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THE EFFECT OF FUEL REDUCTION BURNING ON THE SUPPRESSION OF FOUR WILDFIRES IN WESTERN VICTORIA

RESEARCH REPORT No. 41

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Summary

This report examines the effects of fuel reduction burns on four wildfires in heath and mallee fuel types in the Little Desert and Grampians areas of Western Victoria. These burns prevented each of the four wildfires from reaching a much larger size, thus saving considerable suppression resources and avoiding damage to private property in one case. In addition, on a day when 17 wildfires occurred and fire suppression resources were scarce, the burns reduced the overall demand for resources, and thereby provided an important strategic benefit.

Some other specific conclusions were that:

- established fires that are burning in the Little Desert in heathland that has not been burnt for seven or more years, burning under conditions of 30-35 km/h wind and with an overall Forest Fire Danger Index of 10 or greater, can be too intense to be controlled by direct attack;
- established fires that are burning in the South Wimmera in Brown Stringy-bark heathy woodland that have not been burnt for 25 or more years, burning under conditions of High to Very High Forest Fire Danger Index or greater, can be too intense to be controlled by direct attack;
- mallee-broombrush fuels that have not been burnt for seven years can be an effective barrier to fire spread when the Forest Fire Danger Index is 10 and the wind is $\pm$ 30 km/h;
- for up to 10 years after a burning, the reduction of bark hazard in Brown Stringy-bark woodland can greatly assist fire suppression operations by reducing spotting.

Introduction

Fuel reduction burning is the use of prescribed fire, usually of low intensity beneath the canopy of eucalypt forest, to remove accumulated litter, plant debris or understorey plants which form the available fuel. Fuel reduction burning has been practiced on a systematic basis by land management agencies in parts of Australia for more than 25 years. The purpose of burning is to reduce hazards in several ways:

- reduce the total weight of fuels, so as to reduce the intensity of a subsequent wildfire. This should lead to quicker and easier suppression of the fire with a saving of resources.
- reduce the height of understorey vegetation and hence the flame height and rate of spread of a wildfire.
- remove firebrand material, principally fibrous or flaky bark from the trees, so as to reduce the potential of wildfires to generate spot fires ahead of the main fire front. The reduction of spotting potential can reduce overall rates of spread and make fire suppression easier and safer.
  (CSIRO National Bushfire Research Unit 1987).

In the Horsham Region (see Map 1) of the Department of Conservation and Natural Resources[1] (CNR) fuel reduction burning is conducted in three ways:

- "broad-area" fuel reduction burns aim to burn all of the available fuel on between 50 and 90%[2] of an area. These areas are between 10 and 8 000 ha in size, mainly delineated by existing roads, tracks and fire-breaks, and generally confined to the Grampians National Park and the surrounding public land.
- "strip" fuel reduction burns, of up to 80-100 m wide, aim to burn all of the available fuel on the area between two parallel mineral-earth fire-breaks. The purpose of these burns is to prevent wildfires crossing from or into the Little Desert National Park and the forest blocks of the South Wimmera area. The vegetation of these areas is mainly Brown Stringy-bark (*Eucalyptus baxteri*) open woodland with a highly flammable heath understorey, mallee-broombrush (principally *E. incrassata* and *Melaleuca uncinata*) vegetation (mainly in the Little Desert) or highly flammable heathland (dominated by *Banksia ornata & marginata, Allocasuarina paludosa & pusilla, Leptospermum myrsinoides* and *Xanthorrhoea* spp). In areas with Mallee-Broombrush vegetation, lower flammability and lower levels of available fuel causes less fuel to be removed by fuel reduction burns. Strip burns can cost more than broad-area burns, but affect smaller areas of vegetation.
- "link" fuel reduction burns aim to remove the fuels for a variable distance (usually 50-200 m) from a single fire-break. They are used to connect other areas where the fuels have been reduced by wildfires or fuel reduction burning. Their location varies according to recent wildfire and burning history. These areas have the same vegetation as areas where "strip" fuel reduction burns are conducted. This technique can be less costly than strip-burning because of the reduced track works needed. It is used primarily in the Little Desert National Park.

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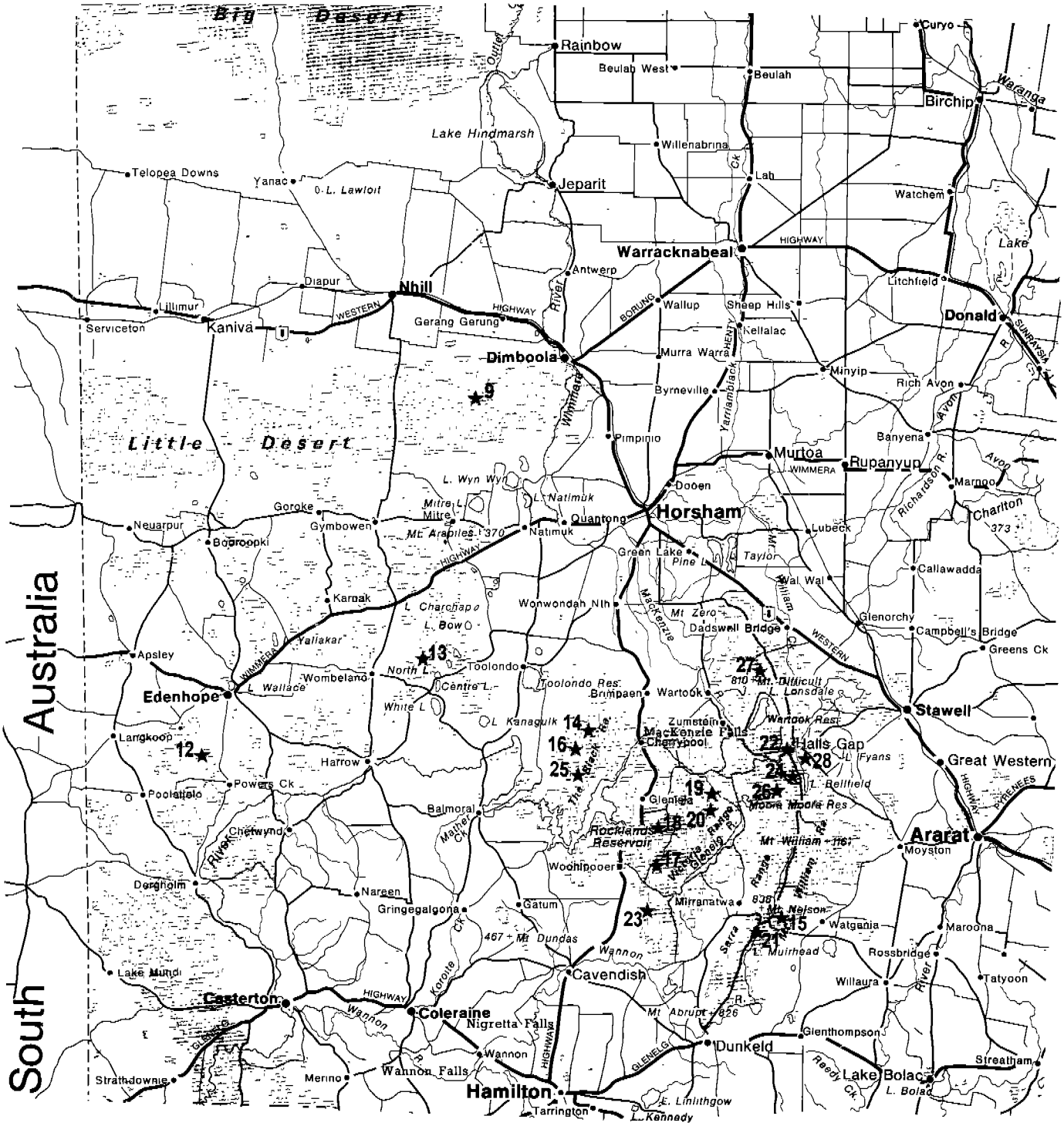
[1] In October 1992 the Department of Conservation & Environment (DCE), the Department of Water Resources and the Office of the Environment were merged to become the Department of Conservation & Natural Resources (CNR). DCE and it predecessor, the Department of Conservation, Forests & Lands (CFL), were formed by amalgamating the former Department of Crown Lands & Survey (including the Vermin & Noxious Weeds Destruction Board), Forests Commission Victoria, and the Ministry for Conservation (principally the Fisheries & Wildlife Division, National Parks Service, and Soil Conservation Authority) in 1983.

