E.P. 115

BAUXITE

JARRAHDALE MINESITE

DENSE ACACIA UNDERSTOREY BURN

R D SMITH

FEBRUARY 90

(Fire. Alcoa.)

As part of the Jarrahdale District's ongoing commitment to the locally produced Minesite Protection Plan an experimental heavy fuel loading burn was undertaken within a rehabilitated mine pit. The burn was also organised to allow Alcoa the opportunity to assess several nutrient issues and to achieve these they had several burn requirements. Alcoa required:-

1. 60 - 70% fuel reduction in research area.
2. No crown scorch.
3. Approximately 300 KW m^{-1} intensity.

The Districts aim was to burn the area, minimise scorch, assess the fuel loadings and compare these to the standard fuels used by the Department, as well as record the burn conditions and weather.

STAND DESCRIPTION:

The burn was carried out in rehabilitated minesite forest of primarily Eucalyptus maculata and Eucalyptus resinifera with other secondary Eucalypt species and very dense Acacia species as an understorey. The area was planted with trees and aircraft seeded with understorey in 1979. The aircraft seeding left the area with striped, rather than uniform, coverage of understorey (see figure 1). The stand is on gravelly soil with steep slopes on the western boundary.

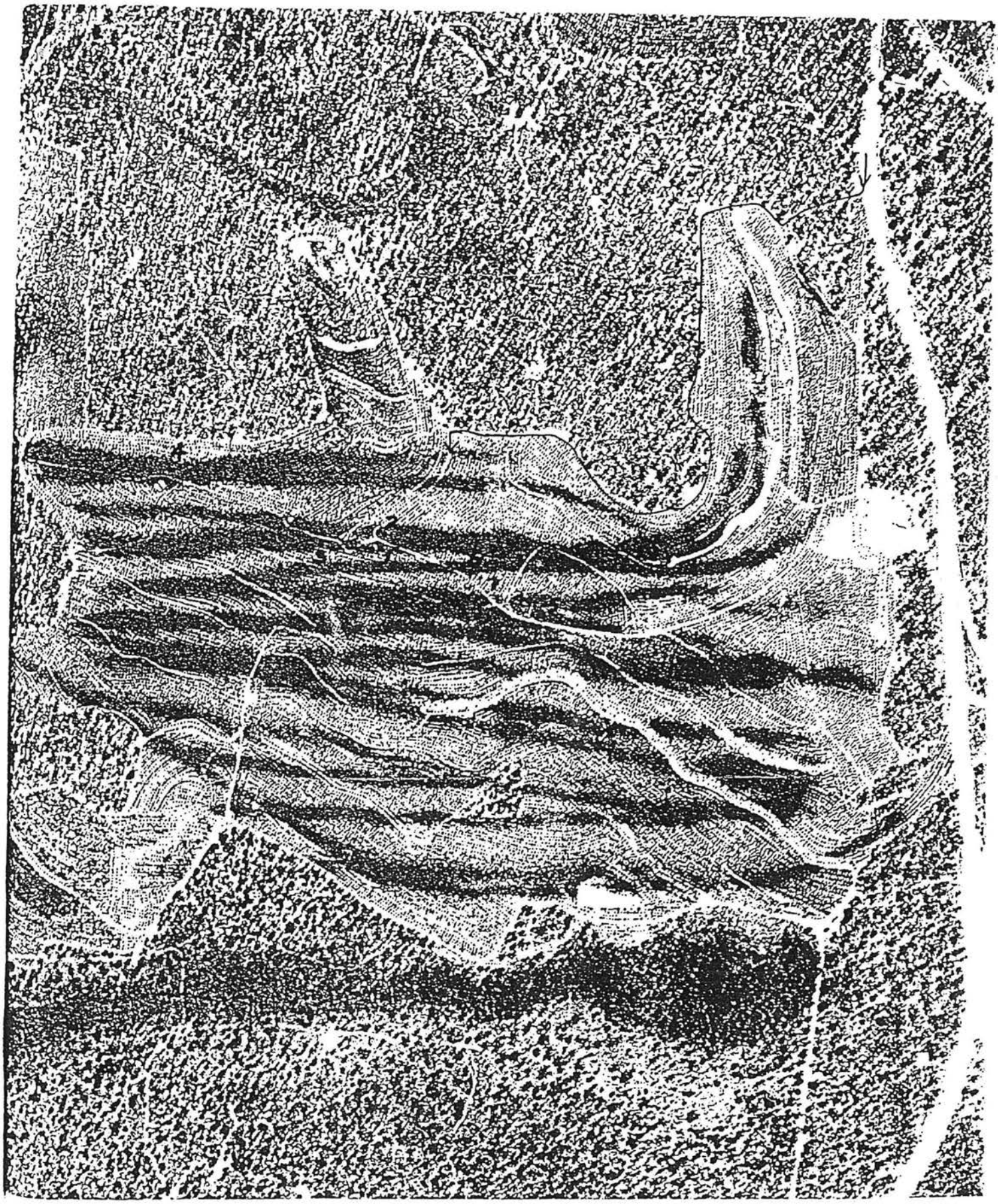


Figure 1. Alcoa sample points and obvious striped rehabilitation pattern.

