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TECHNOLOGY TRANSFER NOTE

M-003

DOCUMENTING WILDFIRE BEHAVIOR: AN EXAMPLE FROM THE 1988 BRERETON LAKE FIRE, MANITOBA

INTRODUCTION

The documented behavior of free-burning wildfires can be a valuable source of information for both fire researchers and operational staff. For example, in an active fire situation fire behavior observations made by suppression personnel allow them to:

(a) inform and update district, regional, and provincial staff of the fire's status on a timely basis,

(b) provide information that can be used to brief both the media and the public,

(c) ensure the safety of firefighting personnel by directing them away from potentially dangerous situations, and

(d) make immediate comparisons between actual and predicted fire behavior.

Also, future benefits can be gained from formally recording the influences of weather, fuels and topography on a fire's behavior. For instance, the information could be used as an effective training tool for suppression staff since individuals relate very well to recent real-life experiences in which they may have been involved.

From a fire research perspective, observations of extreme fire behavior can supplement or verify the data presently used in the development of the Canadian Forest Fire Behavior Prediction (FBP) System. The FBP System database currently consists of 245 experimental/operational prescribed fires and 45 documented wildfires (Lawson et. al 1985). Presently, most of the information regarding fire behavior under extreme fire weather conditions is collected from wildfires since it is difficult to successfully arrange and conduct experimental fires under such conditions. A detailed example of a documented wildfire in the Northwest Territories is provided in Alexander and Lanoville (1987).

The purpose of this note is to summarize the information needed to document wildfire spread rates and to illustrate that this is not a complicated process but merely one that requires a few key observations. An example, taken from the information recorded by the suppression staff at the 1988 Brereton Lake Fire in southeastern Manitoba, has also been included.

INFORMATION REQUIREMENTS

A summary of the information required to accurately document wildfire spread rates is given below. For a more detailed account refer to pages 61-62 in the FBP System User Guide (Alexander and others, 1984).

(1) Forward rates of spread

The position of the head fire at various times during a major run needs to be recorded. Observations can be made easily if landmarks (such as roads, creeks, hydro lines, etc.) are used to plot the progression of the fire on a topographic map, forest inventory map, or recent aerial photographs.

(2) Position of the flanks

Mapping or noting the positions of the fire's flanks (along with that of the head fire) permits the length-to-breadth ratio of the fire to be calculated.

(3) Other fire behavior observations

Other observations not directly required to document the rate of spread but which can be useful in understanding other aspects of fire behavior are:

(a) type of fire (i.e., surface fire, torching, crown fire),

(b) fire whirl development, occurrence of spot fires and associated distances,

(c) flame lengths and/or flame heights,

(d) smoke column characteristics (e.g., height of column, angle of tilt),

(e) suppression effectiveness (e.g., hand constructed

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fire guards are challenged but waterbombers were effective),

(f) depth of burn and mop-up difficulty,

(g) post-fire evidence (e.g., narrow "streets" of unburned trees associated with horizontal roll vortices).

It is worth noting that photographs can be a very useful tool in documenting many aspects of a fire's behavior. They are especially valuable if the time the picture was taken is also recorded. This may be done manually or a camera with a "databack" attachment could be used.

(4) Fire weather observations and fire danger indices

The most significant fire weather parameter to measure during a major fire run is the wind speed and direction. Hourly observations of the wind (along with temperature, and RH, if possible) should be made at a weather station near the fire. However, if this is not possible then estimates of these parameters could be made at the fire site (e.g., use the Beaufort Scale to estimate wind speed) or the information could be obtained from a nearby fire weather station or Atmospheric Environment Service (AES) station. Also, inclusion of the daily fire weather observations that preceded the fire is important for calculating the values of the Canadian Forest Fire Weather Index (FWI) System and for possible future analysis.

(5) Topography and fuel type characteristics

For documentation purposes, details on the topography and fuel type mosaic in the fire area can often be described after the fire has occurred. This may consist of information from 1:50 000 NTS topographic maps, FBP System fuel type maps prepared from LANDSAT imagery or forest inventory data. However, observations of the fire's behavior in the various fuel types and on different topographic features should be noted.

THE 1988 BRERETON LAKE FIRE: A CASE STUDY OF DOCUMENTATION

Observations of the fire behavior at the 1988 Brereton Lake Fire were made by a number of Manitoba Natural Resources staff who were coordinating the fire suppression activities and positioned primarily in helicopters. This information was recorded verbally on tape and also onto the district radio logs. Given below is a summary of the recorded fire behavior at various times during the major run on May 1 (also, see Figure 1) and how it relates to the information required for documentation (note: all times are Central Daylight Time - CDT).