[2] In the Horsham Regional Fire Protection Plan (CFL 1989) a system of zones is used to delineate priority areas for fire protection works (principally fuel reduction burning). For each of the four priority zones specified in this plan, prescriptions for the level and extent of fuel reduction considered appropriate for that level of protection have been set.

Map 1: Location of Fire Origins on 2/12/90 and 3/12/91 in the Horsham Region.



In the 1990/91 fire season fuel reduced areas in the Horsham Region were in a position to affect the control of four wildfires. On 2 December 1990 one fuel reduced area affected the suppression of a wildfire in the Little Desert. On 3 January 1991, three fuel reduced areas affected the suppression of 17 wildfires burning in the South Wimmera and Grampians. Map 1 shows the locations of these fires.

The aim of this report is to examine the impact of these fuel reduction burns on the fire suppression operations.

Examples of Fuel Reduction Burning Affecting Wildfire Suppression.

Case 1. Salt Lake Wildfire, Little Desert National Park (Horsham Fire No 9).

Fuel Reduction Burn

During Spring 1990, a fuel reduction burn ("link" type) was conducted in vegetation had not been burnt since 1976. This burn was located along the eastern side of McCabes Hut Track within the Eastern Block of the Little Desert National Park. Fuel quantities were estimated to be in excess of 20 t/ha; and where Brown Stringy-barks were present the bark hazard, as rated on a four category scale (Wilson 1992), was Very High. The link burn removed all available fuel from 100% of the areas with heath vegetation for widths of 80-200 m along the track; but in areas with less flammable mallee-broombrush vegetation the fuel reduction burn was less effective, removing available fuels from only 0-50% (typically 20%) of the area (Figure 1).

Fire Situation

Lightning started a wildfire in heath near Salt Lake about 8 km to the south-west of McCabes Hut at about 1530 hours on 2 December 1990 (see Map 2). An adjacent landowner reported the wildfire at 1600 hours, and the first CNR crews arrived at the wildfire at 1738 hours, by which time the wildfire was about 250 ha in area.

The forest fire danger (McArthur 1967) had been Very High during the afternoon and moderated during the evening, decreasing from High at 1800 hours to Low by 2200 hours, as shown in Table 1.

At the fire origin, the heath vegetation had not been burnt for at least 20 years and fine fuel quantities in areas adjacent to the wildfire were estimated at about 20 t/ha. The vegetation cover was 60-70%, and height up to 1 m. The bark hazard of Brown Stringy-bark was Extreme. The wildfire burnt rapidly through these fuels, with significant levels of short distance spotting allowing the wildfire to cross Dahlenberg Mill Track easily at about 1600 hours.

To the north of Dahlenberg Mill Track, the heath and mallee-broombrush vegetation had last been burnt in 1983 as part of a vegetation management burn. In the heath fine fuel levels were about 10 t/ha with vegetation cover of 40-50% and height up to 1 m; and in the mallee-broombrush, fine fuel levels were about 5 t/ha with vegetation cover of 40-50% and height up to 0.5 m. The bark hazard level was Moderate.

The average rate of spread of the wildfire at 1847 hours was 1.5 km/h with flame heights of 5 m in heath and 2 m in mallee-broombrush. Spotting from isolated Brown Stringy-barks within the heath was much lower than it had been in the area south of

TABLE 1: Weather Conditions on 2 December 1990 for the Little Desert*.

Time (hours)	1200	1400	1800	2000	2200	2400
Temperature (°C)	33	34	32	27	23	20
Rel. Humidity (%)	35	33	40	55	70	75
Wind Speed (km/h)	24	35	30	35	24	24
Wind Direction	WSW	WSW	SSW	SSW	SSW	SSW
Forest FDI	18 (High)	26 (Very High)	17 (High)	10 (Moderate)	4 (Low)	3 (Low)

* Temperature and relative humidity were measured by thermohydrograph at the CNR Wail work centre, which is 20 km west of the fire area. Wind speed and direction were measured by the CFA Automatic Weather Station located at Horsham, which is 36 km south-west of the fire area. Forest FDI was calculated using the Keetch-Byram Drought Index for Wail, which was 80 on the day of the fire.