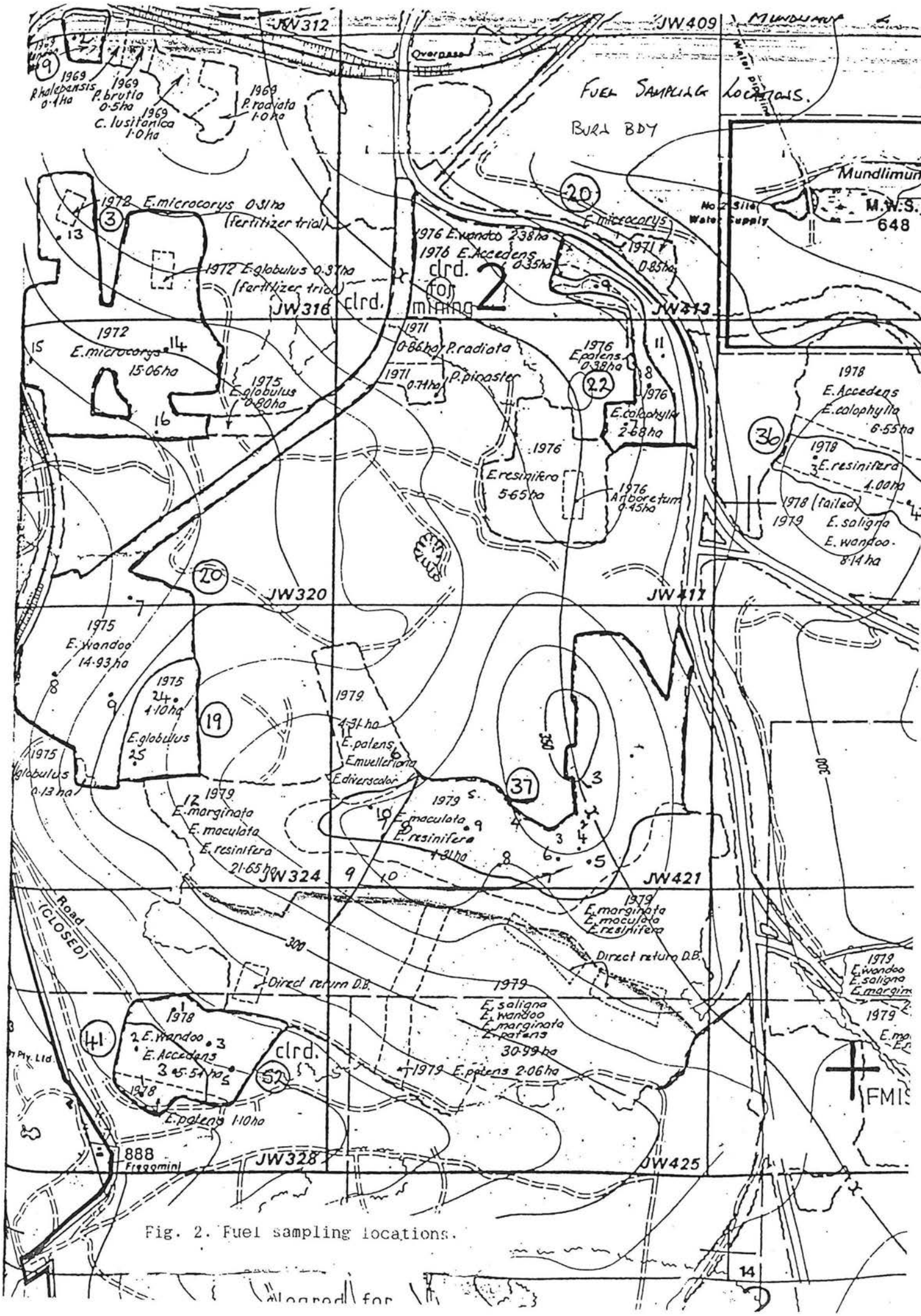


Fig. 2. Fuel sampling locations.

FUEL ASSESSMENT:

Eleven quadrats of one metre square were taken, oven dried (at 105 c for 24 hours) and weighed.

The aerated fuels less than 12mm (by visual assessment) were used. The range of leaf litter weight was 9.58t/ha to 22.39t/ha which produced an average of 14.5t/ha. The aerated fuels, less than 12mm diameter, ranged from 4.33t/ha to 21.16t/ha and averaged 10.89t/ha. A scrub height density profile (figure 3) was established for the burn to enable a correlation analysis between these fuels and the six standard fuels currently used by the Department (figure 4).

Table 1 - Ground and aerated fuel loadings

POINT	TOTAL GROUND FUELS T/HA	FUELS REMAINING POST BURN	AERATED FUELS	GROUND FUELS CONSUMED T/HA
1	17.76	6.18	10.84	11.58
2	10.41	1.32	10.52	9.09
3	10.98	* NB	0	
4	10.27	4.25	4.33	6.02
5	22.39	* NB	0	
6	12.53	.93	16.65	11.60
7	14.07	1.16	20.56	12.91
8	19.28	3.10	21.16	16.18
9	17.27	3.12	10.78	14.15
10	9.58	2.07	12.26	7.51
11	6.11	* NB	17.20	

* NB - NOT BURNT

Assessments by Alcoa indicate that the total fuels were 43% dead.

