PROCEEDINGS

OF THE SECOND WESTERN REGION FIRE WEATHER COMMITTEE

SCIENTIFIC AND TECHNICAL SEMINAR

March 6, 1984
Edmonton, Alberta

Compiled and Edited

by

Martin E. Alexander
WRFWC Chairman

Study NOR-5-191 File Report No. 9

Northern Forest Research Centre
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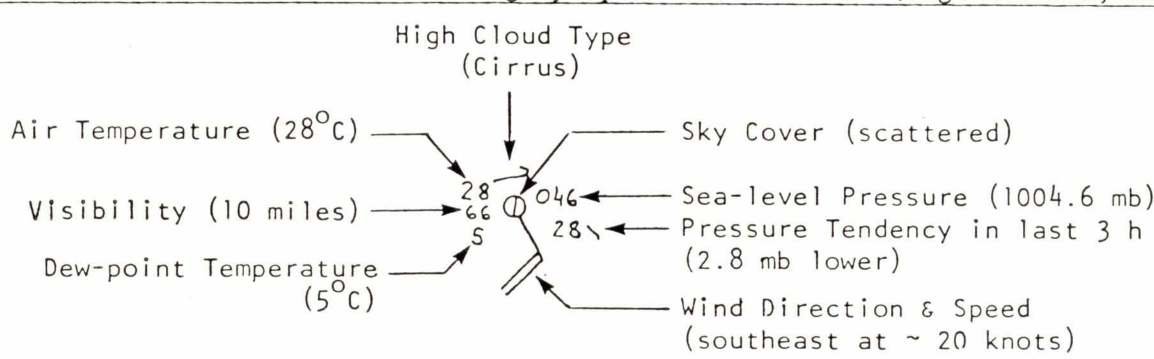
CONTENTS

COVER: Surface weather map for 1200 MDT, August 27, 1981 (courtesy of Alberta Forest Service Weather Section). This day has become known to the Alberta Forest Service as *Black Thursday*. Approximately 350 000 ha, representing about 25% of the total area burned in Alberta during the 1981 fire season, was burnt over during a 10-12 h period.

Sample Station Model Used for Plotting Synoptic Weather Data (High Level A, Alta.):



FOREWORD

The 1975 Federal Department of the Environment (DOE) Policy on Meteorological Services for Forest Fire Control sets out the responsibilities of the Atmospheric Environment Service (AES) and Canadian Forestry Service (CFS) in provision of fire weather forecasts, fire danger forecasts, and other weather-related services to the various fire control agencies. Briefly, this policy gives AES the responsibility of providing current and forecast fire weather and Fire Weather Indices in accordance with the needs of fire control agencies. The CFS role is that of research and development of improved Indices, research on fire behavior relationships with weather factors, and cooperation with AES in preparation of training aids and manuals. Both AES and CFS share the responsibility of improving meteorological services for fire control in Canada.

In 1976, six regional committees[1] were formed to facilitate the implementation of the DOE Policy on Meteorological Services for Forest Fire Control. The "charter" for these regional fire weather committees is as follows:

Membership: 1 or more AES representatives designated by AES Regional Director; 1 or more CFS representatives designated by CFS Regional Director; and 1 or more fire management agency representatives designated by the Provincial or territorial chief(s) of forest fire management.

Terms of Reference: Each Regional Committee will make recommendations to the Regional Directors of DOE Services (i.e., AES and CFS) for the development and implementation of a program of Meteorological Services for Forest Fire Control which is suited to the needs of the Region and is within the DOE Policy and Guidelines thereto.

Guidelines: Regional Committees will be responsible for (a) identifying the needs of regional fire management agencies for meteorological services; (b) making recommendations to the Regional Directors of DOE Services for the development and implementation of the services identified in sub-section (a); (c) monitoring the program and implementing changes, as required; (d) coordinating with the Development Committee; and (e) referring to the Development Committee those recommendations which the Regional Directors of DOE Services have been unable to implement.

The function of the Development Committee, referred to above, is to coordinate, in consultation with the Regional Committees, the development of meteorological services for forest fire management through contacts, at the technical level, between research and development officers of AES and CFS, operations supervisors in the AES field establishments and technical representatives of fire management agencies.

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[1] These were aligned on the basis of the existing AES administrative boundaries: Pacific (British Columbia); Western (Yukon, Northwest Territories, and Alberta); Central (Saskatchewan, Manitoba, and northwestern Ontario); Ontario; Quebec; and Atlantic (Nova Scotia, New Brunswick, Newfoundland, and Prince Edward Island).

INTRODUCTION

The first scientific and technical seminar of the Western Region Fire Weather Committee (WRFWC) was held at the Atmospheric Environment Service's (AES) Western Region office in Edmonton on March 22, 1983. The transactions of that first seminar have been compiled for general distributions[1] Five presentations were made:

- Fifteen Years of Philosophical Examination on Fire and Weather. -- R.E. Schmidt (Indian and Northern Affairs Canada - N.W.T. Region).
- Alberta's Geographical Position in Relation to Fire Weather.-- B. Janz (Alberta Forest Service).
- Historical Fire Weather Analysis -- Banff National Park.-- C.A. White, K. Baker, and J. Kellas (Parks Canada).
- Breakdown of the Upper Ridge Pattern Associated with Extreme Fire Behavior in Alberta.-- N. Nimchuk (Alberta Forest Service).
- Fire Behavior in the Black Spruce-Lichen Woodland Fuel Complex: the Porter Lake Project.-- M.E. Alexander (Canadian Forestry Service).

The second in a series of what is hoped to be a continuing program of seminars was also held at the AES Western Region office in Edmonton on March 6, 1984 in conjunction with the WRFWC annual buisness meeting. Again there were five presentations and this report constitutes the "proceedings" of the second seminar. A list of individuals attending the seminar is given at the end of this report. It is felt that such sessions provide an excellent forum for exchange of information ideas, etc. on fire-weather related topics of interest to all WRFWC member agencies.

M.E. Alexander
WRFWC Chairman

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[1]Alexander, M.E. 1983. Western Region Fire Weather Committee (WRFWC) seminar proceedings (Mar. 22, Edmonton, Alta.). Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Study NOR-5-191 File Rep. No. 5. 11 p.

A COMPARISON OF FIRE-WEATHER SEVERITY IN NORTHERN ALBERTA DURING THE 1980 AND 1981 FIRE SEASONS[1]

by

D.A. Harvey[2]

This study was designed to determine the relative fire-weather severity of the 1980 and 1981 fire seasons in northern Alberta. The two seasons were compared on the basis of several approaches:

1. Frequency of FWI values $\geq$ 19
2. Cumulative Daily Severity Rating
3. Seasonal Severity Rating
4. Fire Load

Sixteen representative stations were selected in northern Alberta (Fig. 1). The Fire Weather Index (FWI) (Canadian Forestry Service 1978) values for each day for each station were tabulated for the period April 21 to September 20 (a total of 153 days). The percentage of days that the FWI was $\geq$ 19 for an average station was then determined. An FWI $\geq$ 19 is the threshold value for the *Very High* fire danger class in Alberta (Kiil et al. 1977). The Daily Severity Rating ($DSR = 0.0272FWI^{1.77}$) as described by Van Wagner (1970), was calculated for each station on a daily basis. The Cumulative Daily Severity Rating for each season was determined by summing all the DSR values for each station. The Seasonal Severity Rating ($SSR = \Sigma DSR/153$) was then calculated for both fire seasons. The 'Fire Load' as used in this study is the product of the SSR and the annual number of fires.

The 1981 season was more severe than the 1980 season according to all the indicators in Table 1. All the methods of estimating the relative severity of the two fire seasons underestimated the relative increase in area burned. An explanation of this could be that in 1981 nearly 25% of the total area burned occurred on one day (August 27). None of the fire-weather severity rating parameters are capable of evaluation the effect of such a day on the seasonal area burned.

The SSR did not do as well as the frequenty of days with FWI values $\geq$ 19 in predicting the total area burned. This was a surprising result because the SSR is designed to give more weight to severe fire weather days as indicated by very high FWI values. However, the area burned depends on many factors that are not direct inputs to any of these methods of rating fire-weather severity. Some of these factors are discussed below.

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[1] *Summary of a presentation made at the Second Western Region Fire Weather Committee Scientific and Technical Seminar, March 6, 1984, Edmonton, Alta.*

[2] *Meteorologist, Weather Section, Forest Protection Branch, Alberta Forest Service, 10625-120 Avenue, Edmonton, Alta. T5E 5S9.*

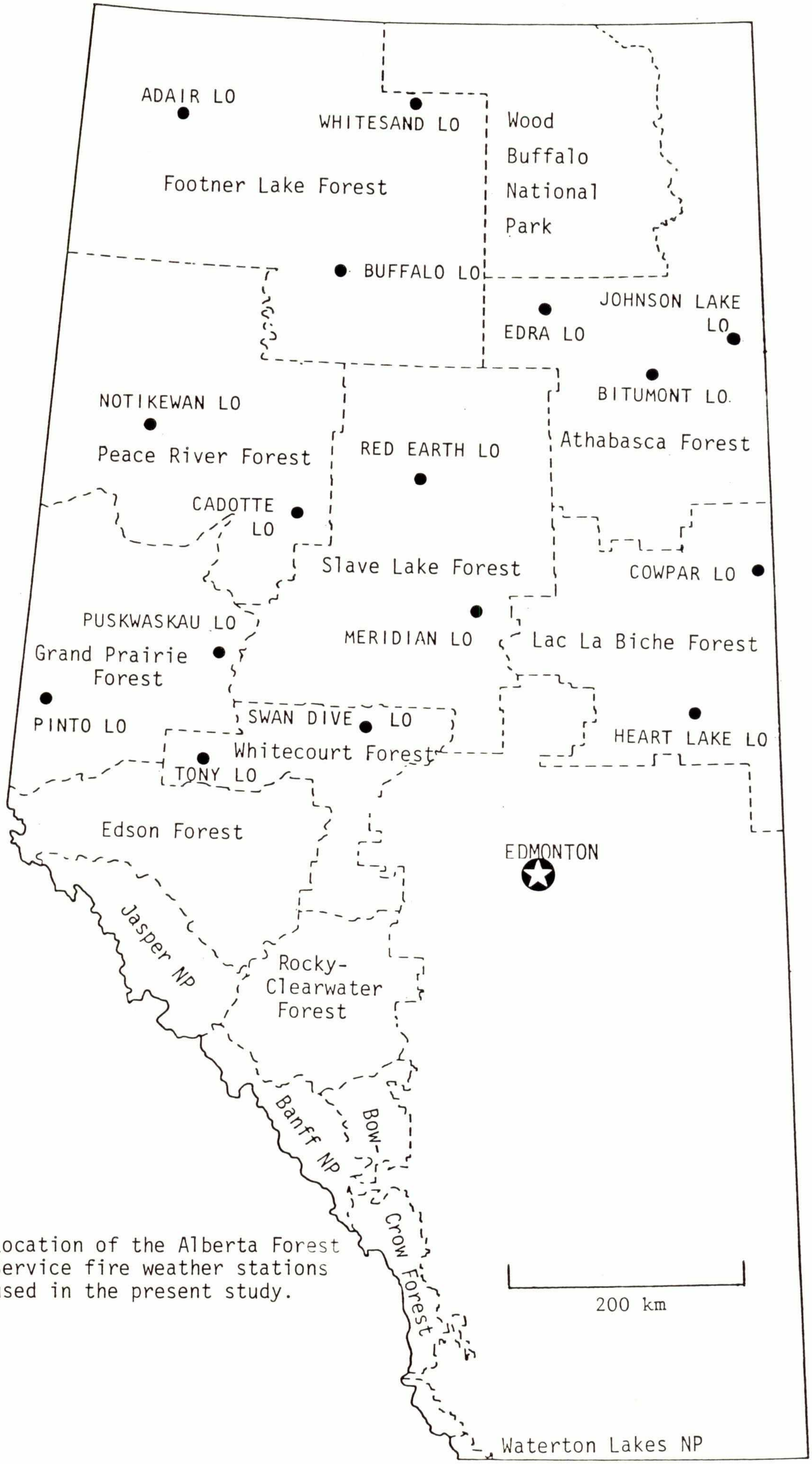

Figure 1. Location of the Alberta Forest Service fire weather stations used in the present study.

