SEAT pilot directed them to.

At 1600, Epperson realized Fire #132 had increased in intensity and begun to change spread direction. Assisted by the SEAT, they reached the open meadow. They first tried to scrape a shelter deployment site in the center of the meadow, but it was too hard for the dozer to break the sod, so they moved toward the west side of the meadow and scratched a deployment area about 75 by 25 feet (three (3) blade-widths). Pib Morris left on his 4-wheeler to find his grandchildren.

At 1605, Epperson decided they should enter their fire shelters as a crown fire approaches. He has contact with Jon Batten (Helitack Foreman on Helicopter 69PF) on the radio.

At 1613, Dick reported to dispatch that fire #132 had bumped hard on Cameron Lake Road. He reported that if the fire jumped the road, dozens of homes would be in danger.

At approximately 1615, Epperson came out of the shelter briefly, and decided they should remain in the shelters longer. He had radio contact with Batten and voice contact with Christie.

At 1630, Batten called Dispatch on his cell phone and informed them that the Cates-Erb dozer, Resource Order E-1, was burned over with Epperson and Christie. He related that he had to help direct them and talk them through the incident, and that it had been a difficult experience for him.

At 1635, Epperson and Christie came out of the fire shelters.

At 1640, the smoke cleared enough that Helicopter 69PF, with Cody Belkoff, EMT, could extract Epperson and Christie. They returned to the helispot.

Epperson was taken to Omak staging and then to the hospital where he was treated and released. Christie left with the dozer owner and was treated and released at the hospital.

INCIDENT OVERVIEW – PART B – VIRGINIA LAKE
Barry Featherly and Kirk Kramer

The response of Barry Featherly, Line Scout and Kirk Kramer, dozer operator, was requested by Ken Kramer, Fire Chief for the Volunteer Fire District #8 through James McCuen, District 8 Commissioner. The equipment they were operating was a D-6 Caterpillar. The request for Barry Featherly came about because of the need for someone who knew the country.

Featherly had come over from the ongoing Soap Lake Fire with Kirk Kramer, operator. They unloaded at a point called the Loop Road (southeast of the fire) and followed the road in. They met with Darrel Dick at around 1300 hours when he first arrived at the fire, briefly discussed the strategy, and then began dozing a fire line heading south to the McMurry Road. Once they reached the McMurry Road they followed it to the west and then northwest to the Soap Lake Road. Upon reaching the road, they were to return, making a double swipe to widen the fire line.

They had reached the area of the old McMurry homestead on their second pass and had noticed the fire was now immediately north of them and in the process of cutting them off from retreating back to the Soap Lake road. Somewhere between 5 and 6 PM, they stopped in the meadow of the old homestead, and noticed that the west end of it had very sparse vegetation. They decided to clear an area there for a safety zone. Kramer then made five swipes to bare the ground to the size of about 42 feet by 55 feet.

They placed the dozer inside the bare area, in a parallel direction to the oncoming fire. They got out of the dozer and went to the front, using the blade for protection. They laid their fire shelters on the dozer track. They stayed in front of the dozer watching the fire for about five minutes. At this point embers began starting small fires in the meadow all around them. They stated that all of a sudden the entire area was on fire and they barely had time to get around and under the dozer. In their haste they left their shelters on the dozer track.

Neither individual could remember how long they had stayed under the dozer, but from best recollection, it seemed about 30 minutes. During that time, they experienced very harsh fire behavior, strong and gusty winds, flying embers, dust and a period where breathing became very difficult from what seemed like a reduction of oxygen.

In the interview, they claimed because things got so hectic, they did not have enough time to deploy fire shelters. The best the two individuals could do was to throw dirt on each other to keep the embers from burning them. Featherly did have a fire shirt and pants, and adequate footwear and gloves. Kramer had a fire shirt, but had Levi jeans and had lost his gloves in the excitement. The crew lacked goggles, and did not deploy shelters.

After the fire passed, they then proceeded walk the dozer out to the east until meeting with Kramer's wife at the Loop Road. She picked them up at this time. They didn't pick the dozer up until the next day.

Neither individual had been burned severely enough to need medical attention, but both were pretty well shaken from the experience.

INVESTIGATION PROCESS

The investigation of the Virginia Lake Entrapment was initiated by the Bureau of Indian Affairs through the National Office of Fire and Aviation.

The Serious Accident Investigation Team (SAIT) received a Delegation of Authority on August 14, 2001, from the Regional Director of the Pacific Northwest Region.

1. Team members were notified on August 13, 2001, and convened at the Spokane Airport in Spokane, Washington at about 1700 hours. The team then traveled to Mt. Tolman to receive the delegation of authority and initial briefing.

2. The team then proceeded to use the procedure outlined in the DOI 485 DM, Accident Investigation.

3. The team visited and examined the incident site on the morning of August 15, 2001. After this the team set up facilities and discussed procedures and assignments.

4. The team interviewed the individuals who deployed their shelters, the helicopter foreman who was in contact with the individuals, and the owner of the dozer.

5. During the course of this investigation the team interviewed witnesses, members of the Colville Agency Fire Suppression organization, the District Eight Volunteer Fire Department, and the Virginia Lake IMT.

6. On August 15th and 16th the team collected additional information pertaining to weather data, burning conditions, fuel combustion, rate of spread, and topography.

7. On the afternoon of August 15th the team learned that another entrapment may have occurred at approximately the same time on the same fire, involving members of the District 8 Volunteer Fire Department. This was confirmed by interview on the morning of the 16th. There were no shelters deployed on this entrapment.

8. Clothing and other personal protective equipment from the original entrapment site was collected and sent to the U.S. Forest Service's Missoula Technical Development Center (MTDC) for determination of fire protection effectiveness.

9. The team conducted interviews on August 16th and 17th and delivered the 72 hour report on August 17th.

10. On August 18, 2001 the team visited and photographed the second entrapment site. No equipment was at the site.

11. The team conducted additional interviews and put together the draft report covering both entrapments on August 19th.

12. The team briefed the BIA Asst. Superintendent, the Colville Agency Fire Management personnel, and members of the tribal council at 1300 hours on August 20th. The team then departed to their homes.