Fig 3 Scrub Height Density Profile Burn JW4421

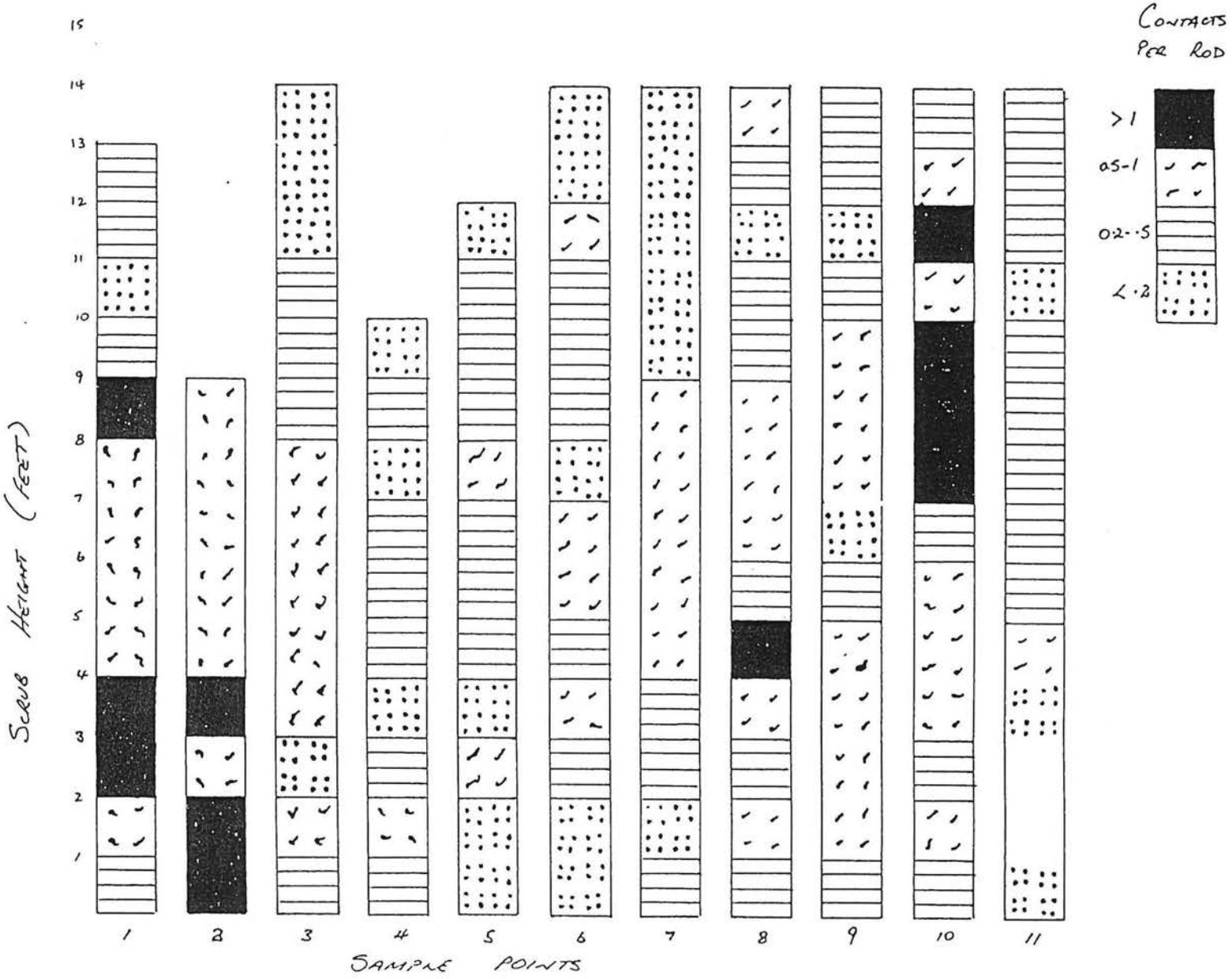
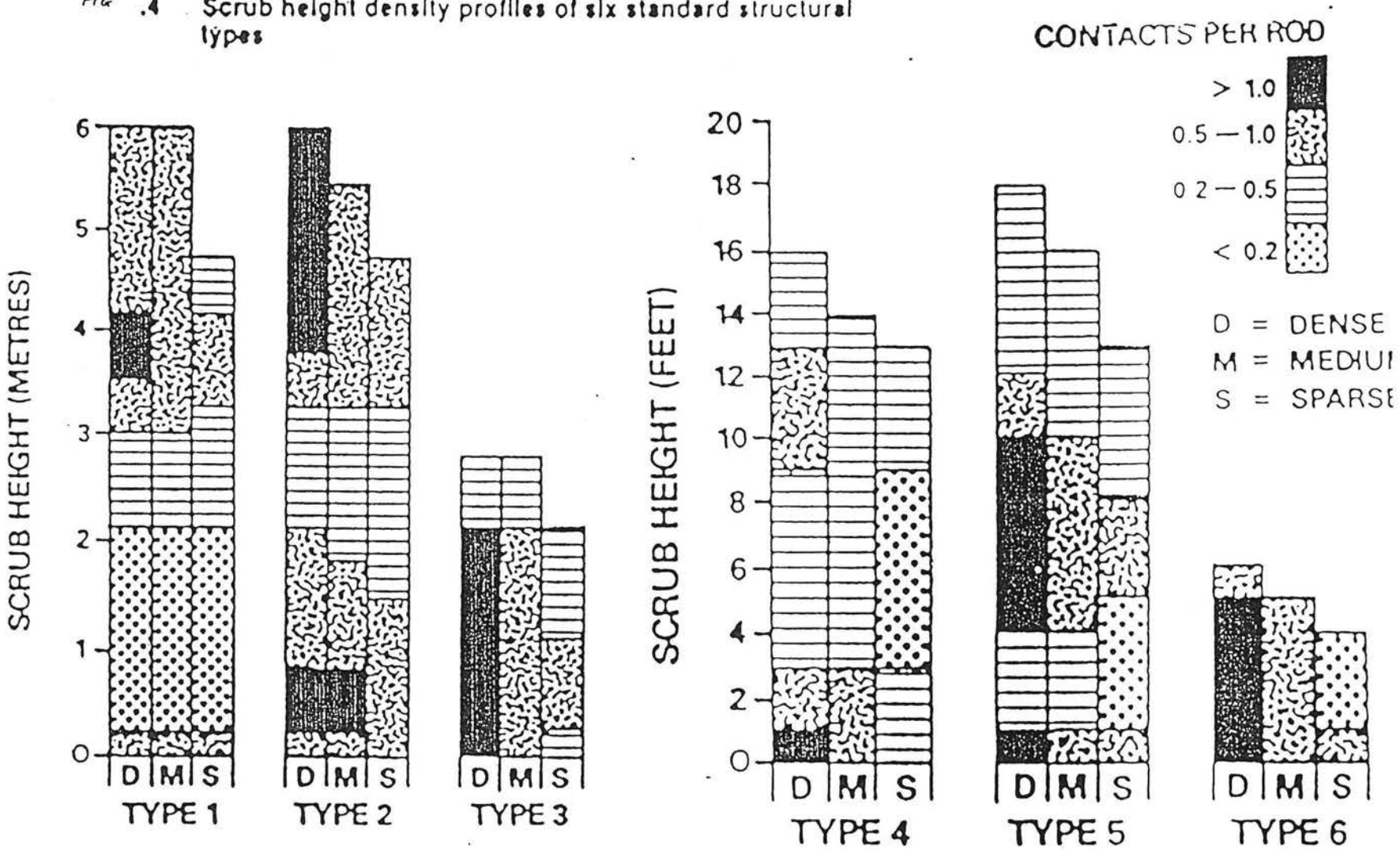


FIG .4 Scrub height density profiles of six standard structural types



WEATHER DATA

Weather data were obtained at the burn and also from Jarrahdale District office on the day of the burn, 2 November 1989.

Maximum Temperature

Office 29°c @ 1500 and 1700 hours.