Table 1. Comparison of 1980 and 1981 fire seasons in northern Alberta.

Parameter	Fire Season 1980	Fire Season 1981	Change relative to 1980
Frequency of days with FWI $\geq$19 (%)	16	23	+1.44
Cumulative Daily Severity Rating (ΣDSR)[1]	372	473	+1.27
Seasonal Severity Rating (SSR)[2]	2.4	3.1	+1.29
Total number of fires	1348	1522	+1.13
Fire Load[3]	3235	4793	+1.48
Total area burned (ha)	672 457	1 365 584	+2.03

[1]Value on September 20.

[2]SSR = ΣDSR/n, where n = 153 days in this case.

[3]Fire Load = SSR x Total Number of Fires.

The percentage of days when the FWI was $\geq$ 19 is the simplest approach to comparing relative fire-weather severity. However, this method does not differentiate between days with an FWI value that is only marginally greater than 19 and those with considerably higher values. The severity of fire behavior increases dramatically as the FWI level increases yet this procedure ignores such differences.

Cumulative DSR curves, when compared for two or more fire seaons, show at what time the fire-weather severity reached the same level. The cumulative DSR curves for the 1980 and 1981 fire seasons, indicate that the cumulative severity of the 1981 season did not exceed that of 1980 until early September.

None of the methods, however, take into account ignition sources and whether or not fires are actively burning. For instance, in 1980, the severe fire weather occurred before the summer lightning season started. In 1981, the lightning occurred before and during the severe fire weather of August and September. This subject has been explored in greater depth elsewhere (Janz 1982).

The Fire Load as used here does take into account the number of fires in the season but fire size is not considered. Fire load is usually thought of as the number and magnitude of fires (i.e., size and intensity) requiring suppression action during a given period within a specific area.

The FWI severity ratings cannot be used as the sole measure of fire suppression effort and costs because these depend to a large degree on ignition patterns, fire management policies, etc. which are not inputs into the calculations. However, they do allow for an objective comparison to be made, strictly in terms of the influence of fire weather on potential fire behavior, of one fire season against another or one station, administrative area, etc. against another.

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Editor's Note: A more complete paper by the same title is currently in preparation for publication in the Forestry Chronicle.

PRESCRIBED FIRE IN BANFF NATIONAL PARK: A CASE STUDY[1]

by

C.A. White[2]

Parks Canada's policy requires that resource management should maintain the natural process of wildland fire in national park ecosystems while minimizing fire threats to park facilities, public safety, and neighboring lands (Lopoukhine and White 1985). Randomly ignited (lightning or accidentally human-started) fires may be allowed to burn in remote park areas. However, carefully monitored planned ignition fires (i.e., prescribed burning) must be considered in heavily developed areas such as the lower Bow River valley (Fig. 1) in Banff National Park (BNP). On September 26, 1983, BNP wardens conducted a planned ignition fire to evaluate the application of prescribed burning techniques in the Rocky Mountain national parks.

The 17-ha Two Jack I unit (#46 in Fig. 1) was selected for BNP's first planned ignition prescribed fire. The area is a montane Douglas-fir and lodgepole pine forest. In BNP, the forests are fire dependent with mean fire intervals of less than 40 years prior to establishment of the park. Historic fires were often of relatively low intensity, burning only in the understory. The Two Jack I unit is situated at an elevation of 1480 m. Slope angles are less than 5°. Surrounding roads and a water-filled canal provided excellent fire guards.

Weather observations were made daily for several months prior to the burn at nearby Banff townsite and on-site at frequent intervals on the burn day. Table 1 summarizes fire weather conditions and Canadian Forest Fire Weather Index System components (Canadian Forestry Service 1978) for the period September 19-27. A ridge of high pressure persisted over Banff for several days prior to September 26, with clear skies, warm temperatures, and westerly winds. On the burn day (September 26), the ridge began to break-down and gusty west winds occurred. A low pressure system, cold temperatures, snow, and upslope north winds occurred in the Banff area by the morning of September 27.

A three-man ignition team lit a series of strip-head fires beginning at 1300 MDT proceeding from NE to SW across the unit. Rates of spread averaged less than 3 m/min with flame lengths of about 1 m. Approximately 15 trees candled during the fire, but despite strong, gusty winds, no sustained crowning occurred. Possibly night time frosts and the low sun angle limited fuel drying under the forest canopy. However, in many spots the fire smouldered for several days, killing trees and removing all litter and duff in several places.

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[1]*Summary of a presentation made at the Second Western Region Fire Weather Committee Scientific and Technical Seminar, March 6, 1984, Edmonton, Alta.*

[2]*Park Warden, Banff National Park, Parks Canada, P.O. Box 900, Banff, Alta. TOL OCO.*

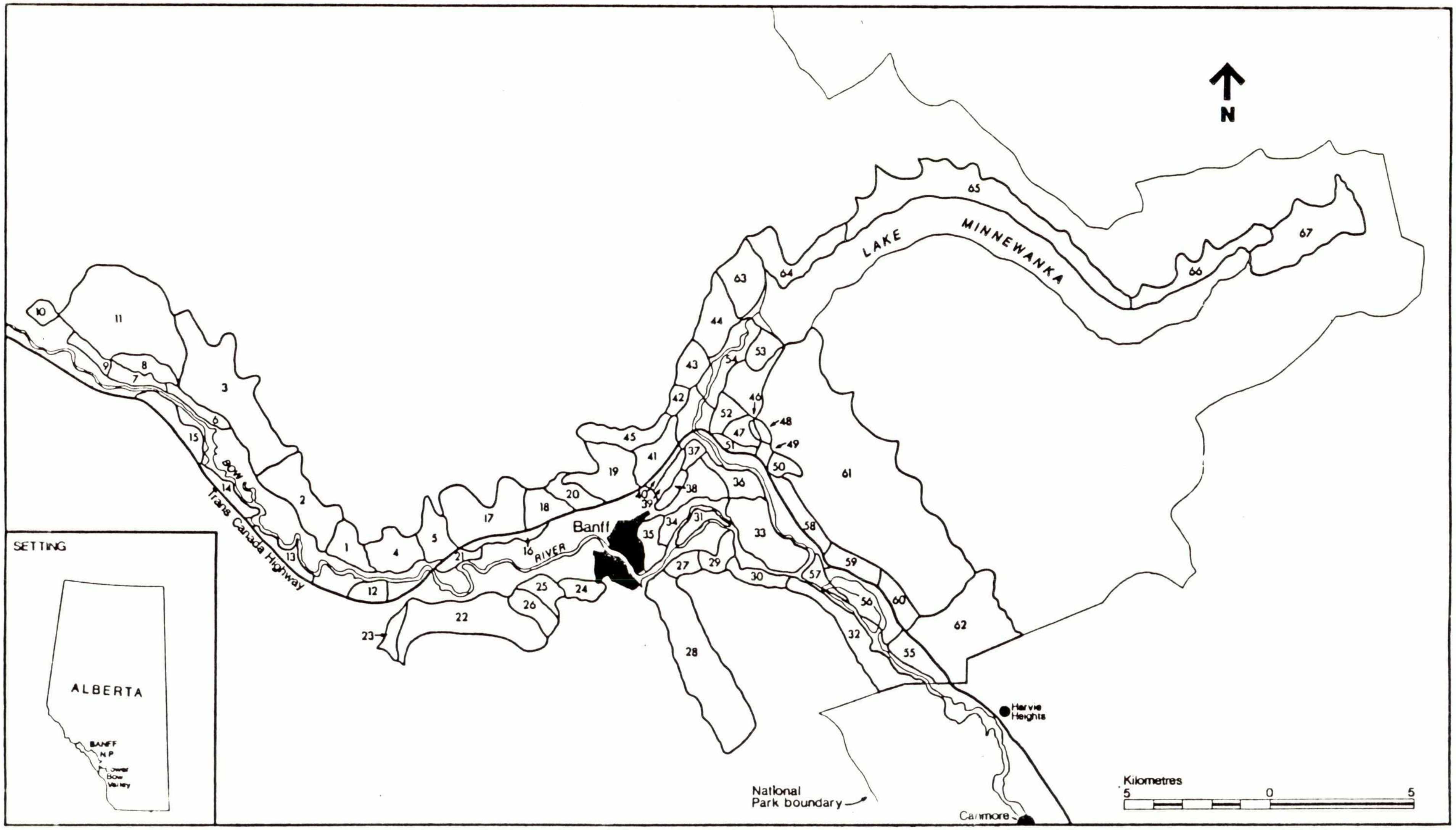

Figure 1. The lower Bow River valley of Banff National Park showing the location of the planned ignition prescribed fire management units.

Table 1. Fire weather observations and fire danger ratings at 1300 MDT as recorded at the Banff synoptic weather station (1397 m ASL) prior to and following the Two Jack I planned ignition prescribed fire in Banff National Park on September 26, 1983.

Day	Dry-bulb temperature (°C)	Relative humidity (%)	10-m open wind Direction (from)	10-m open wind Speed (km/h)	24-h rain (mm)	Canadian Forest Fire Weather Index System components FFMC	DMC	DC	ISI	BUI	FWI
Sep.19	3.5	43	S	7	1.0	74	20	453	1.0	35	2
20	7.5	38	S	18	0.0	83	21	456	4	39	10
21	11.5	50	W	13	0.0	84	22	460	4	39	10
22	15.0	47	WSW	9	0.0	86	23	464	4	42	10
23	16.5	47	SW	5	0.0	88	25	469	4	46	10
24	17.0	43	S	19	0.0	88	27	474	9	46	20
25	18.0	44	SW	13	0.0	88	29	479	6	50	15
26	19.0	29	W	37	0.0	90	32	484	14	55	29
27	2.0	79	N	18	3.0	55	25	455	0	46	1

The Two Jack I planned ignition prescribed fire provided excellent experience to BNP staff. Preburn and postburn fuels, vegetation, and wildlife use are being monitored to evaluate fire effects. Several more units are scheduled for burning in the lower Bow River valley in 1984 (#s 1, 7, 47, 55 in Fig. 1). If these tests of planned ignition fire prove successful, long-term fire management in the lower Bow River valley could require the burning of many units (Fig. 1). Possibly a 'lottery' system will be used to schedule units for burning to help duplicate the randomness of fire in a natural situation. Thus, the Two Jack I burn in BNP may be the first in an ongoing and important vegetation management initiative in Canada's Rocky Mountain national parks. The importance of accurate fire weather forecasting to this program cannot be understated.