Dahlenberg's Mill Track. Direct attack on the head of the wildfire was not possible at this stage. Instead, suppression effort concentrated on controlling the wildfire with a D4 bulldozer (80 kW class) and 4WD slip-on units (400 litres capacity) along the northern edge of the fire with the aim of restricting the spread of the fire on the following day for which south-easterly winds were being forecast.

As the wildfire approached McCabes Hut Track at about 2000 hours, additional fire suppression crews waited in the fuel reduced area east of McCabes Hut Track. They observed that the headfire was burning mainly in the heath fuel types, by-passing the mallee-broombrush areas[3]. The rate of spread in the heath fuels was around 1 km/h, with flame heights of around two to three metres. Direct attack on the head fire under these conditions was still considered to be very unlikely to succeed. The fuel reduced area along McCabes Hut Track (Figure 2) stopped the fire. The very few spot fires which started in the fuel reduced heath on the east side of the track were easily extinguished by the waiting fire crews.

The vegetation to the east of the fuel reduced area consisted of extensive *Allocasuarina* heath (a highly flammable fuel type) and mallee vegetation that had regenerated from a wildfire in 1976 and which had a Very High bark hazard. Observers at the wildfire site estimate that without the assistance of the fuel reduced area the wildfire would have burnt until 2400 hours. During that time, fire suppression would have continued to be difficult, due to the high rates of spread and high flames; and the final wildfire size, without the fuel reduced area, would have been up to 5 times larger[4] (Map 2).

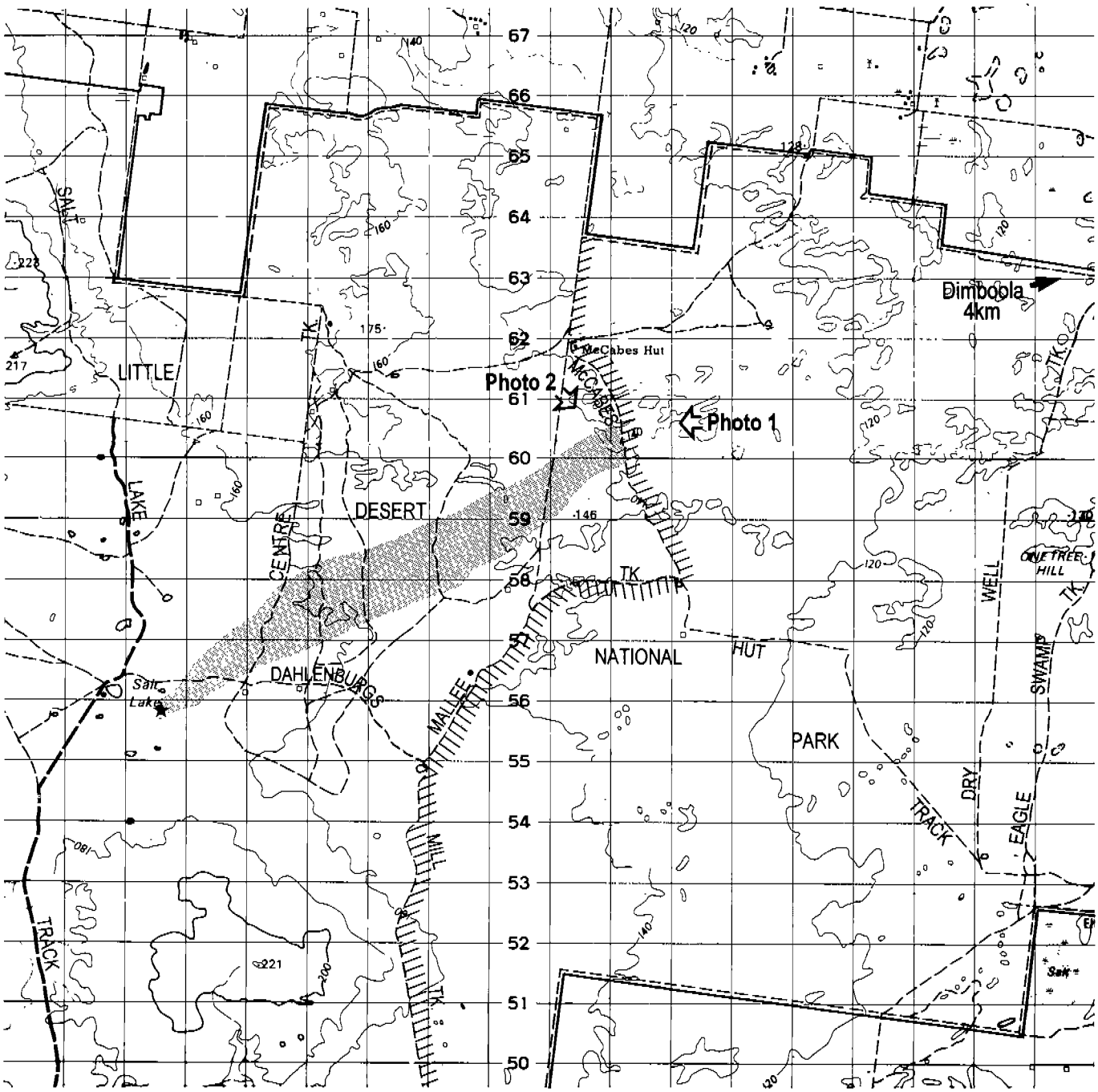
Conclusions from the Salt Lake wildfire

The following conclusions can be drawn from this case study:

- wildfires burning in seven year old heath fuels under conditions of 30-35 km/h wind and Forest FDI 10, can be too intense to be controlled by direct attack on the head fire;
- seven years after fuel reduction burning Brown Stringy-bark woodland, the bark hazard can still be only Moderate. This reduction in bark hazard can assist fire suppression by greatly reducing the generation of spot fires;
- seven year old mallee-broombrush can be an effective barrier to fire spread at a Forest FDI of up to 10;

[3] When the Forest FDI is below 8, fire is not readily sustained in the mallee-broombrush fuel types without strong wind.
[4] Cheryl Wouters, John Young & Jon Sanders pers. comm., Fireline Boss, Air Observer & Fire Controller for the Salt Lake wildfire.

Map 2: Map of Salt Lake Wildfire.



Legend

Wildfire Origin ★

Photograph View Photo

Fuel Reduced Area 1990

Wildfire Area
(at 2000hrs, 2/12/90)

N

0 1 2 3 4km.