Field 29°c @ 1630 hours

Forecast 28°c (figure 5)

Minimum Relative Humidity

Office 20% @ 1700 hours

Field 31% @ 1630 hours

Forecast 38%

Table 2 - SMC and Wind Conditions:

TIME (HRS)	SMC %	ACTUAL WIND	FORECAST WIND
1600	7	CALM	
1630	7	ENE 1-2	
1700	-	CALM	NNW 12
1730	-	CALM	
1800	7.5	NW 2-3	
1830	9	NW 1-2	
1900	9.5	CALM	NW 10
1930	9	NE 1-2	
2000	10	NE 1-2	

Soil dryness index at Jarrahdale office - 323.

As can be seen from the above records and the attached hygrothermograph sheet the fire hazard for the day peaked at 1700 hours (figure 6).

Figure 5. 0745 Forecast, SMC and FDI, also 1300 hours forecast.

```
  * * * AREA FORECASTS * * *                    Todays Time/Date    07:49  02/11/89
  Require all areas ??  N   (press RETURN if you only want normal areas)
     Forecast                                    Time      Winds          Time      Winds
   Weather Area                                (00 hr) Dir Speed      (00 hr) Dir Speed

 02 MUNDARING          Max Temp    30          10-12   SSE  008       12-14   E    011
Date  02/11/89         Min. RH     28          14-16   ENE  014       16-18   NNW  012
Time      07:35         Dewpoint    10          18-20   NW   010       20-08   WSW  012
 Todays Forecast   FINE.
Tomo/rws Outlook   FINE.

 03 DWELLINGUP         Max Temp    28          10-12   NW   018       12-14   NW   019
Date  02/11/89         Min. RH     30          14-16   WNW  018       16-18   NW   016
Time      07:36         Dewpoint    09          18-20   WNW  014       20-08   WSW  014
 Todays Forecast   FINE.
Tomo/rws Outlook   FINE.

 09 SADDLEBACK         Max Temp    27          10-12   NNW  012       12-14   NNW  010
Date  02/11/89         Min. RH     35          14-16   WNW  012       16-18   W    011
Time      07:36         Dewpoint    10          18-20   W    010       20-08   WSW  010
 Todays Forecast   FINE.
Tomo/rws Outlook   FINE.