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Lopoukhine, N.; White, C.A. 1985. Fire management options in Canada's National Parks. *In* Proc. Intermt. Fire Council 1983 Fire Management Workshop on Suppression Options and Alternatives (Oct. 25-27, Banff, Alta.). Govt. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alta. Inf. Rep. NOR-X- (in press).

DOWNSLOPE FOREST FIRE SPREAD: the Torrens example[1]

by

T.A. Van Nest[2], B. Janz[2], and M.E. Alexander[3]

During the early 1980's Alberta's forests played host to some of nature's more spectacular displays of extreme fire behavior. Although most of the major fire activity was concentrated in the northern part of the Province, one fire of particular interest did occur in the East Slopes area northwest of Grande Cache in the Grand Prairie Forest during the 1982 fire season. This fire, now known as the Torrens Fire (DG2-13-82) (Fig. 1), is of interest to the Alberta Forest Service (AFS) for several reasons:

1. Recent fire history in the East Slopes indicates that the optimum combination of fuels, weather conditions and ignition sources required to sustain a major fire occurs infrequently.

2. When this combination does occur, timber losses to fire have been dramatic.

3. Due to the infrequent occurrence of problem fires in the East Slopes in recent times, few personnel now working for AFS have had first hand experience in dealing with fires where topography can become a major factor in determining fire behavior.

The Torrens Fire is noteworthy for one additional reason in that the normal influence of topography was pre-empted by other factors. The somewhat unusual fire behavior exhibited during the day that the Torrens Fire made its major run bears close scrutiny and can lead to some disturbing speculation regarding control dfficulties on future fire occurrences under similar conditions in the East Slopes.

The Torrens Fire was definitely known to have been started by lightning. The last reported lightning activity in the fire area occurred during the evening of June 18. The time of origin was estimated at 1745 MDT. The Torrens Fire was first detected in Twp 60 - Rge 13 - Sec 25 as a "spot" (Fig. 1) by the Torrens Lookout (LO) towerman at 1348 MDT on June 20 and reported to the Grovedale Ranger Station at 1352 MDT. At 1353 MDT a 4-man AFS initial attack crew was dispatched to the reported fire. They arrived over the fire area at 1411 MDT. The fire was estimated to be 4 ha in size at that time and crowning.

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[1] *Summary of a presentation made at the Second Western Region Fire Weather Committee Scientific and Technical Seminar, March 6, 1984, Edmonton, Alta.*

[2] *Fire Behavior Officer and Supervisor-Weather Section, respectively, Forest Protection Branch, Alberta Forest Service, 10625-120 Avenue, Edmonton, Alta. T5E 5S9.*

[3] *Fire Research Officer, Canadian Forestry Service, Northern Forest Research Centre, 5320-122 Street, Edmonton, Alta. T6H 3S5.*

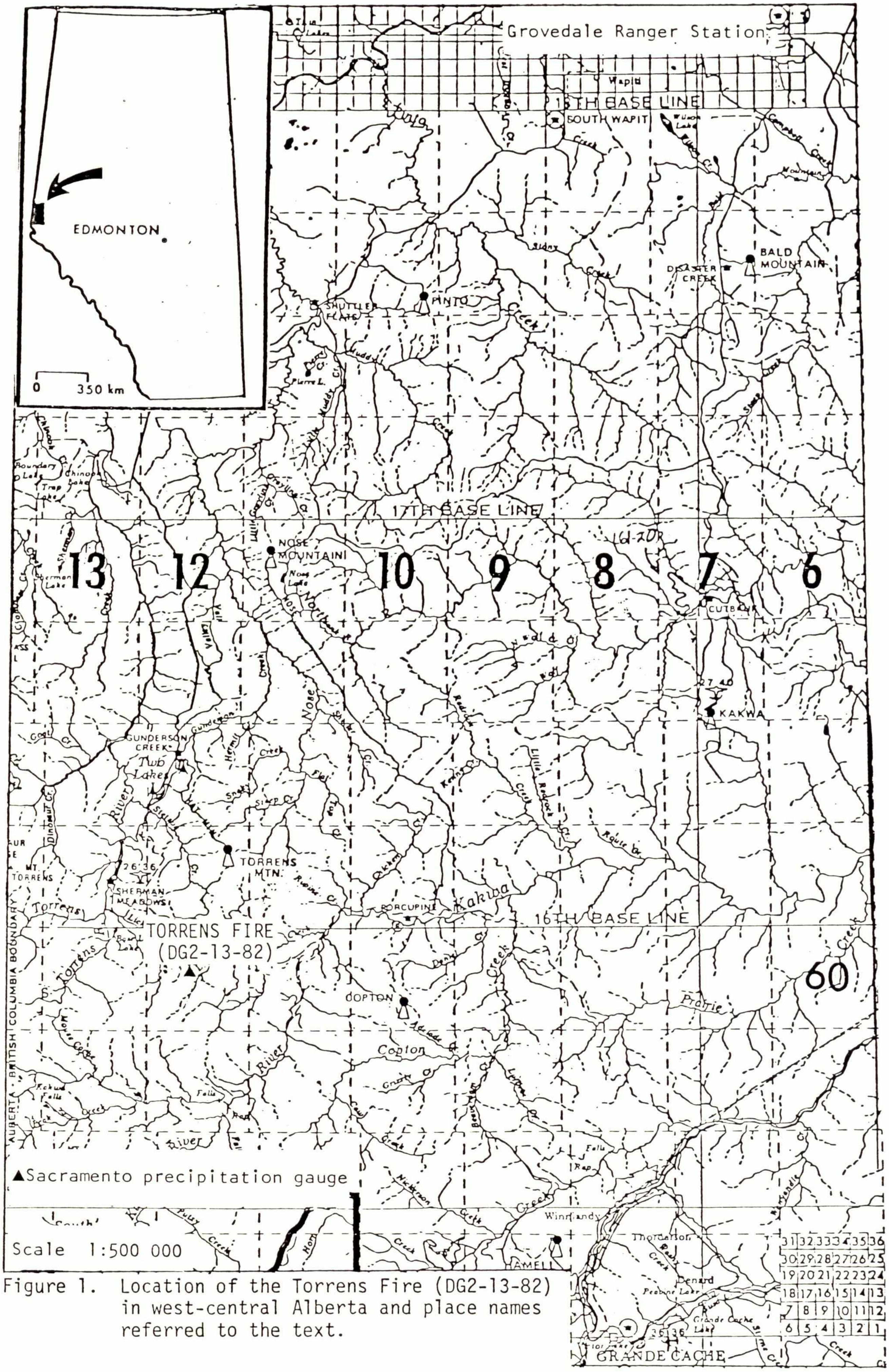

Figure 1. Location of the Torrens Fire (DG2-13-82) in west-central Alberta and place names referred to the text.

A unique photographic record of the fire's development was obtained by the towerman at Copton LO through an excellent series of 35 mm color slides (all times are MDT):

SLIDE 1: 1400 - 12 minutes after discovery.
SLIDE 2: 1405 - 17 minutes after discovery.
SLIDE 3: 1410 - 22 minutes after discovery.
SLIEE 4: 1415 - 27 minutes after discovery.
SLIDE 5: 1425 - 37 minutes after discovery.
SLIDE 6: 1430 - 42 minutes after discovery.
SLIDE 7: 1445 - 57 minutes after discovery.
SLIDE 8: 1500 - 1 h & 12 minutes after discovery.
SLIDE 9: 1530 - 1 h & 42 minutes after discovery.
SLIDE 10: 1600 - 2 h & 12 minutes after discovery.
SLIDE 11: 1615 - 2 h & 27 minutes after discovery.
SLIDE 12: 1700 - 3 h & 12 minutes after discovery.
SLIDE 13: 1730 - 3 h & 42 minutes after discovery.
SLIDE 14: 1830 - 4 h & 42 minutes after discovery.
SLIDE 15: 1845 - 4 h & 57 minutes after discovery.
SLIDE 16: 1900 - 5 h & 12 minutes after discovery.
SLIDE 17: 1905 - 5 h & 17 minutes after discovery.

The fire initially spread cross-slope in a south-easterly direction for ~800 m (Fig. 2). At approximately 1430 MDT the fire switched direction and burned down a 20% slope for a distance of ~1800 m to the bottom of Lick Creek then continued to move easterly with changes in topography having little or no apparent effect on fire spread. The fire continued to burn freely until approximately 2000 MDT at which time the winds died down and the relative humidity increased. Roughly 97% of the final fire area of 1183 ha was attained during this initial burning period.

Fuel types in the main fire area consisted of overmature stands of subalpine fir mixed with white spruce and lodgepole pine (up to 250 yrs. old). An abundance of aboreal lichens were present and these extended from ground level to the top of tree crowns. Surface fuels were generally sparse and existed in the form of scattered shrubs and windfall. Fuel types along the northern portion of the fire area were comprised of young pine stands (*ca.* 40 yrs. old). Fuel continuity decreases as you travel south of the fire area (treeline is approximately 3 km distant).

Topography in the fire area consists of broken terrain (Fig. 2). The area is traversed by three canyons that generally run north and south. Changes in elevation of up to 300 m can take place in as little as 0.8 km horizontal ground distance. Slopes range from 20-60% with 100% slopes common. The elevation of the fire area varies from 1340 m ASL at the eastern extremity to 1740 m ASL near the point of origin.