FINDINGS AND RECOMMENDATIONS

Fire Behavior

Findings:

1. Fuels - The extended drought led to extremely dry fuels. Areas normally considered to be safety zones were inadequate because of this.

2. Weather - Normal diurnal wind changes did not occur on August 13, and a passing storm cell provided for shifting wind direction and increased wind velocities. This contributed to unexpected and extreme fire behavior.

3. Topography - Topography did not allow for direct attack, or effective positions for ground-based lookouts. This contributed to poor and untimely intelligence on fire behavior. The major ridge system paralleled the Okanogan River, and was exposed to major winds. Both of these conditions made the fire area very susceptible to wind influences.

Recommendations:

1. Ensure that daily reminders of extreme fire conditions and expected fire behavior reach everyone involved in fire management activities.

2. NWCG should fully develop recent research findings relating to what constitutes effective safety zones, and incorporate these findings into training and job aids.

3. Grassy meadows should not be considered safety zones for the remainder of the 2001 fire season or at least until extreme fire behavior conditions moderate.

Environmental Factors

Findings:

1. Smoke - Smoke hid the fact that there was a thunder cell moving through the area.

2. Temperature - Sustained high temperatures over several days raised fuel surface temperatures, contributing to rapid ignition and burning of fine fuels.

3. Visibility - Topography (steep canyons and numerous rock outcrops) limited the ability to observe the fire from the ground.

4. Wind - Expected diurnal wind change did not occur. Winds usually shift from a north wind to a south wind by 1530 - 1600 hours. This did not occur during this fire. This could be a warning sign that conditions have changed and standard procedures may not be effective.

5. The amount of rock present in this area made it very difficult to establish fireline to mineral soil. The amount of rock also led to a false sense of security (rock outcrops considered anchor points in the line).

Recommendations:

1. If thunder cells are beginning to form ensure that the information is communicated to the IC.

2. Pay special attention to fuel conditions following several days of hot dry weather.

3. Establish an aerial platform dedicated to nothing but observation of the fire in areas where ground lookouts are ineffective.

4. Be aware of any departure from normal conditions, and use it as a trigger to re-evaluate strategy and tactics.

5. Closely evaluate the adequacy of rock outcrops to act as fuel breaks and anchor points.

6. In this area, stay on established roads or trails with dozers. This would probably hasten fire line construction.

7. When developing strategy, use the risk management process in the Incident Response Pocket Guide (IRPG) NFES #1077.

Incident Objectives

1. Strategy - The strategy was to flank the fire from the roads on top of the ridge and work down towards the river and the Soap Lake road. This led to downhill fire line construction.

2. Strategy - There were not enough resources to implement the selected strategy in a timely manner.

3. Tactics - As the dozers constructed line there was no attempt to burn out the line. They were unable to carry a safety zone (in the black) with them as line was being constructed.

4. Anchor point - There was not an anchor point from which to start fire line construction.

5. Instructions given – The IC gave instructions on how he wanted the line constructed, but it was not clear how far the dozers should go before doubling back and widening their line.

Recommendations:

1. When contemplating downhill line construction, review the downhill fire line construction checklist in the IRPG.

2. Ensure that resources are available to implement the strategy selected.

3. Do not get too far ahead of your burnout operations when constructing indirect or parallel fire line.

4. If you don't have an anchor point that fire cannot breach you must establish one.

Control Mechanisms

Findings:

1. Span of Control - This was a rapidly escalating situation with a constant change in resources available, values at risk, and fire behavior. The number of contacts the IC had to keep in mind and the complexity of the suppression operation escalated very quickly.

2. Communications - Heavy initial attack traffic on the radio made it extremely difficult to communicate when necessary on the fire. The heavy traffic probably discouraged people from even trying to communicate over the radio. Heavy traffic may have also caused problems with the IC confirming whether everyone had heard his order to leave the line.

Recommendations:

1. Use a complexity analysis to determine appropriate level of overhead structure needed for an incident (an example can be found in BLM's Standards for Fire and Aviation Operations Handbook).

2. The communications problems have been known for quite some time. The agency should bring in a Communication Technical Assistance Team (CTAT) to evaluate current and ongoing problems and develop a plan of action to address frequency management and frequency needs.

Personnel Profiles

Findings:

1. Training/qualifications/physical fitness - A dozer boss should have been with the dozer. Epperson was assigned as a line scout but was actually operating as a dozer boss. He is currently carded as a dozer boss trainee.

2. Attitudes - Bureau/Tribal firefighters and District 8 Volunteer firefighters developed a joint strategy for suppression of the fire, but then went their separate ways during implementation of that strategy. The second entrapment/burnover may have been avoided if the command structure had been unified and word of the previous burnover had gotten to the District 8 volunteers.

Recommendations:

1. Make sure personnel are qualified and capable of performing in the position to which they are assigned as outlined in NWCG 310-1.

2. The wild land urban interface problem in this area is going to continue to get worse. The team feels strongly that the agency and the volunteer department must establish a more cooperative relationship. The two entities must resolve differences in the areas of suppression tactics and priorities, even if it takes a conflict resolution mitigation process to facilitate discussions.

3. The MOU should be updated which outlines how the agency, WDNR, and the volunteer districts operate.

Equipment

Findings:

1. Availability - If more dozers had been available a little earlier it might have been possible to team dozers together instead of sending them out alone with no support at all.

2. Availability - The FMC was not available at the time needed to implement the burnout operation as planned.

3. The grousers on the dozer were worn, the undercarriage was worn, and the exhaust flapper did not open all the way, constricting exhaust airflow and thereby reducing the power available to the dozer. If the dozer had been in better condition, it may have been able to work more quickly, getting the fire line established prior to the wind event that caused the blowup.

4. Clothing and equipment - The PPE all worked as designed. The fire shelters reflected radiant heat away from the firefighters and provided a pocket of clean air to breath. Epperson and Christie deployed their shelters and used them to shield themselves from the heat and falling embers. Kramer and Featherly exposed themselves to more risk of injury by not using their shelters. They also reported that it became extremely difficult to breathe for a period of a couple minutes.

Recommendations:

1. Tactically, dozers should be paired if more than one blade width of fire line needs to be constructed. At a minimum there should be a support vehicle of some kind available in the event a dozer breaks down.