(1) Forward rates of spread

1540 h - The fire was detected and reported to the Manitoba Natural Resources office in Rennie. It was located just west of the south railway crossing on highway #307 and was less than than 0.1 ha in size.

1550 h - The fire crowned almost immediately and was heading northward towards the Brereton Lake subdivision.

1634 h - The head fire was estimated to be approximately halfway to Brereton Lake (i.e., a distance of 1.5 km from the point of ignition).

1706 h - The fire was on the last ridge before the swamp (i.e., a distance of 2.4 km from the point of ignition).

1753 h - The head fire crossed the north tracks near the subdivision (i.e., 3.1 km from the point of ignition).

In summary, the fire spread 3.1 km in 2 hours and 13 minutes (133 minutes) for a rate of spread of 23.3 m/min or 1.4 km/h.

(2) Position of the flanks

1746 h - The fire is now spreading at the back.

1806 h - The west side of fire is crowning in black spruce and spreading rapidly.

1924 h - A small spot fire is just east of highway #307.

(3) Other fire behavior observations

1734 h - The head fire is too intense for crews to work in front of so suppression efforts should be restricted to the flanks.

1920 h - The first cottage is lost to the fire.

It was also noted that the fire was not continuously crowning (i.e., some torching was occurring but spread was not sustained through the tree crowns). The fire spread primarily on the jack pine ridges and only occasionally burned through the black spruce stands. Also, some mop-up difficulty was experienced in areas with a southern exposure however this was not the case on north facing sites due to the presence of ground frost at or near the surface.

By the evening of May 1 crews were able to secure a fireline completely around the fire using both natural fuelbreaks and constructed fireguards. A major suppression effort on May 2, which included the use of three CL-215 waterbombers, prevented any further flare-ups from occurring and effectively brought the fire under control.

(4) Fire weather observations and fire danger indicies

Fire weather information was not available from the Natural Resources Office at Rennie but a number of other sources were used to establish the conditions that existed before and during the fire run on May 1 (see Tables 1 and 2). This included the 1300 h CDT observations from West Hawk Lake and Nutimik Lake, the hourly readings on May 1 from the AES stations at Winnipeg, Kenora and Sprague and estimates of the conditions by the suppression staff at the fire.

(5) Topography and fuel type characteristics

The fire area is situated at an elevation of 330 m above mean sea level (MSL). The terrain is gently undulating and had a minimal effect on the fire's behavior.