                                                * * * F1 = EXIT / F2 = S.E.S.M. * * *
 PRESS RETURN FOR MORE DETAILS                                                      C
  * * * AREA FORECASTS * * *                    Todays Time/Date    07:49  02/11/89
  Require all areas ??  N   (press RETURN if you only want normal areas)
     Forecast                                    Time      Winds          Time      Winds
   Weather Area                                (00 hr) Dir Speed      (00 hr) Dir Speed

 12 HARVEY COASTAL     Max Temp    27          10-12   ESE  023       12-14   SE   018
Date  02/11/89         Min. RH     41          14-16   SE   018       16-18   ESE  018
Time      07:43         Dewpoint    12          18-20   SSE  012       20-08   SSW  016
 Todays Forecast   FINE.
Tomo/rws Outlook   A FEW SHOWERS.
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* * * F1 = EXIT / F2 = E.C.M. * * *

PRESS RETURN FOR MORE DETAILS C
* * * FORECASTS CONT * * * Todays Time/Date 07:50 02/11/8

10 GRASSLANDS Time: 07:40 Date: 02/11/89

Lower West: Coastal - HIGH Inland - HIGH
South West: Coastal - MODERATE Inland - MODERATE

SYNOPTIC SITUATION Time: 07:31 Date: 02/11/89

A HIGH CELL OVER THE BIGHT IS DIRECTING A LIGHT TO MODERATE NE-N'LY AIRFL
OVER THE SOUTHWEST OF W.A.
A COLD FRONT APPROACHING FROM THE SOUTHWEST SOULD REACH W.A. TONIGHT AND
CAUSE A FEW LIGHT SHOWERS IN SOUTHERN AREAS.

UPPER WINDS:	3000FT	5000FT	7000FT	(ABOVE SEA LEVEL)
North:	NE 40	NNE 40	N 40	km/hr
South:	N 10	NW 30	NNW 40	km/hr

* * * F1 = EXIT / F2 = E.C.M. * * *

PRESS RETURN FOR NEXT SCREEN C
* * * FMIS DETAILS cont * * * Todays Time/Date 07:53 02/11/89

Please enter INDEX NUMBER)) _

Yesterdays Min SMC	10
Rain to 0800 hours	0.0
Overnight Rn count	3
Todays Maximum SMC	11
Maximum Temperature	30
Minimum Rel Humidity	28
Basic Drying Unit	25

FMIS SQUARE)) 416424
FUEL TYPE)) 01 NORTHERN JARRAH

Time))	0900	1100	1300	1500	1700
SMC	11	9	8	6	8
PMC	11	9	8	6	8