2. When constructing indirect or parallel fire line it is necessary to burn out as line is constructed to carry the safety zone with the suppression resources. If there is no ability to do this the strategy should be re-evaluated.

3. Personnel inspecting dozers must be able to identify wear on dozers and predict the ability of the dozer to perform to its full capability.

4. Consider updating the Emergency Equipment Rental Agreement inspection form to ensure that all important factors in evaluating dozers are covered by the inspection.

5. Ensure that all personnel on the fire are fully equipped with PPE.

6. Consider alternative ways of tracking/finding resources on the fire line (i.e. Put strobe lights on the dozers so they are more visible or add GPS tracking ability to mobile resources).

APPENDICES

APPENDIX 1
FIRE BEHAVIOR ANALYSIS

Drought Conditions

According to the 2001 Fire Season Assessment completed by the Northwest Coordination Center Intelligence Section, the winter of 2000-2001 was the driest in the last 50 years. The overall snow pack for the Columbia Basin was 58% of normal. Eastern Washington did not receive June rains and consequently moved into the summer months with below normal moisture. It further states that eastern Washington is forecast to be warmer and drier than usual. They have the potential for a severe fire season with "a number of large timber and grass fires".

A report prepared by Robbin Boyce, BIA Prescribed Fire Program Manager and Fire Behavior Analyst, reports the Colville Indian Reservation is in an extended drought period. Using soil moisture data he relates the moisture percent of Field Capacity and seasonal moisture deficit for Climate Zones (7 and 9) on the reservation. Included is Climate Zone 6, which borders on the west boundary of Climate Zone 7.

Table 1. Drought Index and Water Deficit For Selected Climate Zones 6,7,9 for Eastern Washington and Colville Indian Reservation.

Climate Divisions	Descriptions	% of Field Capacity	Palmer Drought Index	Keetch Byram Drought Index	Moisture Deficit /Normal (inches)
6	East Slopes Cascades	25.2	-4.1	598	5.08
7	Okanogan Big Bend	12.2	-3.38	702	3.35
9	Northeastern Washington	21.9	-5.44	625	7.39

Reference: Climate Divisions, Descriptions, % of Field Capacity, PDI, and Moisture Deficit from Normal Robbin Boyce Report.

Palmer Drought Index from +4 to –4.

+2 moderately moist, +3 very moist, +4 extremely moist
+1 to –1 is a normal range
-2 moderate drought, -3 severe, -4 extreme drought

Moisture Deficit from Normal: Amount of moisture needed to bring soil into a normal range.

Keetch-Byram Drought Index: Calculated by; Subtract (% Field Capacity) from 100 and multiply by 8.

His report further defines 1000 Hr. Time Lag Fuel Moistures, and live woody fuel moistures for selected timbered sites in the 2800 – 4000 ft. elevations.

Table 2. Fuel Moistures From Oven Dried Weights From Selected Locations on the Colville Indian Reservation, August, 2001.

Location	Live Woody %	1000 HTLF %
Nespelem		8
Gold Mountain		10
Jack Creek	92.6	12.7
Joe Moses Road	150	12.8
Cache Creek	81.1	13.2
South Nanamkin	75.9	10.2
23 Mile	100	13.2

The Boyce Report was supporting documentation for a Tribal Council presentation by Colville Tribal (CT) Fire Management. The general feeling from CT Fire Management and Forestry personnel is they *are* in a drought, and conditions are very high to extreme for intense fires.

Fuels

The surface fuels in the fire area consist of grasses, forbs, sagebrush, and tree litter. Woody debris is usually small branch wood and needle cast. Occasional blow down was scattered throughout the stand. The fire area at both entrapment sites are typical of NFFL Fuel Models 2 and 6. The entrapment sites were both short grass meadows typified by NFFL Fuel Model 1.

Aerial fuels are ponderosa pine. The overstory structure included dominant pine at 40' to 60’ tall, middle story pine at 15’ to 30’, and understory poles, saplings, and seedlings up to 15 feet tall. Stand density could be described as clumpy. In many cases tree crowns exceeded 20’ crown closure in the overstory. Sagebrush appears intermittently throughout the timber stands, and occupies a significant area in the dry openings.

National Fire Danger Rating calculated fuel moistures for the Kramer RAWS on August 12th show 1 HTLFM at 2%, 10 HTLFM at 5%, and 100 HTLFM at 4%. The 1000 HTLFM ranged from 31-45%. Herbaceous fuel moistures were calculated at 2%, and live woody fuel moisture at 60%.

Fire Family charts for 1000 HTLF Moistures and Energy Release Component also reveal Eastern Washington in a severe drought. Large fuel moistures have reached the 97th percentile low point, and ERCs have exceeded it.

Weather

Normal condition for the Omak area during a normal summer is described as hot and dry. Couple the normal trend with an extended drought, and temperatures are consistently high, relative humidity quite low, and local winds are accentuated from surface heating.

On August 11th the National Weather Service (NWS) issued a **Fire Weather Watch** to include all weather districts for possible dry lightning late Sunday afternoon and Sunday night. On August 12th, the NWS issued a **Red Flag Warning** for all weather districts. Dry lightning did develop, but did not enter the reservation. However by 0230 hours on August 13th, lightning did occur on the reservation moving from the southwest to the northeast. It mostly covered the western 1/3 of the reservation in the Omak to Nespelem areas. Lightning was also observed in the Inchelium District in the northeast part of the reservation.

On August 13th the NWS issued a **Red Flag Warning** for continued dry lightning.

The Kramer Remote Area Weather Station (RAWS), which was located within a mile of the fire, shows relative humidity at or below 20% from 1000 hr to 2400 hr on the 12th. Relative humidity at the time of dry lightning (0200 hr – 0330 on August 13th), ranged 22-39%. Winds were recorded at 7 mph with gusts to 10, and then jumped significantly to an average of 10 mph, and maximum gusts to 16 mph. The period 0300 hrs. - 0600 hrs. shows considerable winds with maximum gusts to 22 mph. Dry bulb temperatures at 0800 hrs. reached 80F, and reached a high of 97F at 1500 hrs. Temperatures did not dip below 80F until 2100 hrs. The lowest relative humidity was recorded at 1700 hrs, and was below 20% from 1300 hrs. to 1900 hrs. The combination of high temperatures and low humidity through a major portion of the burning period, contributed to high ignitability of the forest fuels.