During the summer and fall of 1981, the immedaite area in which the Torrens Fire occurred received only local shower activity. Thus, at freeze-up the area could be considered to have received below normal precipitation. The winter of 1981-2 was colder than normal and snowfall was above average. A Sacramento gauge located just south of the fire

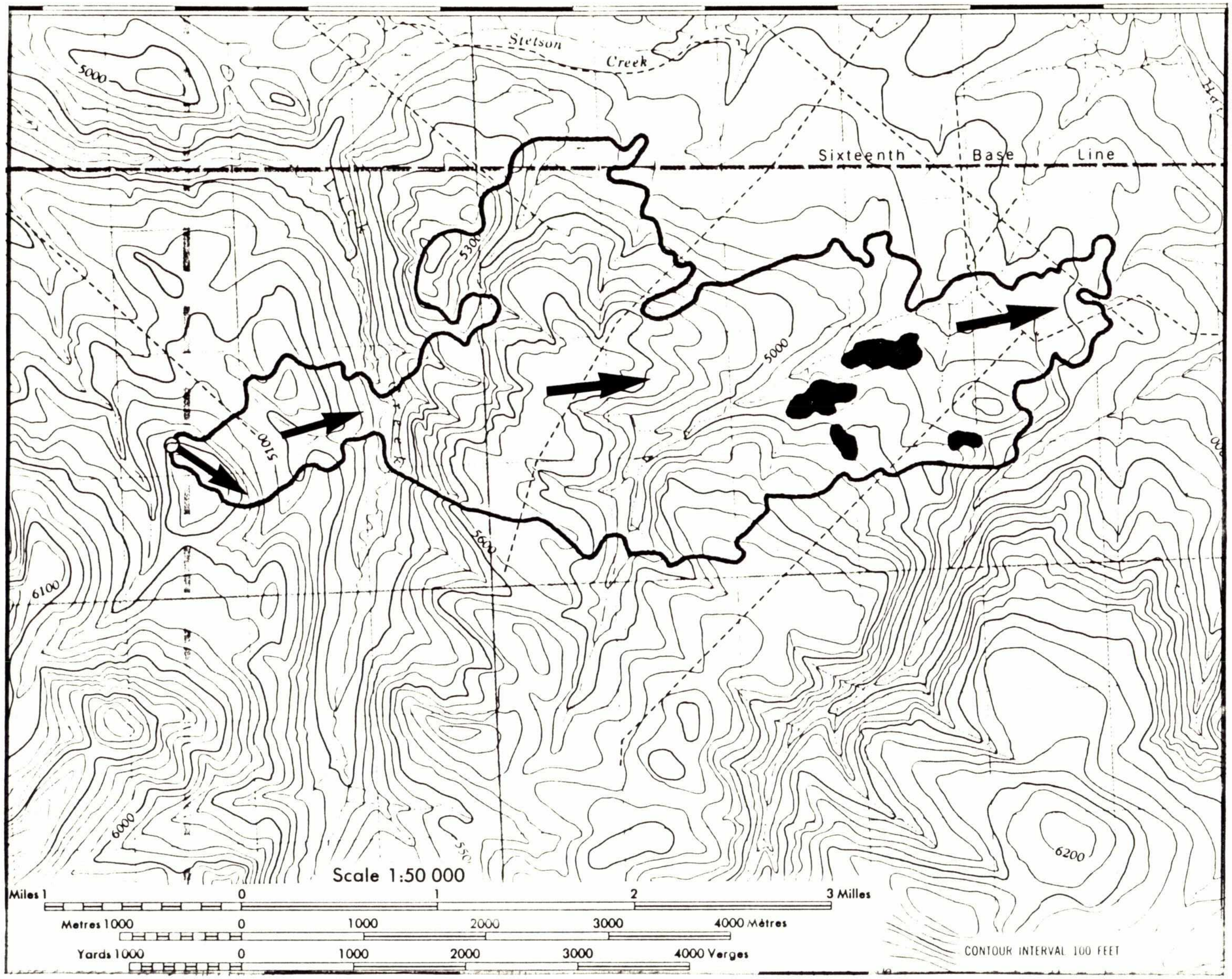

Figure 2. Final area burned by the Torrens Fire (DG2-13-82). The dark spots within the fire's perimeter represent unburned islands.

area (Fig. 1) recorded 368 mm of precipitation (water equivalent) between Oct. 20, 1981 and May 4, 1982 (Jablonski 1982). Essentially snow-free cover was experienced in the general fire area around May 25.

Precipitation during the spring of 1982 was below normal. A total of 28 mm of precipitation fell between May 28 and June 20. Temperatures on the three days prior to discovery of the fire on June 20 were relatively warm for this high-elevation country and were accompanied by low relative humidities. The A.M. and P.M. weather observations at Torrens LO (10 km north of the fire area) for three days prior, during, and one day following the major run on June 20 are documented in Tables 1 and 2. Six days had elapsed since more than 0.6 mm of rain had fallen. The Canadian Forest Fire Weather Index (FWI) System components (Canadian Forestry Service 1984) documented in Table 2 were computed after the fact.

The slides of the Torrens Fire taken from Copton LO and the observed behavior raise a number of questions as to what features of the synoptic weather situation were responsible for the fire to burn downhill. The observed facts are as follows:

1. The 1300 MDT weather observation from Torrens LO indicated towering cumulus (Cu+) and cumulonimbus (CB) clouds -- suggesting instability aloft. Lenticular cloud was also reported -- suggesting gravity waves to the lee of the mountains.

2. The surface map shows a cold front moving through the area (west to east) about noon of the same day (Fig. 3).

3. Upper air charts indicate all winds aloft were westerly -- i.e., no unusual features on upper air charts. (Westerlies aloft of course, if in right direction and right speed contribute to establishment of gravity waves.)

4. The cold front moved through at time when 500 mb ridge was at its maximum development. It broke down slowly during the following week.

5. The slides suggest a northwest wind over the fire area shortly after discovery, but west to southwest winds aloft. (The smoke plume initially moved in a southeast direction but at higher levels it moved east.)

6. The slides give ample evidence that there was subsidence just over the fire area, but as the smoke reached higher levels there was idication of atmospheric instability.

What weather phenomena caused the Torrens Fire to spread so vigorously downslope? The simplest explanation would suggest that it was related to the subsidence normally associated with gravity waves. However, there may well have been a slight inversion or neutral stability over the fire area in the wake of the cold front which had moved through earlier in the day.

A final sobering thought. Are the environmental conditions (i.e., the

Table 1. Morning fire weather observations and temperature/relative humidity extremes recorded at Torrens Lookout (1798 m ASL) before, during, and after the Torrens Fire run on June 20, 1982.

Day	0730-0745 MDT Dry-bulb temperature (°C)	Relative humidity (%)	10-m open wind Direction (from)	Speed (km/h)	Extremes Temperature (°C) Max.	Min.	Relative humidity (%)[1] Max.	Min.
June 18	15.0	36	W	5	23.0	13.0	47	23
19	19.0	35	E	2	23.0	14.0	100	27
20	15.0	39	W	16	22.0	14.0	40	26
21	12.0	60	S	20	19.0	12.0	100	56

[1]Maximum and minimum relative humidities estimated according to procedure described in Appendix A of Burgan et al. (1977).

Table 2. Fire weather observations and fire danger ratings at 1300 MDT as recorded at Torrens Lookout (1798 m ASL) before, during, and after the Torrens Fire run on June 20, 1982.

Day	Dry-bulb temperature (°C)	Relative humidity (%)	10-m open wind Direction (from)	Speed (km/h)	24-h rain (mm)	Canadian Forest Fire Weather Index System components FFMC	DMC	DC	ISI	BUI	FWI
June 18	19.0	29	W	4	0.0	91	26	96	6	31	12
19	19.0	35	E	14	0.1	91	29	103	10	34	18
20	21.0	26	S	21	0.0	92	34	110	16	38	28
21	18.0	43	SW	12	1.0	86	36	117	4	41	11

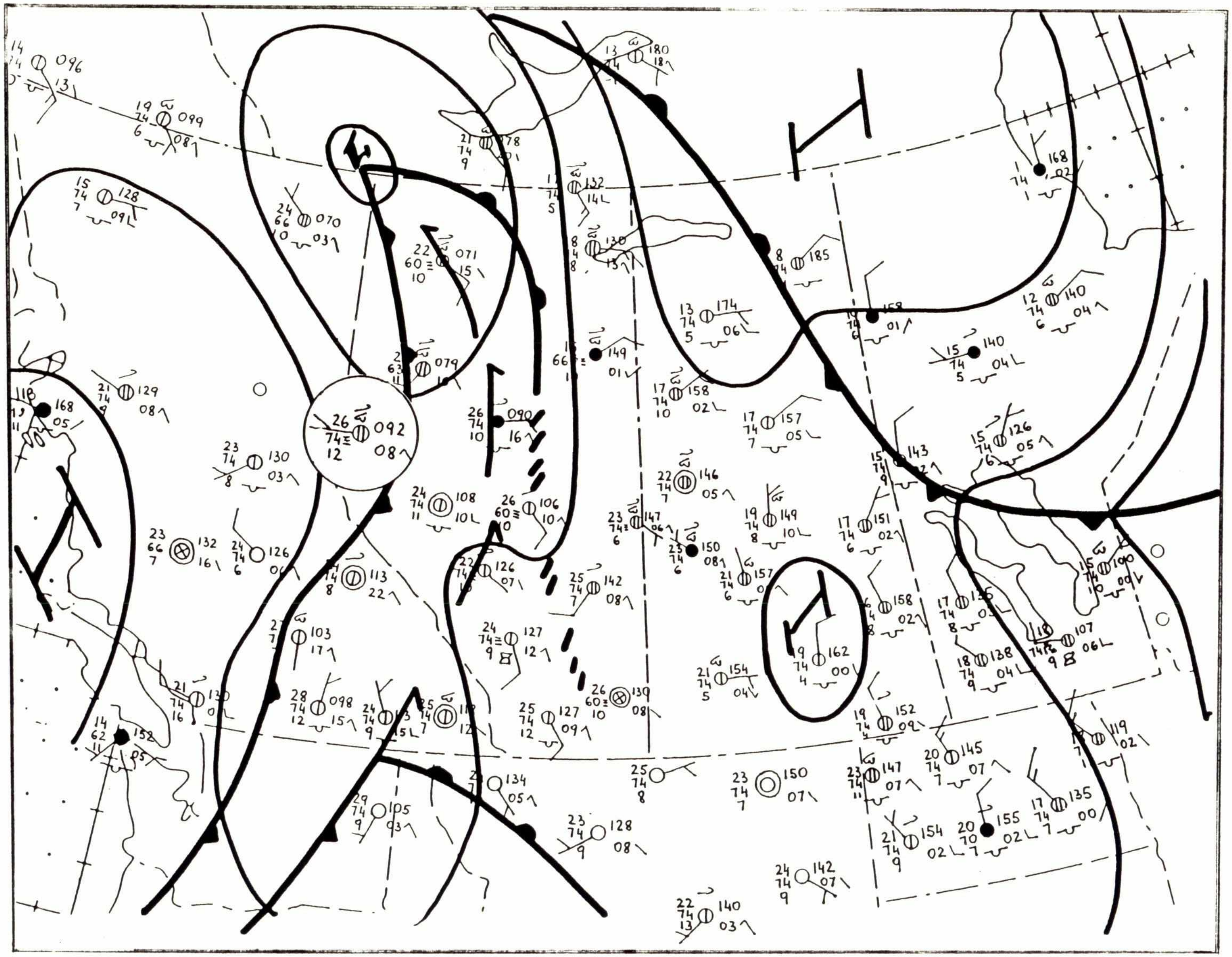

Figure 3. Surface weather map for 1200 MDT, June 20, 1982. Refer to Contents page for an interpretation of the station model used for plotting synoptic weather data.

combination of weather and topography) that was responsible for the fire behavior experienced on the Torrens Fire unique or could it be a common occurrence in the East Slopes? The answer to this question has very strong implications for firefighter safety.

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WILDFIRE DOCUMENTATION IN THE NORTHWEST TERRITORIES:

A CASE STUDY OF FORT SIMPSON-40-1983[1]

by

R.A. Lanoville and R.E. Schmidt[2]

The documentation of wildfires can provide valuable information: the verification of fire spread theories, their application to specific sites, and the recognition of wildfire phenomena hitherto unrecorded. With these ideas in mind, a fire (FS-40), which started in the Blackwater River area of the central Mackenzie valley (Figs. 1 and 2), was documented with emphasis on fire weather and the fire's forward rate of spread. A number of extraneous factors prevented the complete documentation of the fire's history, but the factors which lead to its ignition on June 30, 1983, and its behavior on July 7 and July 8 were documented.