AFF	1.0	1.0	1.0	1.0	1.0
HFROS(MT/HR)	19	24	30	56	30
WIND DIR.		SSE	S	ENE	NNW
WIND SPEED		8	12	14	12

BURN START TIME 0830 HRS OF BURN 12 TOTAL FUEL (T/HA) 8.5

* * * F1 = EXIT / F2 = E.C.M. * * * Selection (+E=Help) __

ENTER INDEX NUMBER OR PRESS RETURN TO ENTER A DIFFERENT FMIS SQUARE C

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  * * * AREA FORECASTS * * *                    Todays Time/Date     14:29  02/11/8
  Require all areas ??  N   (press RETURN if you only want normal areas)
     Forecast                                    Time      Winds        Time      Winds
    Weather Area                                (00 hr) Dir Speed    (00 hr) Dir Spee

 02 MUNDARING          Max Temp   28          10-12  ESE  008        12-14  E    012
Date  02/11/89         Min. RH    35          14-16  ENE  014        16-18  NNW  012
Time      13:01        Dewpoint   12          18-20  NW   010        20-08  WSW  012
 Todays Forecast  FINE.
Tomo/rws Outlook  FINE.

 03 DWELLINGUP         Max Temp   27          10-12  NNE  018        12-14  NNE  018
Date  02/11/89         Min. RH    24          14-16  WNW  018        16-18  NW   016
Time      13:02        Dewpoint   05          18-20  WNW  014        20-08  WSW  014
 Todays Forecast  FINE.
Tomo/rws Outlook  FINE.

 09 SADDLEBACK         Max Temp   27          10-12  NNW  012        12-14  NNE  010
Date  02/11/89         Min. RH    24          14-16  WNW  012        16-18  W    012
Time      13:04        Dewpoint   05          18-20  W    010        20-08  WSW  010
 Todays Forecast  FINE.
Tomo/rws Outlook  FINE.

                                          * * * F1 = EXIT / F2 = E.C.M. * * *
 PRESS RETURN FOR MORE DETAILS                                              C
  * * * AREA FORECASTS * * *                    Todays Time/Date     14:29  02/11/8
  Require all areas ??  N   (press RETURN if you only want normal areas)