Onsite weather was not taken until close to 1100 hrs. Following is a chart of weather readings taken at ridgetop near Little Goose Lake.

8/13/01	North Soap Lake	2830' Elv.	South Aspect	Ridgetop	40% Cover
Time	**Temperature**		**RH**	**Wind Speed**	**Direction**
	Dry	**Wet**			
1050	88	64	36	3-4 g7	N
1210	90	64	24	4-6 g7	N
1800	90	70	36	10-12 g19	N
1850	85	62	27	10-12 g20	N
1931	84	61	29	5-7 g10	N
2000	82	59	25	3-4 g7	N
2030	80	59	28	0-2	W
2100	79	58	27	0-2	W

Onsite weather supports the described fire behavior of moderate to low during the initial hours. Dry bulb temperatures match closely with Kramer RAWS, but wet bulb temperatures departed significantly. Significant differences in fire behavior would have occurred if RAWS site weather had occurred at the fire.

Winds at the time of storm cell passage contributed to the rapid initial spread of fires. The later passage of a storm cell around 1600 hrs (time of the shelter deployment) also made significant contributions to high spread rates, crowning, and spotting.

Local winds usually influence suppression tactics. The orientation of the Okanogan River and associated valley system is conducive to valley wind changes. During the day, with surface heating in the valley system that includes the Columbia River, strong upriver winds (south winds) last until early morning. Then surface cooling changes airflow to a north wind, or downriver. This did not materialize on August 13; Kramer and Omak RAWS both recorded winds that were consistently out of the north almost the entire day for the 12th and 13th.

A passing storm cell caused winds to dramatically increase burning intensities that ultimately forced firefighters to their fire shelters. This storm cell created shifting winds due to the cyclonic action of the low pressure, as well as erratic winds due to the strong down drafts of air from the cell's convective development.

Topography

The fire sits on a major ridge system that forms the top of the canyon wall east of the Okanogan River. It is oriented NE – SW. The river flows north to south into the Columbia River. At the fire, the Okanogan River flows southwest, then due south at the extreme portion of the fire. The main ridge top parallels the river. This is a broad area infused with many pothole lakes, and indentured draws and small canyons that are also oriented north to south.

The significance of this is a high broad ridge exposed to strong valley and prevailing winds. It is especially exposed to passing storm cells that may track along the river.

The thin soils in many places leave exposed rock. This influenced tactics by determining line locations. Dried pothole lakes also contribute to the character of this landscape and played a significant role in this incident.

Observed Fire Behavior

Virginia Lake Fire began about 0230-0330 hours from lightning on August 13th. By noon it was an estimated 50-60 acres and growing at a moderate rate. Fire behavior was described as flame lengths 2-3 feet and backing down slope from the broad ridge top. The many small draws and canyons provided local winds to accelerate burning, but nothing that provided a general momentum to the whole fire. Through the early afternoon, surface fire caused isolated torching in single trees and small groups of saplings and pole sized ponderosa pine.

Onsite weather taken from 1050 hrs. through 2100 hours did show temperatures and humidity as similar to those from the Kramer RAW Station. Tactics were decided based on the initial observation that a backing lower intensity fire could be managed with some indirect fireline.

It is worth noting, that during both high intensity burning periods fire behavior exhibited characteristics of drought. Due to the nature of the fuel types, very low fuel moistures, and high fuel surface temperatures, ignitability was very high. Probabilities of Ignition were calculated at 90-100%.

Entrapment Site 1: This area was affected by high winds generated from a passing storm cell. Winds approached from the south-southwest and quickly reached velocities of 15-50 mph depending on the location. At the staging area on Cameron Lake Road winds measured with a Dyer Wind Meter reached 17 mph at eye level. In Okanogan at the highway, winds were also measured with a Dyer Wind Meter at 50 mph. The fire behavior quickly escalated and ember showers were reported. As the cell moved over the fire, the dominant winds were created by the downbursts. Fireline personnel reported fire spread was occurring in all directions. As the storm moved further northward, the winds switched back to a north to northwest wind.

At the entrapment site, Epperson and Christie used a meadow that was covered by a short grass as a safety zone. They used the dozer to expose mineral soil, and were quickly overrun with fire created from numerous spot fires and active crowning. The meadow in this instance provided a short break in fire intensity due to the short grass.

Entrapment Site 2: Significant observations of fire behavior included:

a. Spotting was prolific and long range to ¼ mile.

b. Meadows of green grass did not provide any security to firefighters. They burned readily and with high intensity.
c. Areas of fine fuels, e.g. meadows, seemed to explode into fire in a moment.
d. Seeking shelter under a dozer without using a fire shelters, they had to endure hot embers, high temperatures, and lots of smoke.
e. There was a short period (1-2 minutes) preceding the meadow bursting into flame, that it was difficult to breathe. It was described as a period where oxygen did not seem available, and they used short quick breaths until it passed.

APPENDIX 2
FIRE ORDERS AND 18 SITUATIONS THAT SHOUT WATCHOUT

Ten Standard Fire Orders

1. **Fight fire aggressively, but provide for safety first.**

COMPROMISED. Downhill line construction without reviewing the checklist and without waiting for burnout crew to back them up. They overextended their escape routes.

2. **Initiate all action based on current and expected fire behavior.**

COMPROMISED. Strategy and tactics based on current fire behavior.

3. **Recognize current weather conditions and obtain forecasts.**

COMPROMISED. Did take a couple of weather readings. Did not obtain a spot forecast.

4. **Ensure instructions are given and understood (not compromised)**

COMPROMISED. Instructions given, but it is questionable on whether they were fully understood.

5. **Obtain current information on fire status.**

NOT COMPROMISED. Initial attack – they were as current as they could be.

6. **Remain in communication with crew members, your supervisor and adjoining forces.**

COMPROMISED. District 8 and BIA forces met to discuss strategy, but then went their separate ways.

7. **Determine safety zones and escape routes.**

COMPROMISED. The identified safety zones and escape routes were not adequate.

8. **Establish lookouts in potentially hazardous situations.**

COMPROMISED. Helicopter was stated to be lookout. However, you can't use a tactical tool as a lookout. You need a dedicated platform.