The documentation begins with the weather which preceded and contributed to the fire's ignition. A high pressure ridge, at 500 mb, developed on June 15 and persisted over the central Mackenzie until July 8 (Fig. 3). This feature produced an island of summer; the forest dried out. On June 28, the ridge started migrating northward, drawing a moister, unstable air mass in its wake. Day and night, for six consecutive days--June 28 to July 3--thunderstorms passed through the Mackenzie valley from Fort Simpson to Norman Wells, resulting in 106 new fire starts. By July 9, the thunderstorm activity abated--the ridge was replaced by a low pressure feature which was centered over the Blackwater River area.

The Blackwater River is located 275 km northwest of Fort Simpson. The Blackwater flows westward from Blackwater Lake, through a wide gap in the Franklin Mountains, and empties into the Mackenzie River. The origin of FS-40 was 5 km south of the Blackwater, on a knobby ridge of the Franklins 1000 m ASL. The fire was periodically observed between June 30, the date of its ignition, and July 7 and each afternoon it crowned in the black spruce fuel types. The fire burned unchecked until the morning of July 8 (limited suppression action began) and except for the southern perimeter, the fire had spread from the mountains onto the flatlands of the Mackenzie and Blackwater River valleys.

On July 5, in preparation for fire suppression operations in the Blackwater area, a fully automatic fire weather station, the FTS 6100 station, was installed in a large clearing on Blackwater airstrip (Fig. 3). The start-up values for the Duff Moisture Code (DMC) and the Drought (DC) of the Canadian Forest Fire Weather (FWI) System (Canadian Forestry Service

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[1]*Summary of a presentation made at the Second Western Region Fire Weather Committee Scientific and Technical Seminar, March 6, 1984, Edmonton, Alta.*

[2]*Fire Behavior Officer and Fire Weather Technician, respectively, Indian and Northern Affairs Canada, Regional Fire Centre, P.O. Box 7, Fort Smith, N.W.T. XOE OPO.*

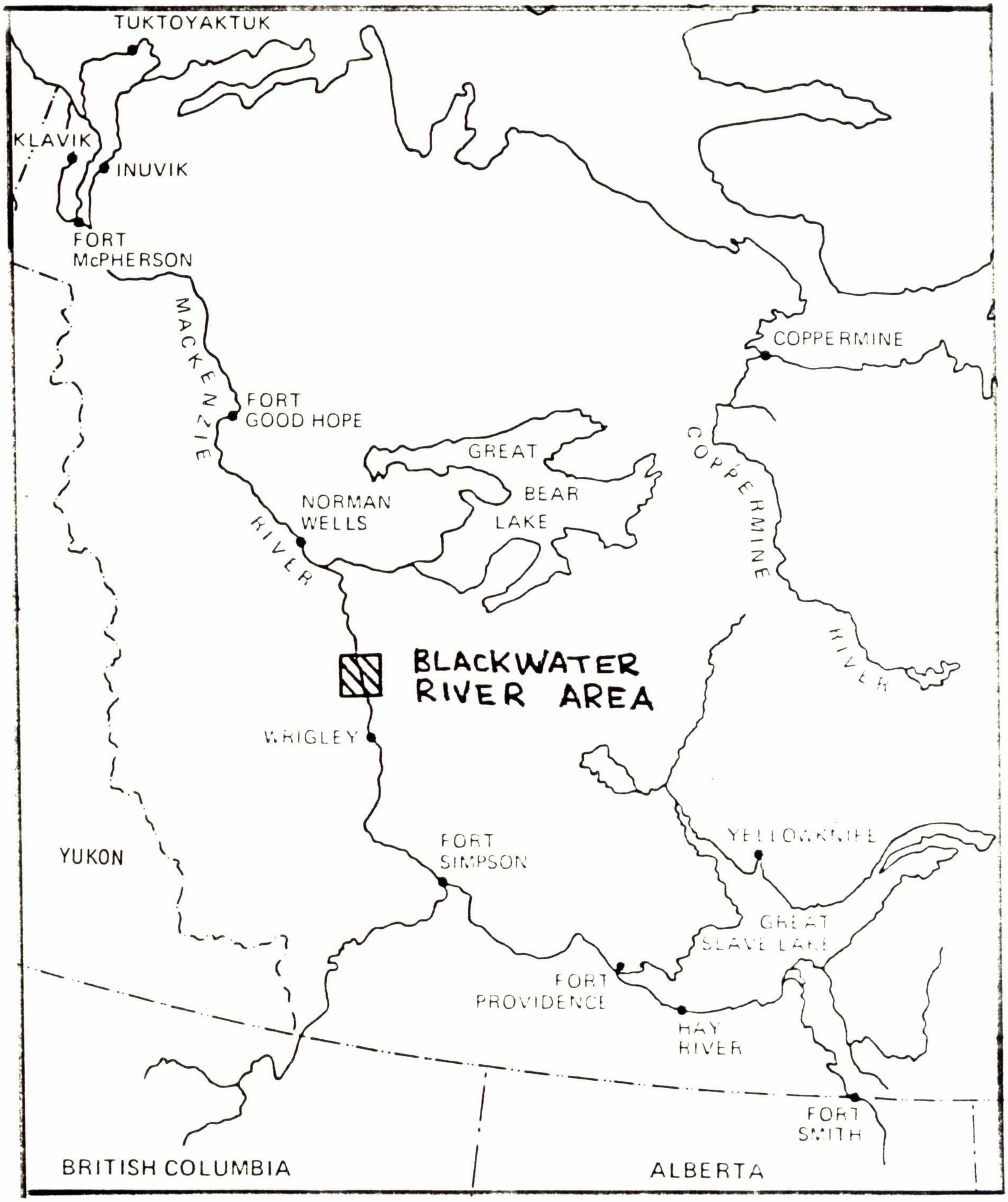

Figure 1. Geographical location of the Blackwater River area in the Northwest Territorires.

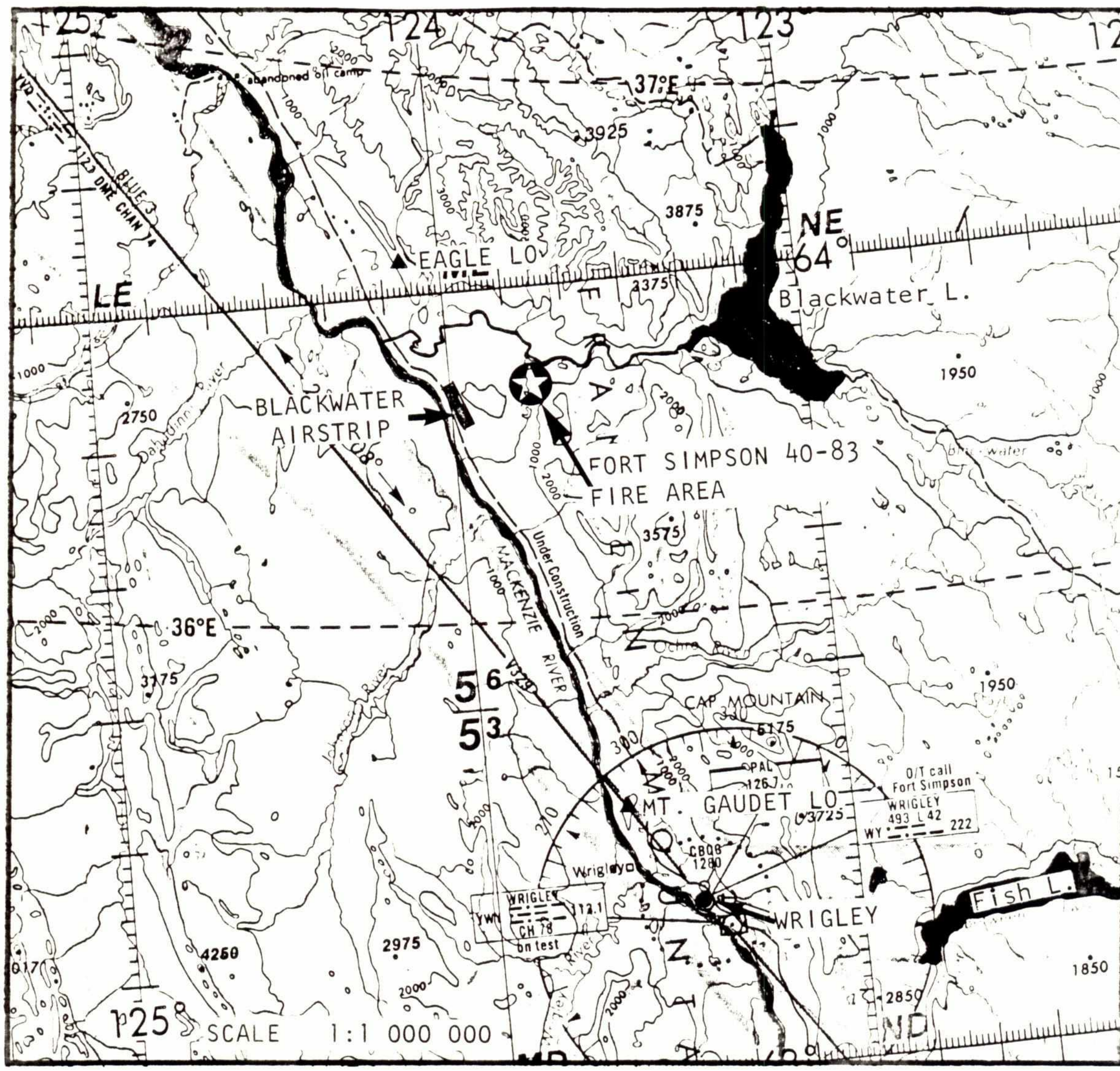

Figure 2. Location of the Fort Simpson 40-83 Fire in the Blackwater River area and place names referred to in the text.