Base map supplied by courtesy of the Department of Finance, Division of Survey and Mapping.

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- a small number of ground resources assisted by a 80-200 m wide, 3 month old fuel reduction burn can stop the forward spread of a 200-500 m wide front burning in 10 t/ha heath fuels with Moderate bark hazard under Moderate Forest FDI conditions (including winds up to 35 km/h).

Cases 2-4. Multiple Wildfire Situation: Meereek, Mt. William Range and Geerak Track Wildfires.

General Fire Situation on 3 January 1991

On 3 January 1991 a Total Fire Ban day was in force for the whole state of Victoria. At around 1200 hours, a cold front began moving through Victoria from the south-west, preceded by numerous thunderstorms. Lightning from these storms ignited 17 fires in the Horsham Region as well as 17 in three adjacent regions. The majority of the Horsham fires occurred between Edenhope and the Grampians (as shown in Map 1). As the weather data in Table 2 show, the Forest Fire Danger Index at Horsham was Very High from midday until at least 2000 hours. The CNR fire suppression resources that were available for first attack on these fires included 107 fire-fighters based at Edenhope, Natimuk, Horsham, Cavendish, Halls Gap and Stawell.

The 17 fires in Horsham Region on 3 January 1992 are summarised in Table 3. Although five of these fires remained "not found", crews were required to search for all confirmed sightings of smoke that afternoon. Four fires required most of the fire fighters deployed (77 of 107); and fuel reduced areas were in a position to directly assist the suppression of three of these fires. These fuel reduced areas were also in a position to influence the suppression strategies and resource deployment for all 17 fires.

The specific and general effects of fuel reduction burns on the fire suppression operations at three of these fires (Meereek, Mt. William Range and Geerak Track) are described below.

TABLE 2: Weather Conditions on 3 January 1991*.

Time (hours)	1200	1400	1500	2000
Temperature (°C)	37	41	40	36
Rel. Humidity (%)	23	17	19	23
Wind Speed (km/h)	12	22	17	17
Wind Direction	NW	NW	NW	West
Forest FDI-Edenhope	24 (High)	42 (Very High)	34 (Very High)	26 (Very High)
Forest FDI-Halls Gap	26 (Very High)	47 (Very High)	37 (Very High)	29 (Very High)

* Temperature, relative humidity and wind were measured by the CFA Automatic Weather Station located at Horsham, which is 95 km north-east of the fire area at Meereek, and 75 km north-west and north of the fire areas at Mt William Range and Geerak Tk respectively. This station was the best available to represent the weather conditions in the three fire areas. Forest FDI calculated using the metric Keetch-Byram Drought Index for Edenhope (63) and Halls Gap (100) respectively.

TABLE 3: Details of Fires Attended (started on 3 January 1991)*.

Fire No.	Fire Name	Area (ha)	Time Started	Time/Date Controlled❶	CNR Fire Fighters	CFA Units	Other Resources❷
12	Meereek	400	1204	1900 3/1	11	18	2 Dozers
13	Jilpanger	450	1325	0600 4/1	23	5	1 Dozer
15	Mt William Range	25	1330	1615 4/1	19	0	Fire bomb
14	Yulong Road	0.1	1345	1350 3/1	1	2	
16	Mt Byron	0.1	1350	1700 3/1	4	0	Fire bomb
17	Geerak Tk	70	1350	2357 3/1	24	8	
18	Andersons	0.1	1400	1700 3/1	3	2	
19	Red Rock 1	0.1	1400	0600 4/1	7	0	Hover-ex & Fire bomb
20	Red Rock 2	0.1	1400	1145 4/1	3	0	Hover-ex & Fire bomb
21	Wannon Bridge	0	1400	Not Found	3	0	
22	Mackeys Peak	0	1400	Not Found	0	0	Aerial Recce
23	Tea Tree Ck	1	1400	1700 3/1	3	3	
24	Serra Range	0	1400	Not Found	0	0	Aerial Recce
25	Black Range 3	0.1	1400	1200 4/1	2	0	
28	Boronia Peak	0	1700	Not Found	0	0	Aerial Recce
26	Eastern Wall	0.1	1730	1615 4/1	0	0	Fire bomb
27	Mt Difficult	0.2	1730	1641 4/1	4	0	Hover-ex & Fire bomb
17	Fires (in total)	946.9			107	38	

* These details were taken from the CNR Final Fire Reports.

❶ "Controlled" = fire enclosed within control lines, only patrol required; "Not Found" = fire not found following investigation of initial report.

❷ Other resources used at these fires include:
"Dozer(s) = bulldozer,
"Fire bomb" = "Phoschek"® fire retardant dropped on fire by fixed wing aircraft,
"Hover-ex" = direct attack on fire by fire crews trained to exit from a helicopter hovering 2-3 metres above the ground,
"Aerial Recce" = observation of fire from a fixed wing aircraft.

Case 2. Meereek Wildfire, Durong Crown Land Reserve, South Wimmera (Horsham Fire No 12)