9. **Retain control at all times.**

COMPROMISED. Although the IC did try to maintain control, resources got spread far enough apart that he really couldn't. He had no control over the Kramer dozer and was unable to consistently communicate with everyone on the fire(the whole concept of the Incident Command System and Unified Command is not understood here).

10. **Stay alert, keep calm, think clearly, and act decisively.**

NOT COMPROMISED. Epperson and Christie, and Kramer and Featherly did an excellent job of meeting this order.

18 Situations That Shout "Watch Out!"

1. **The fire was not scouted and sized up.**

NOT A FACTOR.

2. **You are in country not seen in the daylight.**

NOT A FACTOR.

3. **Safety zones and escape routes are not identified.**

CONTRIBUTING FACTOR. They were identified, but were not adequate. Escape routes were too long and safety zones were too small. General knowledge of safety zones, but no specific knowledge of safety zones. Identified safety zones were the green meadows sprinkled throughout the area. In a normal year, this might be adequate. However, in a drought year such as this one, they are deployment sites – not really safety zones. Escape routes were inadequate.

4. **You are unfamiliar with weather and local factors influencing fire behavior.**

NOT A FACTOR. Familiar with factors during a normal year. Did not seem to factor in the drought conditions and adjust strategy to account for extreme fire behavior.

5. **You are not informed of tactics, strategy, and hazards.**

NOT A FACTOR.

6. **Instructions and assignments are not clear.**

INFLUENCED. The instructions to double your line should have been more clearly defined.

7. **No communication link has been established with crew members or your supervisor.**

CONTRIBUTING FACTOR. Heavy initial attack load on all frequencies. Very steep country limited ability to maintain communications at all times.

8. **You are constructing line without a safe anchor point.**

CONTRIBUTING FACTOR.

9. **You are building fireline downhill with fire below.**

CONTRIBUTING FACTOR.

10. **You are attempting a frontal assault on the fire.**

NOT A FACTOR. Intent was to flank.

11. **There is unburned fuel between you and the fire.**

CONTRIBUTING FACTOR.

12. **You cannot see the main fire and are not in contact with someone who can.**

CONTRIBUTING FACTOR. Kramer and Featherly could not see main fire. Epperson and Christie were in contact and could see fire.

13. **You are on a hillside where rolling material can ignite fuel below you.**

NOT A FACTOR.

14. **The weather is becoming hotter and drier.**

CONTRIBUTING FACTOR.

15. **The wind is increasing and/or changing direction.**

CONTRIBUTING FACTOR.

16. **You are getting frequent spot fires across the line.**

NOT A FACTOR.

17. **The terrain and fuels make escape to safety zones difficult.**

CONTRIBUTING FACTOR.

18. **You are taking a nap near the fireline.**

NOT A FACTOR.

APPENDIX 3
DELEGATION OF AUTHORITY

UNITED STATES GOVERNMENT

MEMORANDUM

DATE: AUG 14 2001

REPLY ATTN OF: ACTING Northwest Regional Director

SUBJECT: Delegation of Authority

TO: Roy Dorre, Team Leader

This memo provides official Delegation of Authority for the conduct of serious accident investigation for:

Fire Name: Goose Lake Fire
Location: Colville Agency, Bureau of Indian Affairs
Date of Occurrence: August 13, 2001

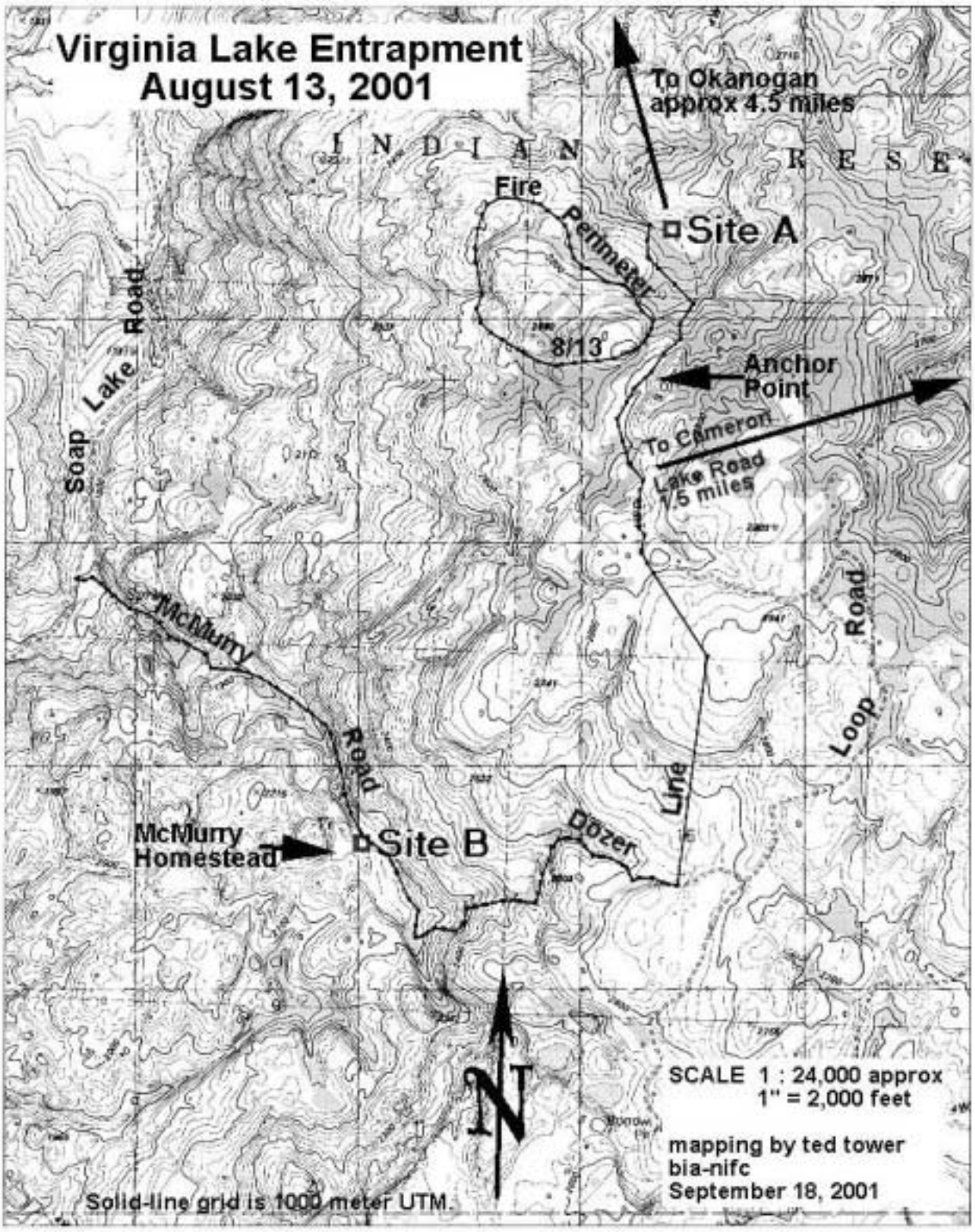
As Team Leader, you are responsible for ongoing (daily) briefings to me. The information you provide will be shared with the Bureau Designated Agency Safety and Health Official, and the Bureau Safety Manager. You are also responsible for the following formal briefings/reports in accordance with the Departmental Manual 485, Chapter 7.