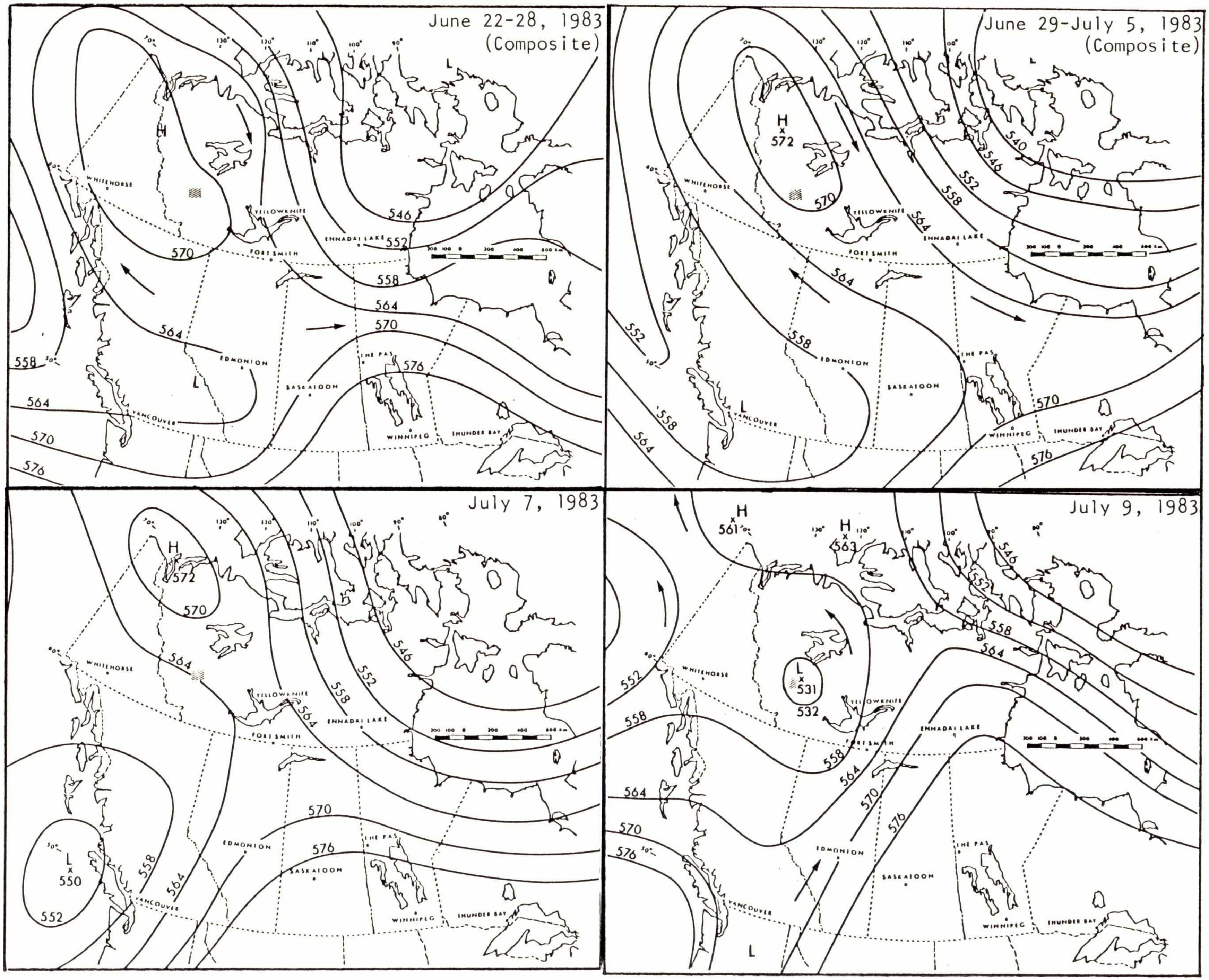

Figure 3. Daily and composite 500 mb charts prior to and during the Fort Simpson 40-83 Fire in the Blackwater River area, N.W.T. (shaded area).

1978) were derived from values calculated at nearby weather stations (Guadet and Eagle Ridge Lookouts); the Fine Fuel Moisture Code (FFMC) of the FWI System was derived from observed behavior on FS-40 Fire during the afternoon of July 5. On July 8, a manual weather station was installed on the southern perimeter of the fire in support of a planned burning-out operation. The weather readings and FWI System components based on the FTS 6100 station at the Blackwater airstrip, from July 6 to July 10, are summarized in Table 1.

Table 1. Fire weather observations and fire danger ratings at 1300 MDT associated with the Fort Simpson 40-83 Fire as recorded at the Blackwater airstrip temporary weather station between July 6-10, 1983.

Day	Dry-bulb temperature (°C)	Relative humidity (%)	10-m open wind Direction (from)	10-m open wind Speed (km/h)	24-h rain (mm)	Canadian Forest Fire Weather Index System components FFMC	DMC	DC	ISI	BUI	FWI
July 6	18.4	41	-	7	0.0	90	53	182	6	63	17
7	23.1	31	SE	18	0.0	91	57	190	12	66	29
8	21.2	41	SE	18	0.0	91	60	198	12	66	29
9	21.0	55	NW	8	0.0	90	62	206	6	72	19
10	24.0	39	NW	9	0.0	90	65	214	7	72	21

Two measurements of forward rate of spread were made, one on July 7 and the other on July 8 (Table 2). The first was from the natural expansion of the fire, which spread from the base of the mountains to the edge of the Blackwater River. On July 7, FS-40 advanced an active crown fire displaying short-distance spotting up to 100 m; the convection column leveled off at 3500 m above ground and was strongly angled to the northwest (in the direction of the fire's spread). The column collapsed about 2000 MDT signaling the end of any significant expansion for the remainder of the day. The second measurement was from the burning-out operation conducted on July 8 to eliminate a potentially costly fire control problem. Again, the flame front spread as an active crown fire. Because the smoke obscured the view at the head of the fire, spotting could not be confirmed. The convection column was weakly formed and rose to 2200 m above ground and collapsed when the burn-out fire ran into the main fire, which was inactive at the time. In both cases, the fuel type was black spruce-lichen (moderately dense overstory). The trees varied in height between 3-10 m and had dense crowns which extended to or near the forest floor. Between the trees, the forest floor consisted of a lichen layer. A mat of feather mosses and prostrate shrubs was present directly beneath the trees.

Table 2. Rate of spread (ROS) measurements and associated burning conditions documented during the Fort Simpson 40-83 Fire in July, 1983.

Day	Time (MDT)	10-m open wind speed (km/h)	FFMC	ISI	ROS (m/min)
July 7	1700	20	93	17	17
July 8	1900	19	91	13	16

The burnout operation on July 8 also afforded the opportunity to assess the forward rate of spread of a point ignition and an established "line" fire burning under nearly identical environmental conditions. The point ignition originated from an unintentional "drip" from the helitorch device following the line of fire applied during the burnout operation. The resulting 'spot fire' advanced 50 m in 20 min, before being suppressed, for an average spread rate of 2.5 m/min compared to the line fire which progressed 335 m in 21 min for a mean forward rate of spread of 16 m/min.

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THE ASH WEDNESDAY BUSHFIRES OF 16 FEBRUARY 1983 IN SOUTH-EASTERN AUSTRALIA: Video Tape[1]

overview by

M.E. Alexander[2]

The 20-min video tape shown at the seminar was edited by Mr. N.P. (Phil) Cheney from Australian television coverage of the wildland fires that devastated south-eastern Australia on February 16, 1983. Mr. Cheney is a Senior Research Scientist with the Commonwealth Scientific and Industrial Research Organization's (CSIRO) Division of Forest Research located in Canberra, A.C.T. The following overview was prepared from the published material that has become available on the Ash Wednesday bushfires (see References listed on Page 27).

On February 16, 1983, weather conditions, fuels, and ignition sources combined to produce the most devastating bushfires seen in the states of South Australia and Victoria since 1939. The 'Ash Wednesday' Fires (the grass and forest fires ironically coincided with Ash Wednesday in the Christian calendar) erupted in an area reaching from a point north of Adelaide, South Australia to the Melbourne region of Victoria (Fig. 1).

Some 22 major fires occurred and these burnt a total area of approximately 350 000 ha and resulted in the loss of 75 lives (civilians and fire fighters), 2463 houses, and substantial losses of other property (e.g., livestock). Maximum head fire spread rates of 18-22 km/h were documented in "grasslands" (a single fire run of 65 km was recorded) and 12-14 km/h in native hardwood forests and exotic pine plantations (maximum spot fire distances of 10 km and flame heights of 200 m were reported).

By mid-February 1983, south-eastern Australia was continuing to experience one of the worst droughts ever recorded. Severe rainfall deficiencies, which began in 1982, continued into 1983. Many stations in South Australia and the forested areas of Victoria reported their lowest rainfall on record for the 10-month period ending on January 31, 1983 (Fig. 2). The prolonged drought did however reduce the fire hazard in most grassland areas because growth was poor and the fuel quantities were correspondingly low.

The specific meteorological conditions that give rise to severe burning conditions in south-eastern Australia are well known. Both Victoria and South Australia are located to the southeast of the expansive desert areas of interior Australia. Anticyclonic subsidence in summer leads to the development of air masses with high surface temperatures and low

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[1] *Summary of a presentation made at the Second Western Region Fire Weather Committee Scientific and Technical Seminar, March 6, 1984, Edmonton, Alta.*

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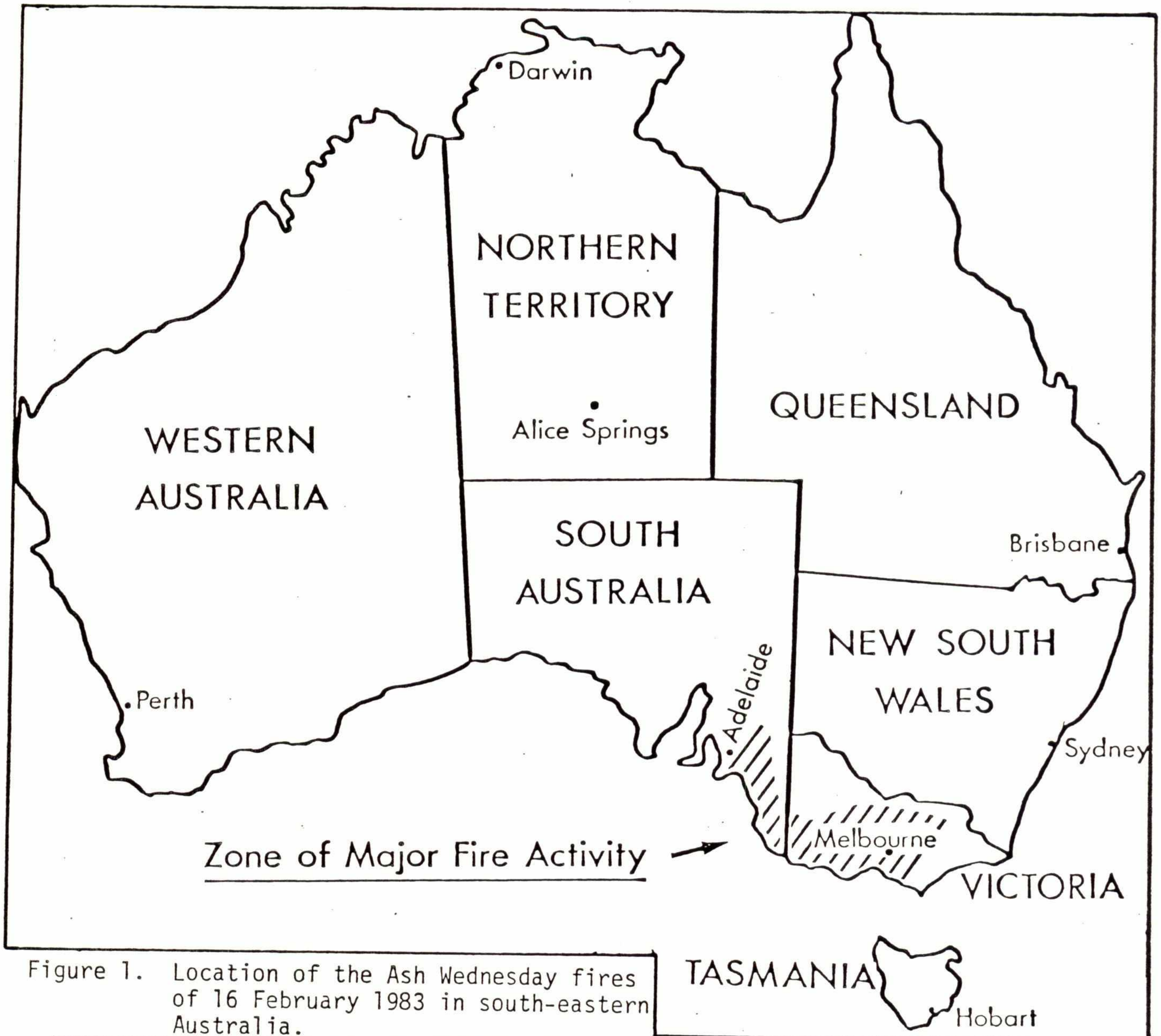

Figure 1. Location of the Ash Wednesday fires of 16 February 1983 in south-eastern Australia.