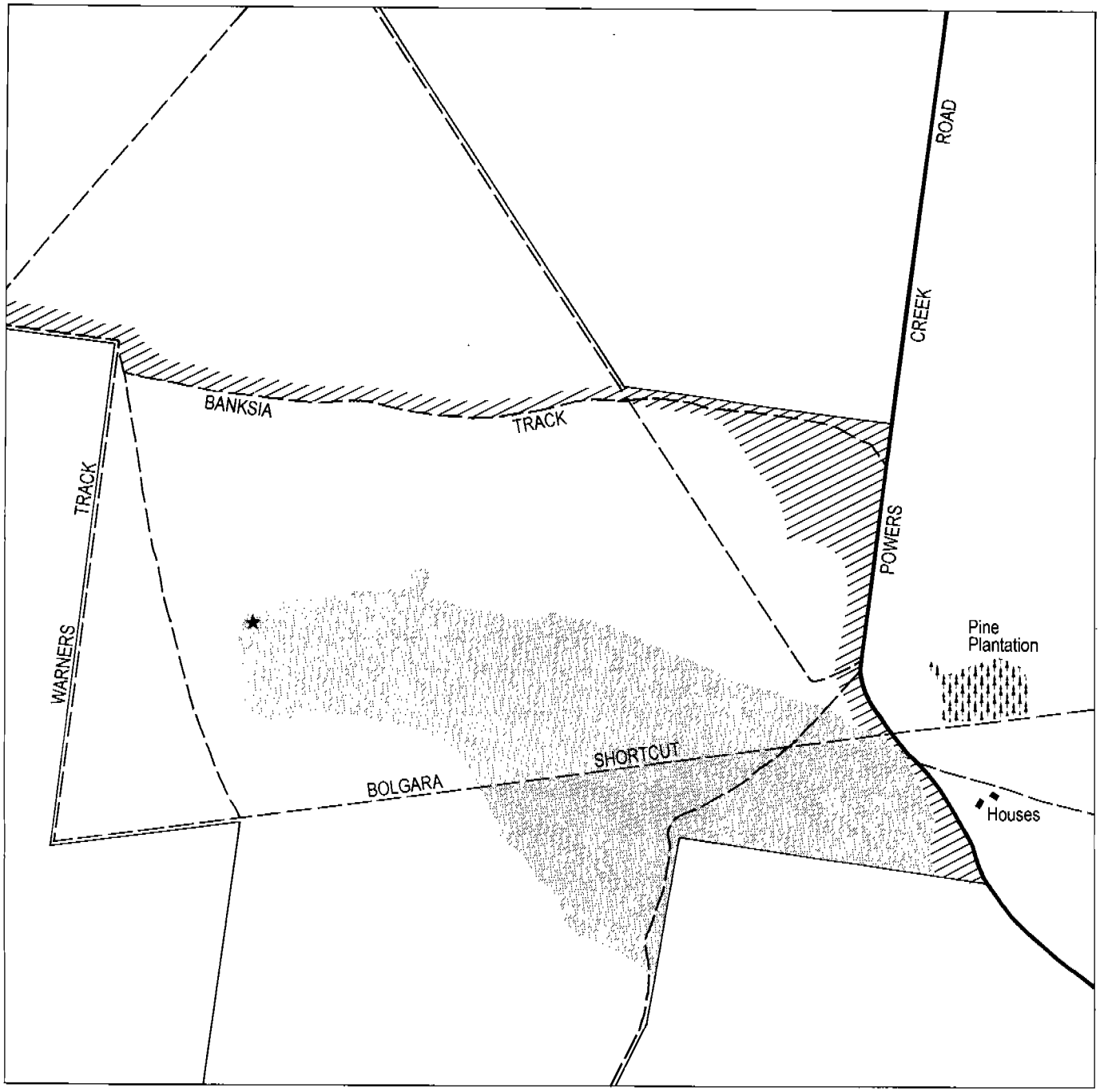
Fuel Reduction Burn

A fuel reduction burn ("strip" type) 50-100 m wide had been conducted in Brown Stringy-bark woodland with a heathy understorey in May 1990. This burn was located along Banksia Track and Powers Creek Rd in the Durong block of the South Wimmera as shown in Map 2. This burn had removed all of the available fuels from 100% of the area and had reduced the bark hazard to Moderate. In areas not burnt fuel levels were high (15-20 t/ha) and the bark hazard was Extreme.

Fire Situation

At 1219 hours lightning started a wildfire in Stringy-bark Woodland, most of which had not been burnt for 25 years. Fire crews arrived at the wildfire at 1250 hours to find that the wildfire had spread 600-800 m and was spreading steadily in a easterly direction with a rate of spread of 1.2-1.6 km/h. Additional resources were sought, as direct attack on the headfire was deemed unsafe. Fanned by a north-westerly wind, the wildfire approached Powers Creek Rd at about 1330 hours. Flame heights were 10 m

Map 3: Map of Meereek Wildfire.



Legend

Wildfire Origin ★

Fuel Reduced Area 1990

Wildfire Area

N

0 500 1000m.

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and rates of spread continued at around 1-1.5 km/h. Short distance spotting from the Brown Stringy-bark trees made direct attack unsuccessful in the woodland areas.

Fire suppression resources patrolled along Powers Creek Rd and along the forest/grassland boundary, waiting for the fire front. The headfire struck the fuel reduced strip and spotted over at two points. The CNR and CFA crews that were patrolling Powers Creek Rd quickly suppressed these spotfires. The remainder of the fire front was temporarily halted by a ploughed fire-break along the boundary of the cleared private property. However the fire burnt through gaps in this fire-break and into adjacent grassland. Once the fire front entered into the grassland, additional crews (mainly CFA) suppressed the fire using direct attack. The fire was controlled by around 1900 hours.

Conclusions from the Meereek wildfire

The following conclusions can be drawn from this case study:

- fires burning in 25 year old Brown Stringy-bark woodland with a heathy understorey under conditions of High to Very High Forest FDI, can be too intense to be controlled by direct attack;
- a seven month old fuel reduction burn 50-100 m wide can be effective in stopping a fire front burning under conditions of 30 km/h wind and FDI 40 with Extreme levels of bark hazard;
- Moderate levels of bark hazard can persist for at least seven months after burning in Brown Stringy-bark woodland.

Case 3. Mt William Range Wildfire, Grampians National Park (Horsham Fire No 15)