Preliminary brief (24 hours)
Expanded brief (72 hours)
Final report (45 days)

This investigation shall be conducted objectively to gather facts and evidence related to the accident in accordance with the guidelines also set in Departmental Manual 485, Chapter 7. If you have any questions, please contact Stanley Speaks, at (503) 231-6702.

APPENDIX 4

MAP OF THE ENTRAPMENT SCENE


Virginia Lake Entrapment
August 13, 2001
To Okanogan
approx 4.5 miles
I N D I A N
R E S E
Fire
Perimeter
Site A
8/13
Soap Lake Road
Anchor
Point
To Cameron
Lake Road
7.5 miles
McMurry
Road
Road
Loop
Line
Dozer
McMurry
Homestead
Site B
N
SCALE 1 : 24,000 approx
1" = 2,000 feet
mapping by ted tower
bia-nifc
September 18, 2001
Solid-line grid is 1000 meter UTM.

Appendix 5

Serious Accident Investigation Team Members

BUREAU OF INDIAN AFFAIRS
SERIOUS ACCIDENT INVESTIGATION TEAM
VIRGINIA LAKE ENTRAPMENT
AUGUST 18,2001

ROY H. DOORE, Team Leader
Natural Resource Officer
Bureau of Indian Affairs
Blackfeet Agency
P.O. Box 880
Browning, MT
Phone: (406) 338-7520
Email: roydoore@bia.gov
FAX: (406) 338-7116

JIM STEELE, Fire Behavior Analyst
Training Specialist
Northern Rockies Training Center
Aerial Fire Depot
5765 West Broadway
Missoula, MT 59808
Phone: (406) 329-4923
Email: jsteele01@fs.fed.us
FAX: (406) 329-4922

CARL GOSSARD, Chief Accident Investigator
Bureau of Land Management
3833 S. Development Avenue
Boise, Idaho 83705
Phone: (208) 387-5419
Email: cgossard@nifc.blm.gov
FAX: (208) 387-5179

DOUGLAS MARYOTT, Operations Specialist
U.S. Forest Service
Coeur d'Alene River Ranger District
2502 E. Sherman Avenue
Coeur d'Alene, Idaho 83815
Phone: (208) 769-3035
Email: dmaryott@fs.fed.us
FAX: (208) 769-3062

DEL OSTENBERG, Team Liaison
Mount Tolman Fire Center
BIA Fire Management Training Officer
P.O. Box 188
Keller, WA 99140
Phone: (509) 634-3100
Email: mtfctrn@hotmail.com
FAX: (509) 634-3149

BENJAMIN R. CHIO, SAFETY SPECIALIST
Bureau of Indian Affairs
Division of Safety and Risk Management
505 Marquette N.W., Suite 1425
Albuquerque, NM 87102
Phone: (505) 248-5060, Ext. 22
Email: benjaminchio@bia.gov
FAX: (505) 248-5064

LINDA NEE, Documentation
Bureau of Indian Affairs
Colville Indian Agency
P.O. Box 111
Nespelem, WA 99155
Phone: (509) 634-2327
Email: linda.nee@colvilletribes.com
FAX: (509) 634-2356

TED TOWER, Final Report and Mapping
Bureau of Indian Affairs
National Interagency Fire Center
3833 S. Development Ave
Boise, ID 83705
Phone: (208) 387-5565
Email: mailto:Ted_Tower@nifc.gov
FAX: (208) 387-5580

Appendix 6

Chronology of Events

August 12, 2001

0930 - 2100 Red Flag Alert issued by National Weather Service for thunderstorms, lightning, possible dry lightning. Fire Management prepositions suppression forces anticipating fires.

2100 Storms split and skirt the reservation. Personnel are cleared to return home.

August 13, 2001

0230 Storm cells enter the district.

0330 Residents begin calling Fire Management Dispatchers with fire reports.

0428 First Dispatch log entry regarding fire detection on Omak Lake Road.

0431 A fire report below Clay Grade above Goose Lake. (Fire #123) at 30-40 acres and moving .

0502 Darrel Dick talks with Dave Nee regarding fires.

0505 Fire report (Fire #122) across from Mission turnoff, Engine 22 is there with Richard Epperson.

0508 Colville Tribal Police begin first evacuations of residents at Mission turnoff.

0532 Fire #122 is reported at 150 acres and going strong. Structure protection in progress but may lose control.

0550 Emergency Management requests structure protection east of Omak; Epperson will be the contact.

0559 Dick orders resources Fire #122. He uses his cell phone due to the amount of radio traffic. He orders 2- Dozers, 2- 20 person crews, 2- Water Tenders w/3 drivers, and SEAT aircraft.

0612 A report from helicopter 69PF that the Goose Lake Fire (#123), along the River, is about 60 acres, involving pine trees and the wind could push this fire.

0705 Message from helicopter 69PF that the wind switched at Big Goose Lake, coming from NNW and the fire is burning hot.

0706 Fire #123 threatens 400 tons of hay located above the rim.

0757 Dick ready for SEAT retardant drops on fire #122.

0826 Dick calls dispatch on his cell phone to report progress of fires. Says he will not need the second SEAT and will use T-431 for a couple more drops.