     Forecast                                    Time      Winds        Time      Winds
    Weather Area                                (00 hr) Dir Speed    (00 hr) Dir Spee

 12 HARVEY COASTAL     Max Temp   30          10-12  N    023        12-14  WNW  015
Date  02/11/89         Min. RH    33          14-16  WNW  010        16-18  WNW  012
Time      13:00        Dewpoint   12          18-20  WSW  012        20-08  SSW  016
 Todays Forecast  FINE.
Tomo/rws Outlook  A FEW SHOWERS.

                                          * * * F1 = EXIT / F2 = E.C.M. * * *
 PRESS RETURN FOR MORE DETAILS                                              C
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The cloud cover prior to 1600 hours was 6/8 and this cleared progressively to nil cloud cover by nightfall. The weather map (figure 7) provides an indication of the weather pattern.

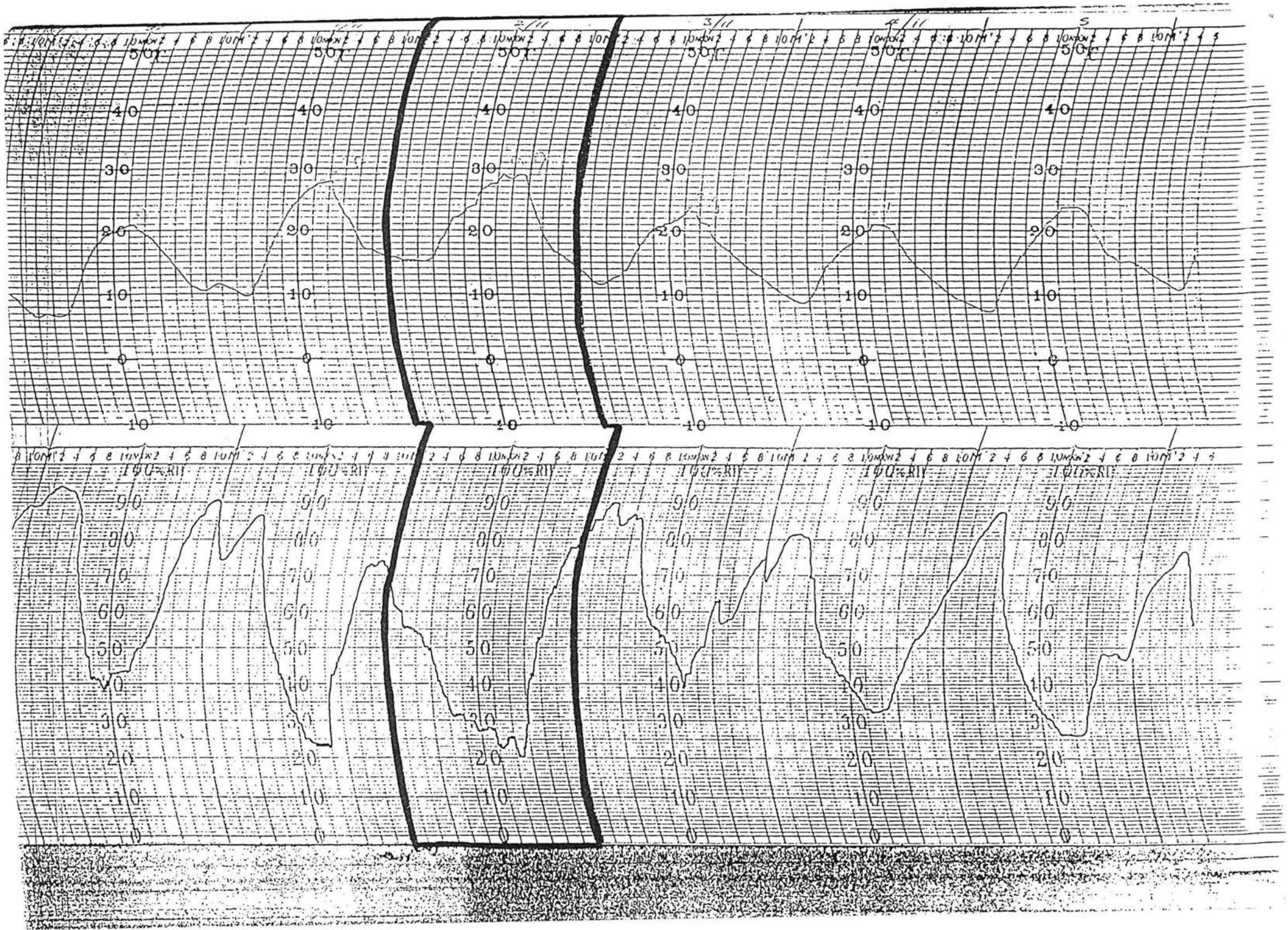
FIRE BEHAVIOUR

The table below indicates the fire behaviour for the various sites within the burn and at various times. The burn was commenced in the south-west corner and was stripped out from south to north.

Table 3 - Fire behaviour & Weather data.

				ROS		FLAME LENGTH					
						HEADFIRE		FLANK		TAIL	
TIME	SMC%	TEMP°C	RH%	A	B	A	B	A	B	A	B
1600	7	27.5	34	30	-	0.25	-	0.25	-	0.25	-
1630	7	20	31	35	-	1	-	1	-	0.5	-
1700	no read.	-	-	-	-	-	-	-	-	-	-
1730	no read.	-	-	-	-	-	-	-	-	-	-
1800	7.5	25	33	30	25	1-2	1	1	0.5	0.5	0.2
1830	9	21	39	10	20	0.25	0.7	-	0.5	-	0.2
1900	9.5	20.5	51	10	30	0.25	1.5	0.25	0.5	0.25	0.2
1930	9	20	44	20	30	0.5	1.5	0.25	0.3	0.25	0.2
2000	10	24	31	20	30	1	1.5	0.25	0.3	0.25	out

ROS in M/hr
A+B are separate assessors.



(Inc. in W.A.)

GLEAN OUTES
ATHER SERVICES

Telephone: (09) 383 7104
Facsimile: (09) 383 7107

ANALYSIS at 0600 WST

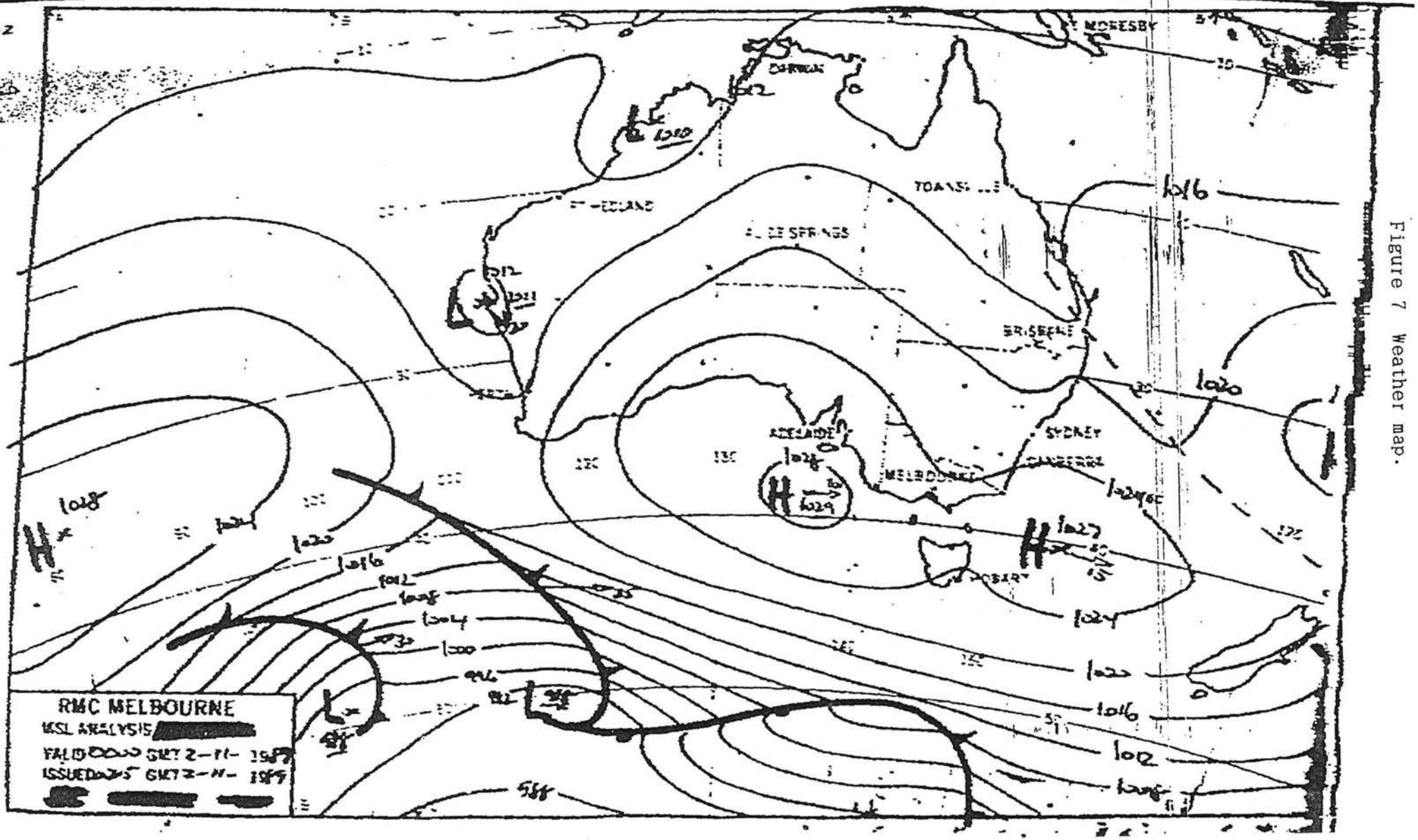


Figure 7 Weather map.

Using the formula of

$$\text{Intensity} \quad \frac{\text{rate of spread x fuel consumed}}{2}$$