Fuel Reduction Burn

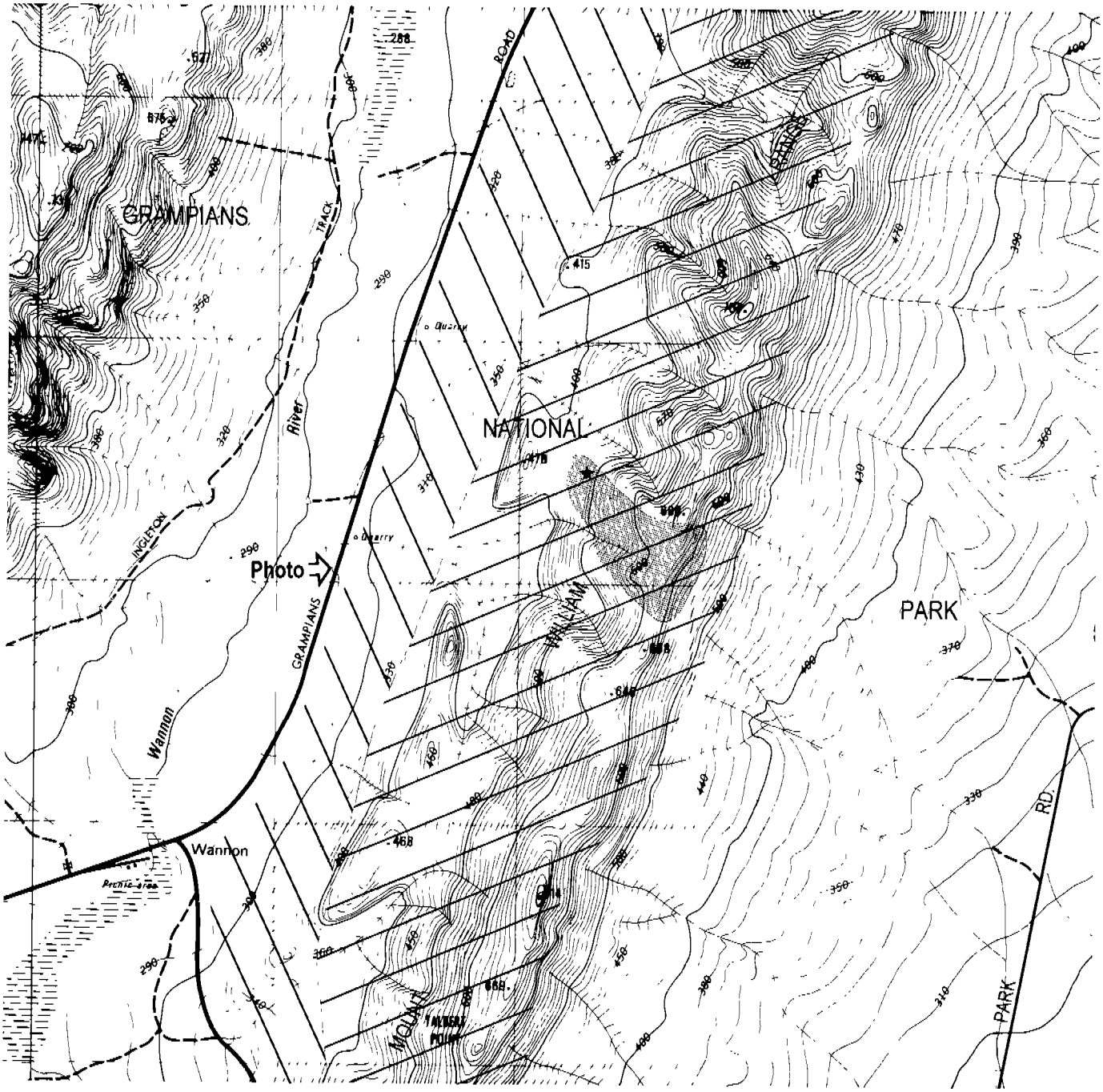
A fuel reduction burn ("broad-area" type) had been conducted in two stages in the 3 300 ha block of the southern Mt William Range as shown in Map 3. The first stage in 1987 involved fuel reducing the edges of the block to a width of approximately 200-500 m, and the second stage in 1988 involved the aerial ignition by helicopter of the remainder of the block. About 70% of the area was burnt, and by the time of this wildfire, about 6 t/ha of fine fuel had reaccumulated, with 15-30% vegetation cover and a height of up to 0.5 m. The woodland vegetation in this area varied in height from 15 m at the foot of the range to about 2 m on the ridge top. The bark hazard was Moderate in areas that had been fuel reduced and was Very High elsewhere.

Fire Situation

A lightning strike started a wildfire at around 1330 hours within the area that had been fuel reduced in 1988 (see Figure 3). An aircraft was over the wildfire area by 1430 hours, and reported the wildfire to be burning sporadically upslope with a rate of spread in unburnt areas of approximately 1-1.5 km/hr but at less than 0.5 km/h in fuel reduced areas[5]. The wildfire reached the top of the ridge at around 1630 hours. Several loads of fire retardant were applied to the area ahead of the fire front to prevent spotfires starting on the east side of the ridge. Ground crews finally reached the wildfire at about 1800 hours and reported that the wildfire's behaviour varied from a crown fire (2-3 m flame heights with considerable short distance spotting) to a low

[5] John Miller pers. comm. Air Attack Supervisor for the Mt William wildfire..

Map 4: Map of Mt William Range Wildfire.



Legend

Wildfire Origin ★

Photograph View Photo

Fuel Reduced Area 1987 1988

Wildfire Area

N

0 500 1000 m.

Base map supplied by courtesy of the Department of Finance, Division of Survey and Mapping.

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surface fire (flame heights less than 0.5 m and no spotting)[6]. Fire crews needed only to construct hand-trails to control the most active sections of the wildfire edge between fuel reduced areas. The fuel reduced areas prevented the wildfire from spreading. The final wildfire size was 25 ha, as shown in Figure 3.

The main value of the presence of these fuel reduced areas to the fire suppression effort was their influence on overall fire suppression strategy (i.e. the management of the multiple fire situation). The Fire Control Team was able to allocate fewer resources to this fire than would have needed if the fire had not occurred in a fuel reduced area. This type of fire would, without the help of fuel reduced areas, have required more ground crews (about 20 persons) to walk into the fire to construct control lines, as well as additional aircraft for fire bombing and hover-exit work. Had first attack failed (which it undoubtedly would have in the absence of the effects of the fuel reduction burn[7]), the subsequent suppression operation would have involved burning out the entire 3 300 ha block, which would have required the use of additional resources for back-burning and aerial ignition work over another one to two days. Hence fewer resources were required for the whole situation; and the resources which would otherwise have been needed for this fire were used on the other 16 fires.

Conclusions from the Mt William Range wildfire

The following observation can be drawn from this case study:

- a 2 year old fuel reduction burn, which covered about 70% of the area in heathy woodland, can be effective in limiting the spread of a wildfire burning under Very High FDI conditions.