0836 Dick calls dispatch on the radio and estimates Fire #122 is about 200 acres.

0914 Dick calls dispatch on his cell phone and requests they dispatch T-431 to Fire #123.

0917 Kirk Kramer from Fire District 8 calls Tribal Dispatch and informs them he is on North Soap Lake Rd. Allen Abrahamson, Dozer Operator for Fire Management, called dispatch to pickup Kramer cat, move to Sec. 6 or 7, T32N, R26E (#132).

0933 Dispatch calls Colville National Forest requesting availability of heavy retardant aircraft. None were readily available.

0940 Kurt Kramer calls Tribal Dispatch and informs them they are at North Soap Lake, Fire #132, at North Soap Lake turnoff, going to North end of Soap Lake.

0946 Dispatch calls Fire 123 and reports a heavy air tanker from Moses Lake will arrive. There is no ETA, will not have a lead plane.

0959 Person in Forestry car 63 reports that Fire #123 is in the rocks. Dispatch informs them that Helicopter 69PF is enroute to assist.

1013 Helicopter 69PF enroute to Fire #123 reports to Dispatch they can see a column (Fire #132) coming over Soap Lake or Cameron Lake.

1017 Helicopter 69PF reports to Dispatch that Fire #123 is on Tribal Protection; N 48.17.67 , W 119.35.01.

1022 Archer from Fire District 8 calls Dispatch and reports he is on the Cameron Lake Road and cannot find his way in.

1043 First heavy air tanker (PBY) on scene for Fire #123. Continues dropping through 1106 hr. with a second load.

1046 Helicopter 69PF begins using bucket and water drops on Fire #123.

1058 Dick calls Dispatch and orders 2-4000 gallon tenders, will settle for 1 for Fire#123.

1108 Allen Antoine reports Fire #132 is getting more active, torching in the NW corner, wind is pushing hard from N to S.

1112 Kramer calls Dispatch, engine went by us and we need assistance.

1148 Dispatch calls Fire #132 and requests if SEAT is available. Reply is negative.

1155 Jim Nanamkin calls Dispatch and reports a column by Buffalo Corrals (Fire #132)
1207 Fire #123 calls Dispatch and reports update: 75 acres, growing to the west, no timber, sagebrush, dozer unable to get down here.

1211 Dispatch calls Dick for status on his fire. Since it is in mop-up they request him to go to Fire #132. He assigns Steve Laramie as IC at Fire #122, and informs dispatch he (Dick) will take some of the resources with him.

1213 Dispatch calls Forestry 24 and requests diverting SEAT to Fire #132.

1228 Forestry Vehicle 63 reports to dispatch they are on the Main Cameron Lake Road, they are being stopped by road construction; cannot get fire trucks through.

1240 Helitack (Car 8) reports to Dispatch the engines had to pull out. Fire #132 was getting too hot. Need to make sure all cats get out. Also making sure a 68-year-old man is out of here as well, he walks this area frequently.

1259 Dick reports to dispatch he is through the roadblock going to #132
.
1312 Dispatch called Fire #132 to get hold of Kramer and find out if Shapely residence is in danger. Structures are about 1 mile to the east.

1318 Dispatch orders 2 heavy air tankers from Okanogan National Forest.

1330 Epperson, Pib Morris and dozer operator John Christy leave road and begin fireline construction toward Highway 97.

1337 Helitack (Car 8) calls Dispatch and reports SEAT T-431 has arrived at Fire #132.

1338 Dick reports Fire #132 is 50-60 acres and orders 2 dozers, a 20-person crew. He reports it is "tough to get close, loose, lots of ground".

1414 Dispatch calls Dick: Epperson is leading cat, Kramer cat is also working, and SEAT is making drops.

1421 Dispatch calls Wenatchee Dispatch regarding status of Tanker 31. It was diverted, no others available.

1432 Antoine reports to Dispatch the fire has jumped the NW line, 40-50 acres, cat broke down. Fire making runs on SW and NW sides. Trying to catch it using dozers (Fire #123 Goose Lake).

1435 Dispatch calls Northeast WDNR for availability of heavy air tanker. They respond they have to check and will call back.

1515 Dick calls Dispatch that Fire #132 is lost on the NE side, they are pulling back to main Cameron Lake Rd.

1518 Dexter Nicholson calls Dispatch and reports lightning in progress at Inchelium.

1519 Dick reports to dispatch that the threat is East to main Cameron Lake Road. If the fire crosses this road there may be houses in danger, within 1 mile.

1530 Jon Batten (Helicopter Manager) reports to dispatch that helicopter 69PF has used 2.5 hours at Fire #132.1537 Batten requests through dispatch that CTPD block Cameron Lake Rd. and loop.

1550 (Approximate time) Epperson & Christy decide to abandon line construction and go to old lake bed area for protection against increasing fire intensity.

1552 (Approximate time) Epperson requests a drop from SEAT to cool off fire so they could pass through and proceed to known meadow.

1559 Dispatch calls Connie at Emergency Management: notified that 2 residences at Cameron Lake Loop Rd. need structure protection.

1600 Epperson realizes Fire #132 has increased intensity and changes begin in spread direction. They reach an open meadow and choose this as their best site to withstand a potential burnover. Batten, 69PF, remains in contact with Epperson.

1602 Ground was hard and did not let the dozer blade penetrate to scrape. After trying to plow up a mineral soil patch, they moved to another site on the west side of the same meadow. The second site allowed 3 scrapes to mineral soil. Pib Morris leaves area on his 4 wheeler to find his grandchildren.

1605 Epperson decides they should enter their fire shelters after crown fire coming their way.

1613 Dick reports to dispatch the fire bumped hard on Cameron Lake. If the fire crosses the lake dozens of homes will be in danger.

1615 (Approximate time) Epperson comes out of fire shelter briefly and decides they should remain in shelters longer. Epperson remains in contact with Batten and relates he received minor burns on his hands. Batten decides to switch with Cody Belkoff because Belkoff is an EMT.

1618 Dispatch calls Wenatchee Dispatch for availability of heavy air tankers; none available.

1630 Batten calls dispatch on his cell phone and informs them the Cates-Erb cat was burned over; Epperson and the operator Christie . He relates he had to help direct them and talk through the burnover; it was a difficult experience for him.