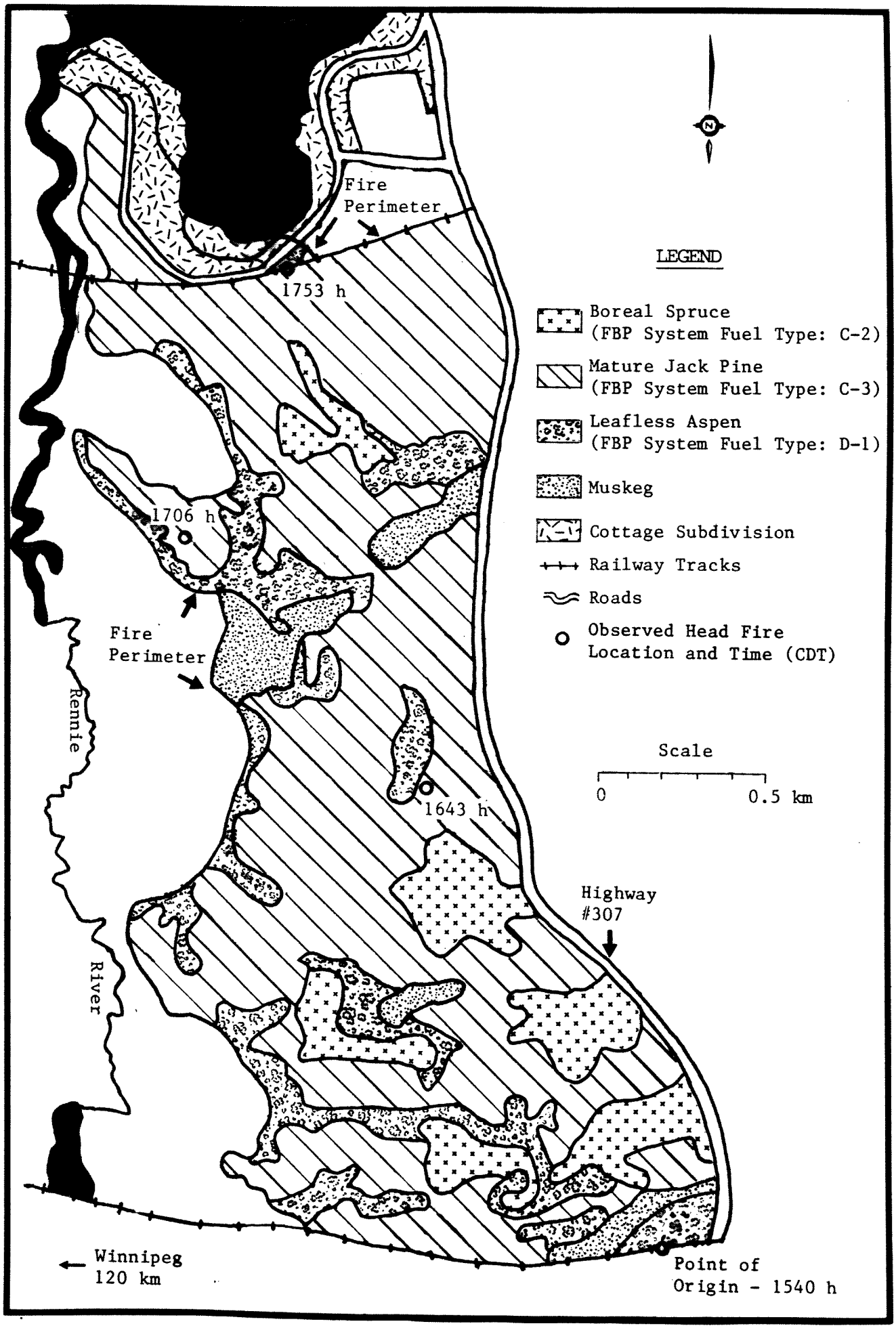

Figure 1. FBP System fuel type and fire progress map for the Brereton Lake Fire, May 1, 1988.

Table 1. Fire weather and fire danger conditions which preceded the occurrence of the 1988 Brereton Lake Fire.

Date	1300 h Weather Observations[1]				FWI System Components[2]					
	Temp. (°C)	RH (%)	Wind (km/h)	Rain (mm)	FFMC	DMC	DC	ISI	BUI	FWI
04/21	2.0	73	12.5	0	83	30	236	3.1	46	9
04/22	3.5	72	1.5	0	83	31	238	1.7	46	5
04/23	6.0	49	7.0	0	84	31	240	2.7	47	8
04/24	9.5	47	12.5	0	86	33	243	4.3	49	12
04/25	3.5	86	13.0	4.7	44	22	235	0.1	35	0
04/26	5.5	45	9.0	0.1	65	23	237	0.8	36	1
04/27	10.0	33	14.5	0	81	24	239	2.5	39	6
04/28	18.0	19	16.5	0	91	28	244	11.3	44	23
04/29	22.0	18	12.5	0	94	33	249	13.6	49	27
04/30	22.0	32	16.0	0	93	36	254	14.4	54	30
05/01	22.5	40	27.5	0	91	40	260	20.9	58	39

[1] Observations from the West Hawk Lake (331 m MSL) and Nutimik Lake (302 m MSL) fire weather stations were averaged to obtain the values for the Brereton Lake area (note: these stations are operated by Manitoba Natural Resources and located approximately 30 km southeast and north of the fire area, respectively).

[2] FWI System calculations began on April 21 with the following moisture code starting values: FFMC-85, DMC-30, and DC-235.

Table 2. Fire weather and fire danger conditons during a major fire run at the Brereton Lake Fire on May 1, 1988.

1700 h Fire Weather Obsevations[1]		Adjusted FWI System Values	
Temperature	26.0°C	FFMC	91
RH	21 %	ISI	22.4
Wind	SSE 30 km/h	FWI	42
Days Since Rain[2]	6		

[1] Estimates were made by fire suppression personnel and substantiated with data from the AES weather stations at Kenora (75 km east; 411 m MSL), Winnipeg (120 km west; 239 m MSL), and Sprague (90 km south; 329 m MSL).

[2] Greater than 0.6 mm.

The fuel types in this area were primarily mature jack pine (FBP System Fuel Type: C-3), with some small stands of boreal spruce (C-2) and trembling aspen prior to leaf flush (D-1). The forest inventory information for the area within the perimeter of the fire has been broadly categorized according to the FBP System fuel type classification. A map depicting these fuel types is shown in Figure 1.

CONCLUDING REMARKS

During wildfires, suppression personnel are often in the best position to make fire behavior observations. A good example of this occurred at the Brereton Lake Fire and the efforts of the suppression staff should be commended in this regard. This type of information can serve a number of purposes (e.g., for use at post-fire boards of review, to verify the FBP System relationships, etc.) and therefore, operational staff should be encouraged to make similar observations in the future. Such information could then be forwarded to the author of this note or to a member of the Canadian Forestry Service Fire Danger Group for further analysis.

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K. G. Hirsch
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