Case 4. Geerak Track Wildfire, Grampians National Park (Horsham Fire No 17)

Fuel Reduction Burn

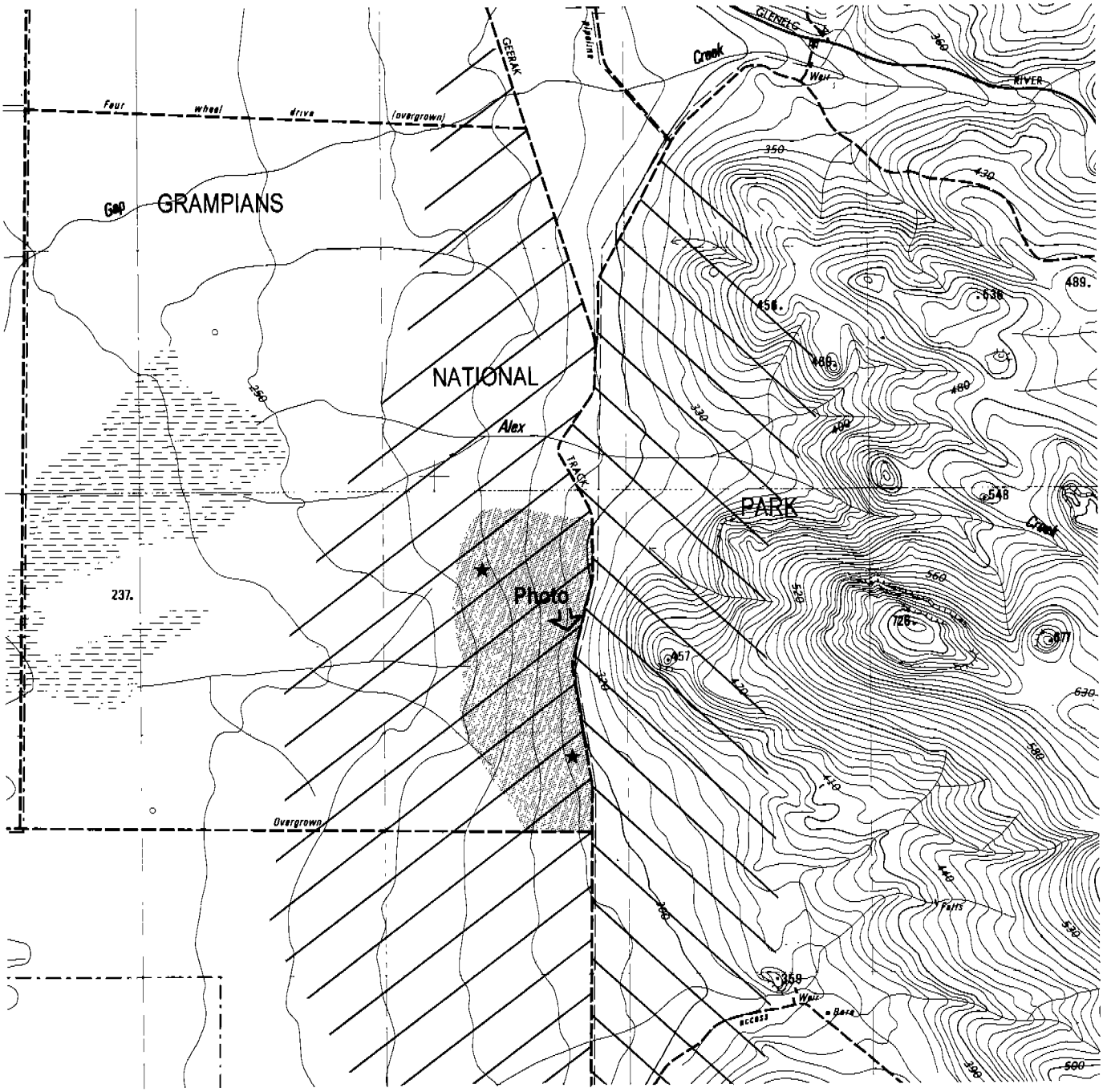
Two areas on the slopes of the southern Victoria Range, on either side of Geerak Track south of the Glenelg River Rd, had been fuel reduced; the east side in 1988 and the west side in 1980. The fuel quantity in the heath and woodland to the east of Geerak Track was approximately 2.5 t/ha, with 10-20% cover of vegetation up to 0.25 m in height and Moderate bark hazard. To the west of Geerak Track fuel quantity was approximately 10 t/ha , with 40-60% cover of vegetation up to 0.75 m in height and High bark hazard.

Fire Situation

Lightning caused two wildfires at about 1350 hours in the 1980 fuel reduced area west of Geerak Track. The first CNR crews arrived at around 1430 hours, and began to control the western edge of the fires. Some sporadic spotting was observed and flames climbed the trunks of about 30% of the Stringy-bark trees. Aerial observers noted a spotting distance of 50-70 m[8]. Direct attack on the head of either wildfire was not possible at this stage. By about 1450 hours, the two fires had joined and were spreading slightly upslope and east towards Geerak track. Fire-fighters patrolled Geerak track suppressing spot fires on the east side of the track in the 1988 fuel reduced area. The 1988 fuel reduced area stopped the fire spreading further east, even

[6] David Munday pers. comm., Fireline Boss for the Mt William wildfire.
[7] David Munday pers. comm.
[8] Graeme Saunder pers. comm. Assistant Fireline Boss for the Geerak Track wildfire.

Map 5: Map of Geerak Track Wildfire.



Legend

Wildfire Origin ★

Photograph View Photo

Fuel Reduced Area 1980 1988

Wildfire Area

Base map supplied by courtesy of the Department of Finance, Division of Survey and Mapping.

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though severe crown and understorey scorch occurred for up to 30 m across the track (Figure 4). Map 5 shows the final wildfire area of 70 ha.

Under the prevailing conditions on the day of the wildfire, had first attack failed (which it undoubtedly would have in the absence of the effects of the fuel reduction burns[9]), the wildfire would have taken several days to control, requiring a much higher level of resources (about 20-30 persons and 2 aircraft) and have exceeded 1 000 ha in size.

Conclusions from the Geerak wildfire

The following conclusions can be drawn from this case study:

- bark hazard levels in Brown Stringy-bark can remain in the Moderate to High range for at least 10 years after a fuel reduction burn,
- very little spotting occurred where the bark hazard was High under Very High FDI conditions,
- at Very High FDI in 10 year old heathy woodland, a 27 month old fuel reduced area with width 50-100 m can prevent fire spread, and
- fires burning in 10 year old Brown Stringy-bark woodland with a heathy understorey with High bark hazard under conditions of Very High Forest FDI, can be too intense to be controlled by direct attack;

Discussion

The failure of first attack on the Salt Lake and Meereek fires shows that fire suppression by direct attack can fail at FDIs as low as 10. This is consistent with the work of Wilson (1992, 1993) which relates bark and elevated fuels to the limits of fire suppression. For these two fires, this can be attributed to the high flame heights and rates of spread caused by the elevated fuels in Little Desert heathlands, and the high levels of spotting caused by the bark fuels in Brown Stringy-bark woodlands. Forecast fire weather conditions exceed a maximum FDI of 10 on about 40% of days during the months December to March (data from the Bureau of Meteorology for Melbourne, (O'Bryan 1991), so fires in the Little Desert, South Wimmera and Grampians[10] will often not be controlled by first attack. Under these conditions, fires will freely increase in size until weather conditions abate or the fires encounter areas where fuel levels are lower either because of naturally occurring low fuel areas (e.g rock), or back-burning (indirect attack) or earlier fuel reduction burning.