1635 Epperson and Christy come out of fire shelters. Belkoff and 69PF pilot have an opening in the smoke, land near the parked dozer and pick up Epperson and Christy from the deployment site.

1640 Batten calls dispatch and reports they had landed and extracted both people from the burnover, and they will check them out. Sometime later, Epperson uses a cell phone and calls Dispatcher Peggy Ostenberg at Mt. Tolman Fire Center. Epperson remains at helispot with Batten until the road clears. Christy goes with Dick who eventually delivers him to his lowboy. Christie leaves the fire area with Cates, owner of the dozer/lowboy.

1756 Dispatch calls Dick and informs him they need weather in 10-minute intervals, plus all weather before, during, and after the burnover, Del Ostenberg will be the Officer in Charge until the investigation team arrives.

1800 Osteberg meets Batten and Epperson on the Cameron Lake Road.; Epperson rides with Ostenbergl to the staging area in Omak.

1813 Dick reports to Dispatch they are evacuating the south end of Fire #132, the Cameron Lake Road, lost this fire big time

.

1830 Dick reports to dispatch that the Virginia Lake Fire is blowing up big time

.

1845 Rick Paris, a Bureau of Reclamation employee trained in Critical Incident Stress Debriefings, arrives at Omak staging to assist.

2020 Nanamkin takes Epperson to the hospital to get examined.

2030 Nanamkin sees Christie and family leaving the hospital.

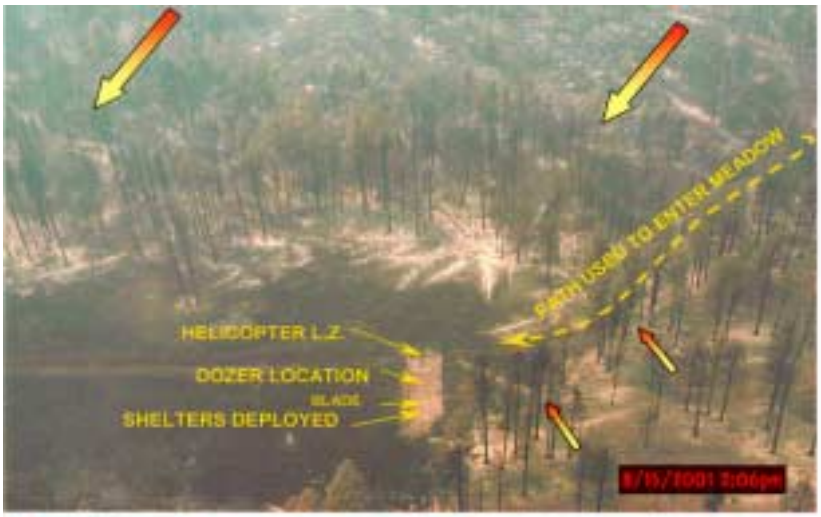
2123 Ostenberg interviews Christie regarding burnover.

2124 Scott at Fire #125 reports to Nee they are pulling out due to fire runs from #132.

2130 Scott calls Nee to report the abandonment of Fire #125, a farmer said Fire #132 will overrun it.

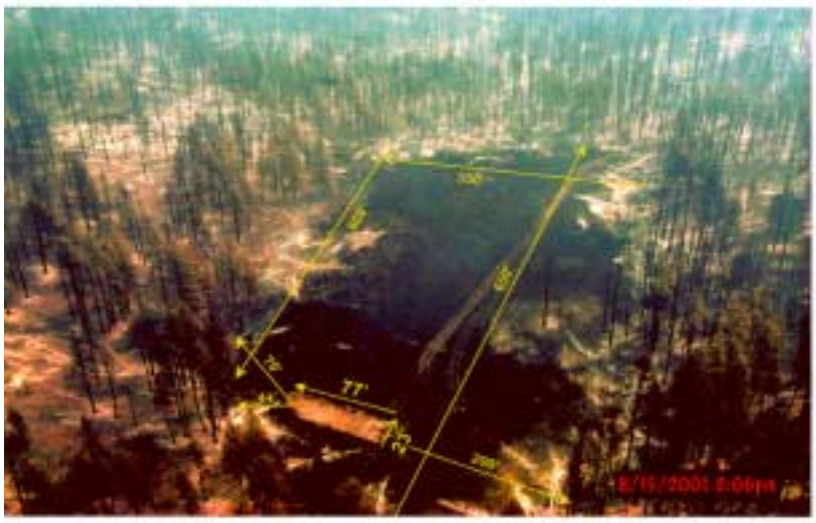
2306 Ostenberg met with Dusty and Monte to verify Pib Morris and grandchildren had left the fire area.

APPENDIX 7
PHOTOS OF THE SITES



Arrows show direction of main fire spread and post-passage torching. Cleared area shows where the dozer was positioned and where shelters were deployed in front of the dozer blade. Dominant wind and fire spread is from the south.

Looking east shows extent on meadow and burn intensity. It also shows the location of the first attempt to scrape to mineral soil. This failed because of an impenetrable surface. They moved farther west and were successful at scraping a deployment site.



Looking east at the rough dimensions of the meadow and deployment site. A GPS traverse of the meadow measured about 4 acres in size. Distance from the closest maximum intensity was 200 feet, with the dozer as a shield. Shelter occupants reported high temperatures, turbulent winds, and pin holes developing on their shelters during the fire's passing.

Entrapment Site B shows the area where it was scraped to mineral soil, five dozer blades wide. Pink ribbon shows the position of the dozer, and hard hats approximate where Barry Featherly and Kirk Kramer took refuge under the dozer. Direction of spread is south.

Dimensions of the entrapment Site B. Featherly and Kramer waited out the fire's passing for about 30 minutes, during which they experienced smoke inhalation, shortness of breath for about two minutes, and extinguished with dirt the small fires that started under the dozer.

View of the terrain and fuels directly west of Site B. Fire moving quickly up this small canyon entered the entrapment site in the lower right corner. Inspection of this area shows all fuels were involved and contributed to the fire's spread and intensity.

Minor burning in collection of small woody debris. This was extinguished using a fire extinguisher carried on the dozer.

Minor melt damage to the lower flat portion of the dozer seat.