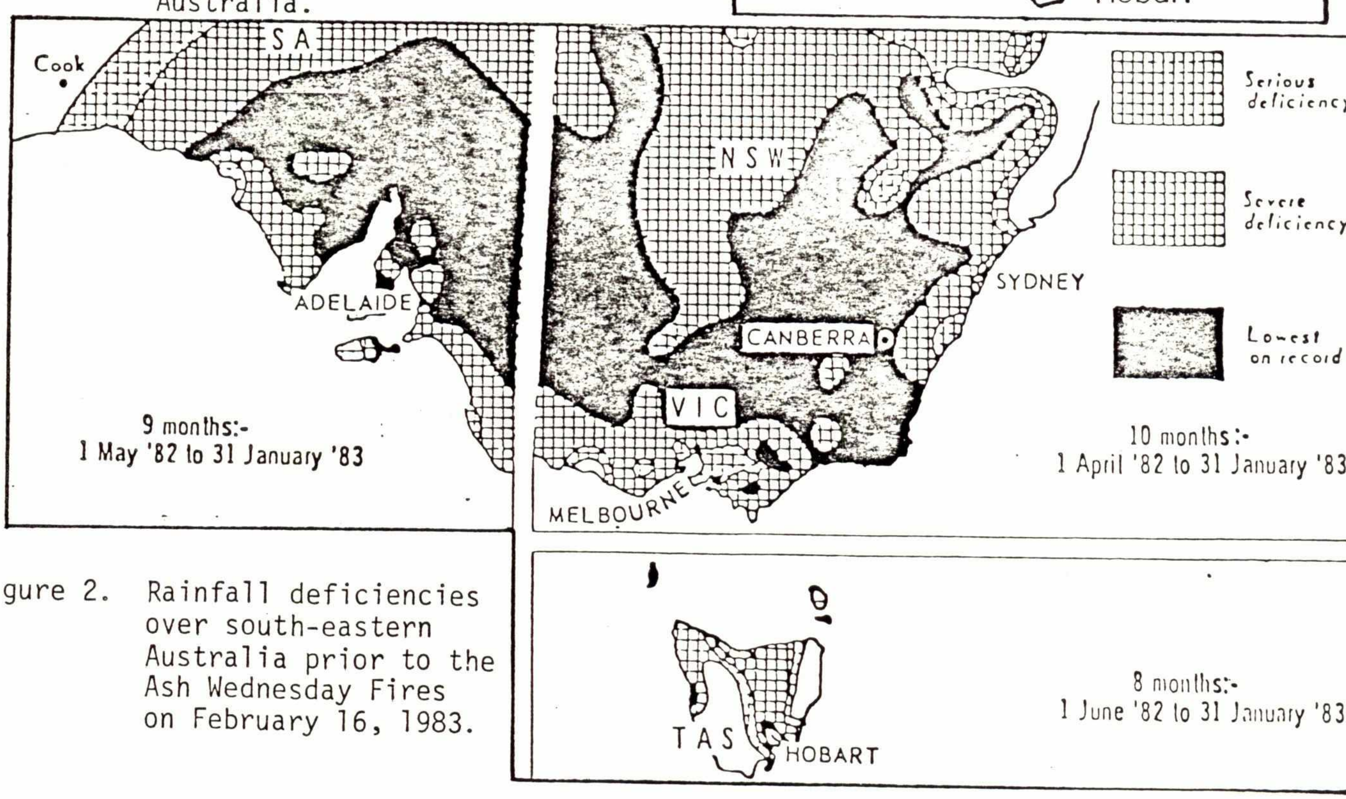

Figure 2. Rainfall deficiencies over south-eastern Australia prior to the Ash Wednesday Fires on February 16, 1983.

relative humidites. The west to east movement of anticyclones, usually in the latitude of the Tasman Sea, brings hot dry northerly to north-westerly winds from the centre of the continent. Such a synoptic-scale situation was responsible for the fire weather associated with the bushfires on Ash Wednesday and in other years (e.g., McArthur et al. 1982). The specific details are described below.

On February 15 an anticyclone over New Zealand extended a ridge towards central Australia, and in the Southern Ocean a cold front was advancing northeastwards. The pressure gradient over eastern Australia, was fairly weak and surface winds were light. This is a familiar pattern in summer and usually recurs every 7-8 days. The pressure gradient usually becomes steeper as the front approaches, bringing strong dry northerly winds to southern Australia ahead of a cool change with south to south-westerly winds.

A deep reservoir of hot dry air existed over central Australia during the afternoon of February 15. This was drawn southwards over South Australia by large pressure falls in the Great Australia Bight, with the speed of the airflow gradually increasing. Combined with the overall eastward movement of the approaching systems, this in turn resulted in the advection of hot, dry air southwards over western Victoria.

The temperature discontinuity between the hot, dry air mass over south-eastern Australia, and the cold air moving up from the Southern Ocean resulted in the intensification of the newly formed front on the Great Australian Bight during the morning of February 16 -- Ash Wednesday.

The frontal system and associated cloud mass in the Great Australian Bight continued to move rapidly eastward and had now become the major influence on the weather (Fig. 3). By Ash Wednesday afternoon the front had intensified further as it approached south-eastern Australia due to the effects of the large thermal contrast between the very hot land mass and the much colder ocean surface ahead of the front, the hot dry air flow continued to strengthen and become more turbulent producing gale force north-north-westerly winds, very high air temperatures, very low relative humidities, and extensive areas of raised dust and smoke which dramatically reduced visibility. At 1500 h local time on February 16 the Mount Gambier Aerodrome in South Australia and the Melbourne Airport in Victoria (see Fig. 4 for locations) recorded maximum air temperatures of 43°C and minimum relative humidities of 7% and 5%, respectively.

The dry cold front moved across South Australia and Victoria during the afternoon and late evening of February 16 and by 0300 h on February 17 it had crossed into New South Wales (Fig. 4). Mean wind speeds of at least 40-50 km/h were recorded at many stations prior to the frontal passage. With the passage of the front, winds changed sharply to south-southwesterly and increased in strength to 70 km/h, with gusts in excess of 110 km/h, for up to 2 hours afterwards. Following passage of the front, there was a marked drop in temperature and an increase in relative humidity. Winds moderated considerably and tended to be more south-southwesterly.

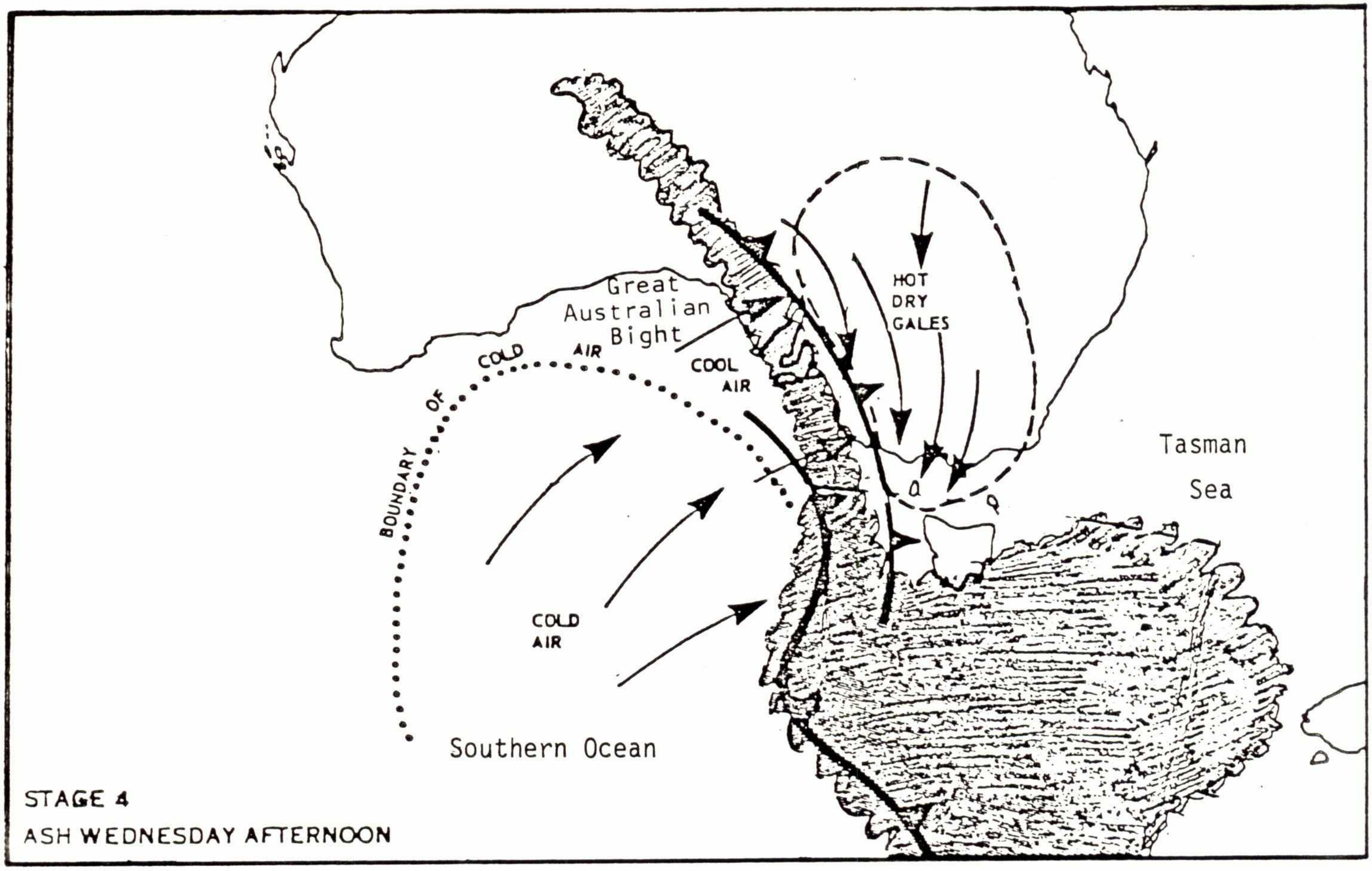

Figure 3. Atmospheric circulation over south-eastern Australia during the afternoon of February 16, 1983 (after Country Fire Authority 1983)