The successful containment of each of the four fires studied shows that, for at least two years, a fuel reduced area in heath and heathy woodland can be effective in restricting fire spread under conditions of Very High (up to 40) FDI. This applies to established fires that are burning in fuels where bark hazard is Extreme, and where the width of a fuel reduced area is only 50 - 100 m (with ground support). Fuel reduced areas can clearly limit the size of particular wildfires and reduce the costs, time and difficulty of suppressing them.

An important component of this fuel reduction effect is the reduction in levels of bark, particularly of stringy-bark eucalypts. The presence of stringy-bark fuels greatly increases the probability of spotting (Cheney 1985). Low intensity fuel reduction burning (less than 300 kW/m) can remove up to 7 t/ha (10 cm of bark thickness) from

[9] Roger Edwards pers. comm., Fireline Boss for the Geerak Track wildfire.
[10] Forecast FDI conditions at Stawell and Nhill are usually similar to if not higher than those at Melbourne.

long unburnt stringy-barks (Tolhust et al 1992). The fires studied show that in Brown Stringy-bark Woodland this fuel reduction effect on bark can persist and effectively help fire suppression under Very High FDI conditions for at least 7 - 10 years.

Thunderstorm activity often causes multiple fire ignitions in remote and/or widespread locations and in terrain where access may be difficult (Rawson et al 1985). This study shows that, in these situations when resources are scarce, fuel reduction burns can contribute significantly achieving fire control.

To be effective strategically, a program of fuel reduction burns in the Little Desert, South Wimmera and Grampians needs to be well planned in terms of location, extent and type. In the Little Desert and South Wimmera areas, strip and link fuel reduction burns of 80-200 m width around the perimeter of and within the larger blocks of public land can form a strategic network of fuel reduced areas (including past wildfires), thus restricting the spread of wildfires when the fire danger is Very High. In more contiguous areas of forested land, like the Grampians, fuel reduced areas need to be larger so as either to prevent or to slow the development of lightning strikes into large wildfires, or to be able to absorb the momentum of a wildfire once it is established.

Conclusions

Fuel reduction burns, up to ten years old, can help stop particular wildfires from reaching a much larger size and becoming more costly, difficult and time-consuming to suppress. A key part of the effectiveness of a burn is the reduction of bark fuels. The burns can be in the form of linear strips or broad areas.

Fuel reduction burns can provide strategic protection against outbreaks of multiple fires by reducing the requirements for suppression resources. To managers of land in remote and/or widespread locations and where terrain may limit access, this strategic benefit is perhaps the most useful.

Fuel reduction burning in strategic locations is a most appropriate, effective and practical tool for protecting forested public lands and adjacent assets from wildfires.

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The *Bibliography of Fire Ecology in Australia* (Gill *et al* 1991) was used in the research for this report.

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Figure 1: Link Burn at McCabes Hut Track (before Salt Lake wildfire).
View to the north along McCabes Hut Track from the junction with Mallee Track. The variable width of the fuel reduction burn is due to the change between heath and mallee-broombrush vegetation types.

Figure 2: Salt Lake Wildfire
View to the south west across McCabes Hut Track towards the wildfire area. The wildfire has burnt directly into the large fuel reduced area. Unburnt patches within and to the left of the wildfire area are mallee-broombrush vegetation. These areas contain less flammable fuels and bare sand can be seen through the canopy.

Figure 7: Mt William Range Wildfire.
The wildfire was started by a lightning strike in inaccessible country the centre left of the picture, and spread up the spur towards the top of the ridge in the right of the picture. Note the burnt tree crowns on the ridge and slopes of the wildfire area.

Figure 8: Geerak Track Wildfire.
View south along Geerak track. The wildfire spread from the right of the picture toward the track up a slight rise, but failed to cross the track. The scorch in the fuel reduced area on the left side of track was caused by the intense radiant heat from the wildfire. Despite this intense fire behaviour this fuel reduced area did not readily support spot fires.

References

Cheney N. P. (1985) New Approaches to Fire Danger and Fire Behaviour in Proceedings of Fire Weather Services Conference, Adelaide May 1985.

Conservation, Forests and Lands Dept., Horsham Region (CFL) (1989) *Regional Fire Protection Plan* Department of Conservation, Forests and Lands, Victoria.

Gill A. M., Moore P. H. R. and Armstrong J. P. (1991) *Bibliography of Fire Ecology in Australia (Edition 3).* Department of Bushfire Services, New South Wales, Sydney.

McArthur A. G. (1967) Fire Behaviour in Eucalypt Forests. *Commonwealth of Australia Forestry & Timber Bureau Leaflet No 107.*

CSIRO National Bushfire Research Unit (NBRU) The Effectiveness of Hazard Reduction Burning. *The Fireman* Operations Supplement 18 November, 1987.

O'Bryan D. (1991) *FFDI as a Planning Tool for Fire Protection.* unpublished paper in Fire Planning Notes (1993) Fire Management Branch, Department of Conservation and Environment Victoria.

Rawson R., Billing P. and Rees B. (1985) *Effectiveness of Fuel Reduction Burning.* Fire Research Report No. 25, Fire Protection Branch, Dept Conservation, Forests and Lands, Victoria.

Tolhurst K. G., Flinn D. W., Loyn R. H., Wilson A. A. G. & Foletta I. (1992) *Ecological Effects of Fuel Reduction Burning in a Dry Sclerophyll Forest: A summary of principal research findings and their management implications.* Forest Research Centre, Dept Conservation and Environment Victoria.

Wilson, A A G (1992) Eucalypt Bark Hazard Guide *Fire Research Report No 32* Fire Management Branch, Department of Conservation and Environment Victoria.

Wilson, A A G (1993) Elevated Fuel Guide *Fire Research Report No 35* Fire Management Branch, Department of Conservation and Natural Resources Victoria.

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