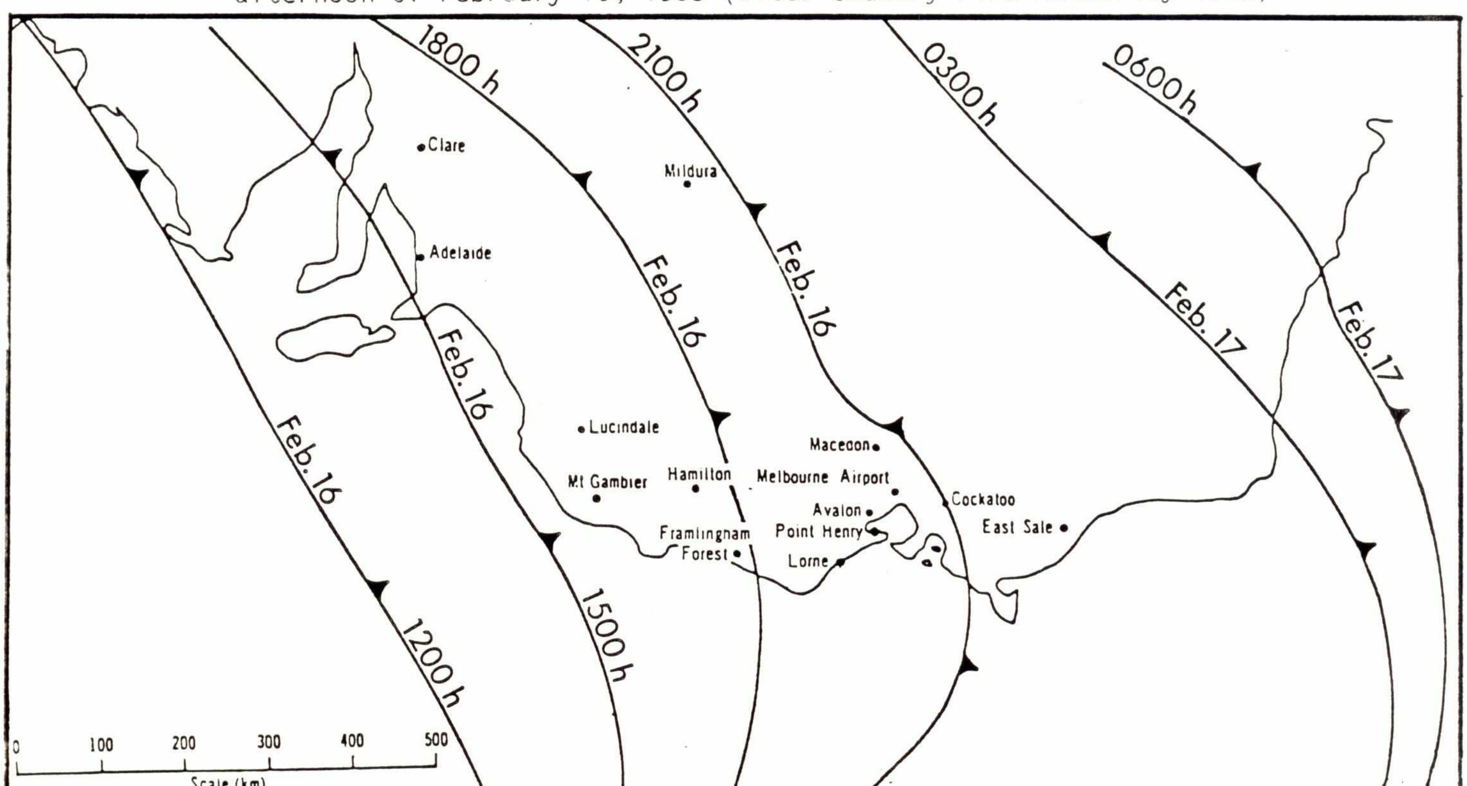

Figure 4. Progress of the dry cold front across south-eastern Australia on February 16-17, 1983 (after Country Fire Authority 1983).

Numerous man-caused fires started throughout Ash Wednesday and spread rapidly south-southeasterly under the influence of strong north-northwesterly winds. When the wind changed to the south-southwest after passage of the dry cold front, fires broke away along the whole of the eastern flanks. Such a spread pattern is exemplified by the Cudgee-Ballangeich Fire (Fig. 5) which resulted from two independent ignitions which eventually burned approximately 50 000 ha of pasture lands after joining together following the south-westerly wind change (the fire is located near Framlingham Forest in Fig. 4). The two separate fires advanced at 5.8 km/h and 8.5 km/h, respectively, prior to the frontal passage just before 1800 h. The series of "tongues" or "fingers" that resulted from the change in wind speed and direction were due to a combination of partial containment along the eastern flanks, fuel discontinuities, and the flames being "blown out" along sections of the fire front.

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<u>Editor's Notes:</u> A technical report on the weather conditions associated with the Ash Wednesday Fires prepared by the Australian Bureau of Meteorology, Melbourne, Victoria, is currently "in press."

The Alberta Forest Service-Forest Protection Branch, N.W.T. Northern Affairs Program-Regional Fire Centre, Forest Technology School at Hinton, and Atmospheric Environment Service-Western Region have obtained copies of the video tape.

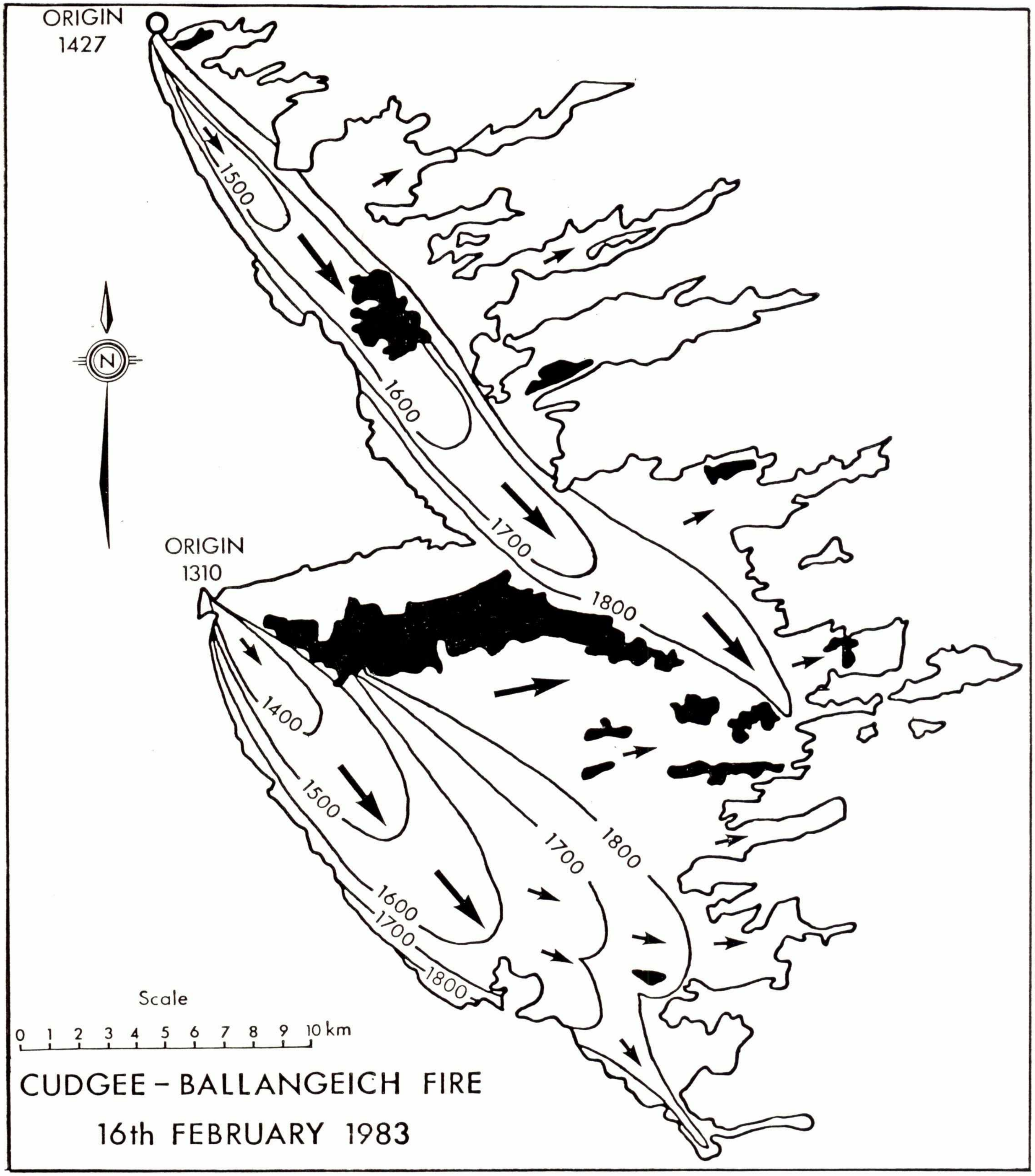

Figure 5. Progress of the Cudgee-Ballangeich Fire in south-western Victoria prior to and following the frontal passage on February 16, 1983 (after Country Fire Authority 1983). The dark areas within the fire's perimeter represent unburned patches.

LIST OF SEMINAR ATTENDEES

Name	*Title*	*Affiliation*[1]
ABBOT, Ed	Park Warden	Parks Canada, EINP, Ft. Saskatchewan
ALEXANDER, Marty	Fire Research Officer	CFS, NoFRC, Edmonton
BOWETT, Brian	Sr. Meteorologist	AES, ALWC, Edmonton
BURNETT, Dave	Meteorologist	AES, ALWC, Edmonton
CARNELL, Dave	Sr. Park Warden	Parks Canada, JNP, Jasper
DREWS, Manfred	Hydrometerologist	AES, West, Reg., Edmonton
HARVEY, Dahl	Meteorologist	AFS, Weather Section, Edmonton
JANZ, Ben	Meteorologist	AFS, Weather Section, Edmonton
LANOVILLE, Rick	Fire Behavior Officer	INAC, RFC, Ft. Smith
LUKIWSKI, George	Park Warden	Parks Canada, EINP, Ft. Saskatchewan
McGILL, Randy	Park Warden	Parks Canada, EINP, Ft. Saskatchewan
MAFFEY, Murray	Fire Research Technician	CFS, NoFRC, Edmonton
MANN, Av	Chief-Scientific Services	AES, West. Reg., Edmonton
MEADOWS, Neil	Meteorologist	AES, ALWC, Edmonton
NIMCHUK, Nick	Meteorologist	AFS, Weather Section, Edmonton
POWELL, John	Climatologist	CFS, NoFRC, Edmonton
SCHMIDT, Ray	Fire Weather Technician	INAC, RFC, Ft. Smith
THOMSON, Bruce	Meteorologist	AES, West. Reg., Edmonton
WALLACE, Yvonne	Meteorologist	AES, ARWC, Edmonton
VAN NEST, Terry	Fire Behavior Officer	AFS, Ops. Section, Edmonton
WHITE, Cliff	Park Warden	Parks Canada, BNP, Banff

[1]ABBREVIATIONS: EINP = Elk Island National Park; JNP = Jasper National Park; BNP = Banff National Park; CFS = Canadian Forestry Service; NoFRC = Northern Forest Research Centre; AES = Atmospheric Environment Service; ALWC = Alberta Weather Centre; ARWC = Arctic Weather Centre; AFS = Alberta Forest Service; INAC = Indian and Northern Affairs Canada; RFC = Regional Fire Centre.

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PROCEEDINGS OF THE SECOND WESTERN REGION FIRE WEATHER COMMITTEE SCIENTIFIC AND TECHNICAL SEMINAR - March 6,1984, Edmonton, Alberta