The maximum intensity could have been -

$I = 35 mhr^{-1} \times 16.18 t/ha = 283 kwm^{-1}$

The maximum intensity could have been -

$I = 10 mhr^{-1} \times 6.02 t/ha = 30 kwm^{-1}$

therefore fire intensity range of 30 kwm^{-1} to 283 kwm^{-1}

The fire behaviour noticeably dropped after 1700 hours when the fire hazard had peaked and the humidity rose and temperature dropped. The cloud cover also noticeably diminished from 6/8 around this time to nil at dark. See the photographic record at the back of the report for fire behaviour.

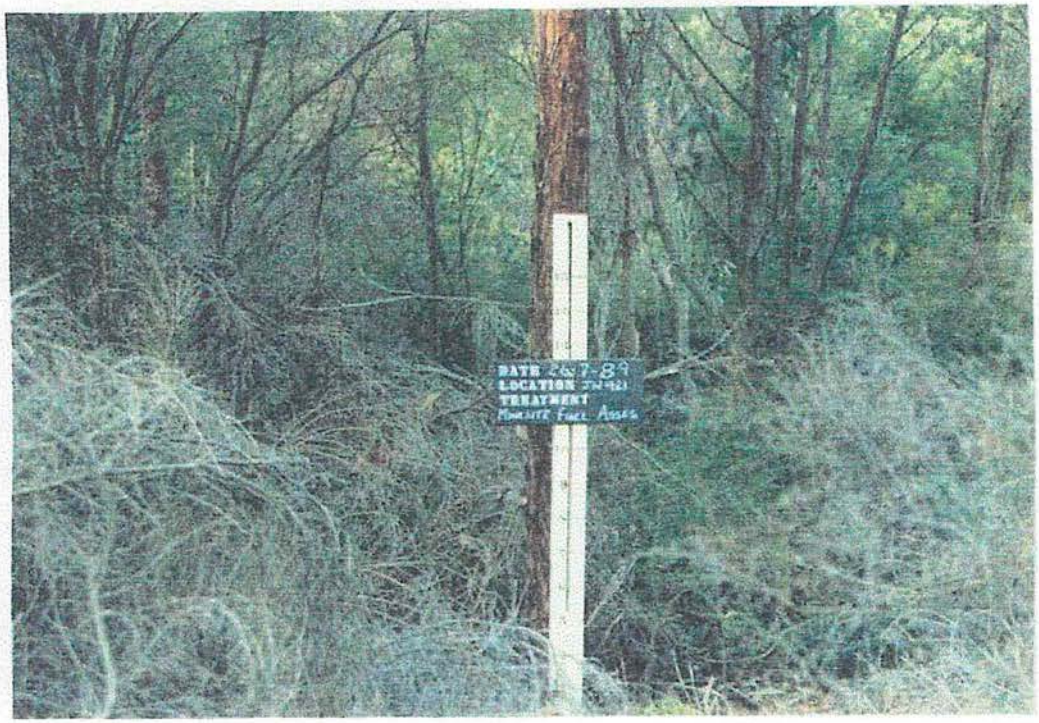
CONCLUSION

A successful burn in these very heavy fuel loadings can be achieved with the right atmospheric conditions. These appear to be calm winds, clear sky and a falling fire hazard. The SMC needs to be low enough to sustain fire without being wind driven and the fire spots need to be spaced far enough apart that the junction zones of the fires occur when the hazard has dropped sufficiently. The rising humidity and falling temperatures also help to keep the flame height down sufficiently so that the aerated fuels do not become ignited. By minimising flame height and fire intensity the Eucalypts suffered minimal damage.

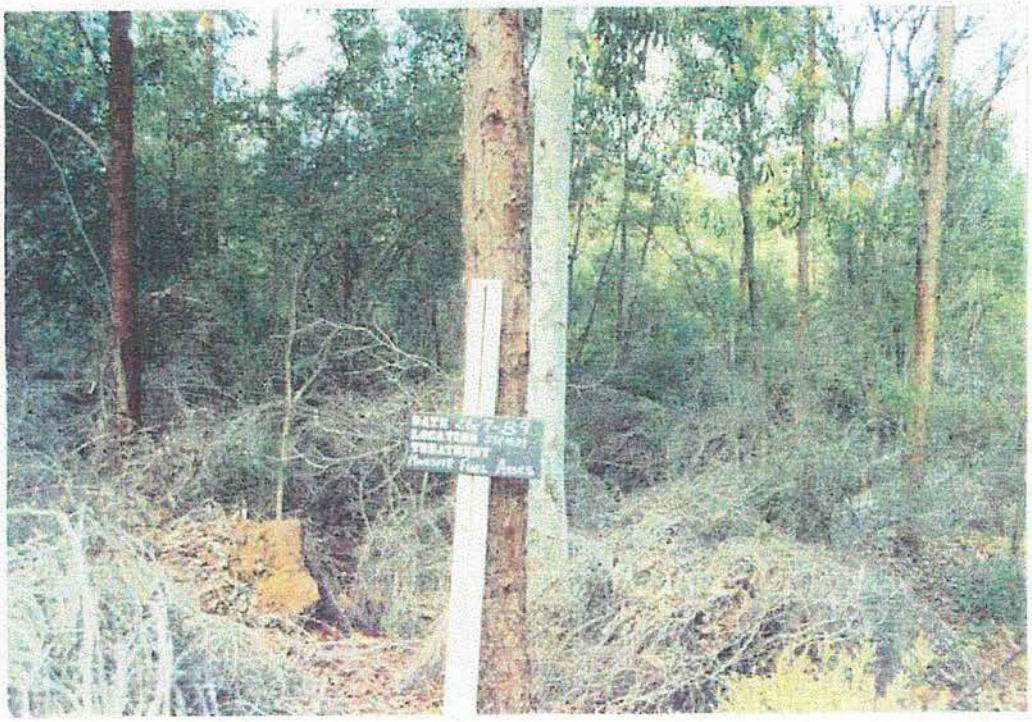
A further operational trial is planned for 1990 in an area of continuous ground fuels to test the success of burning without the stripped scrub as occurred with the 1989 burn.

The technical advice from L McCaw was very much appreciated in preparing the fuel assessment and burning methods.

A photographic resume of the burn as it progressed.

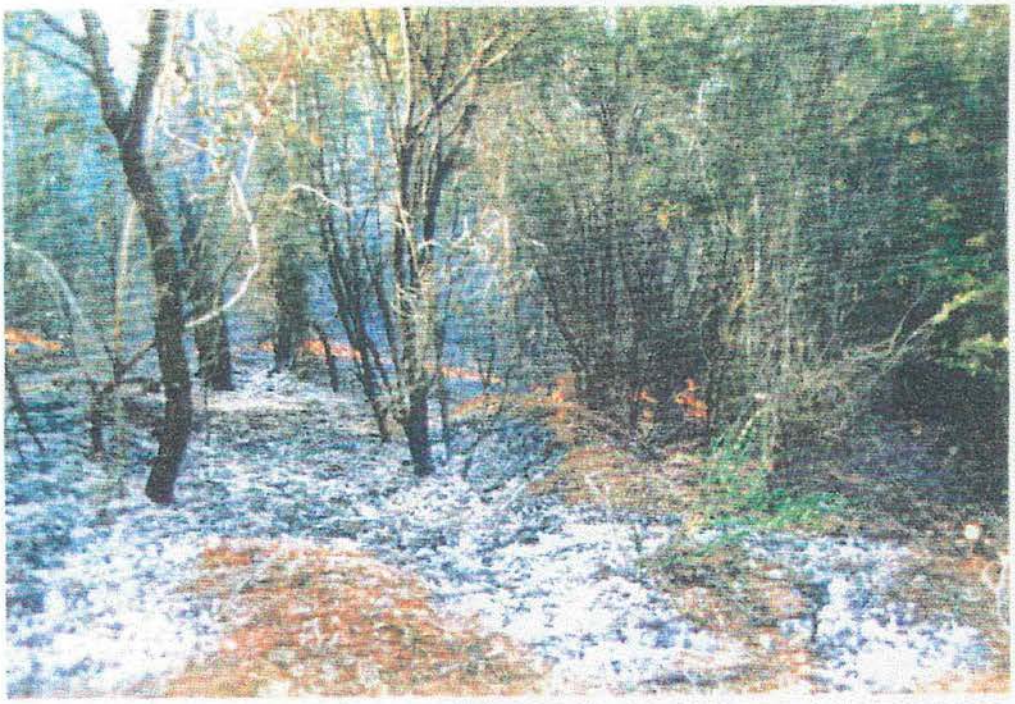


Fuel loadings prior to burning

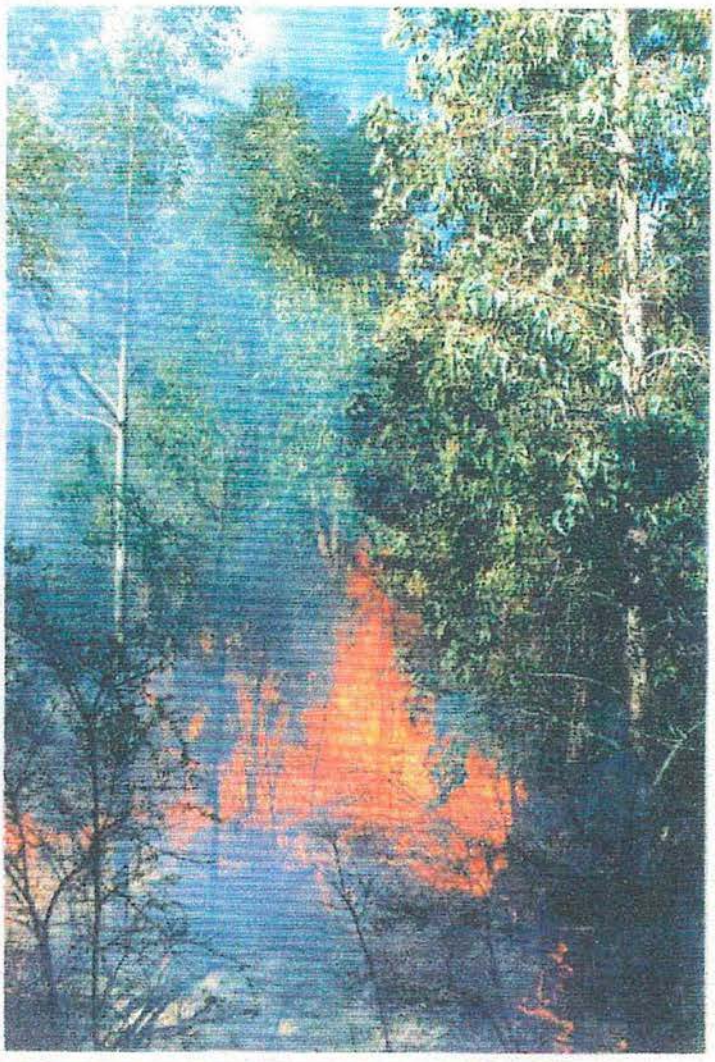


Fire behaviour at 1552 - 12 minutes
after initial ignition.

Fire behaviour 30 minutes after lighting (1610hs)

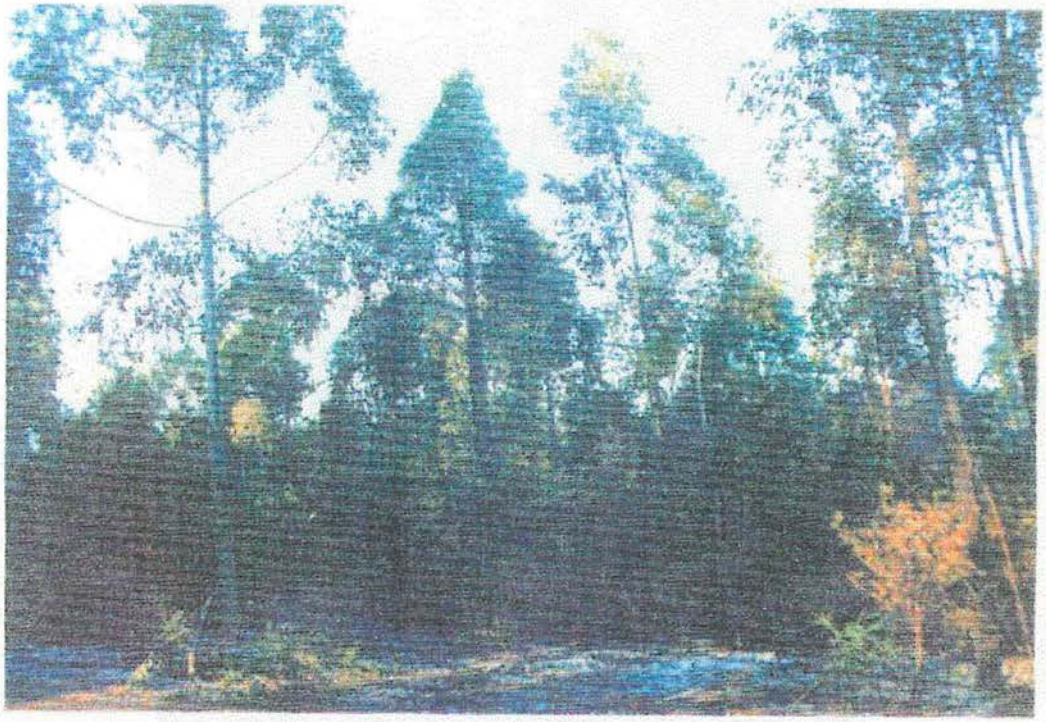


1750 HOURS FIRE BEHAVIOUR - 2 hours after ignition.

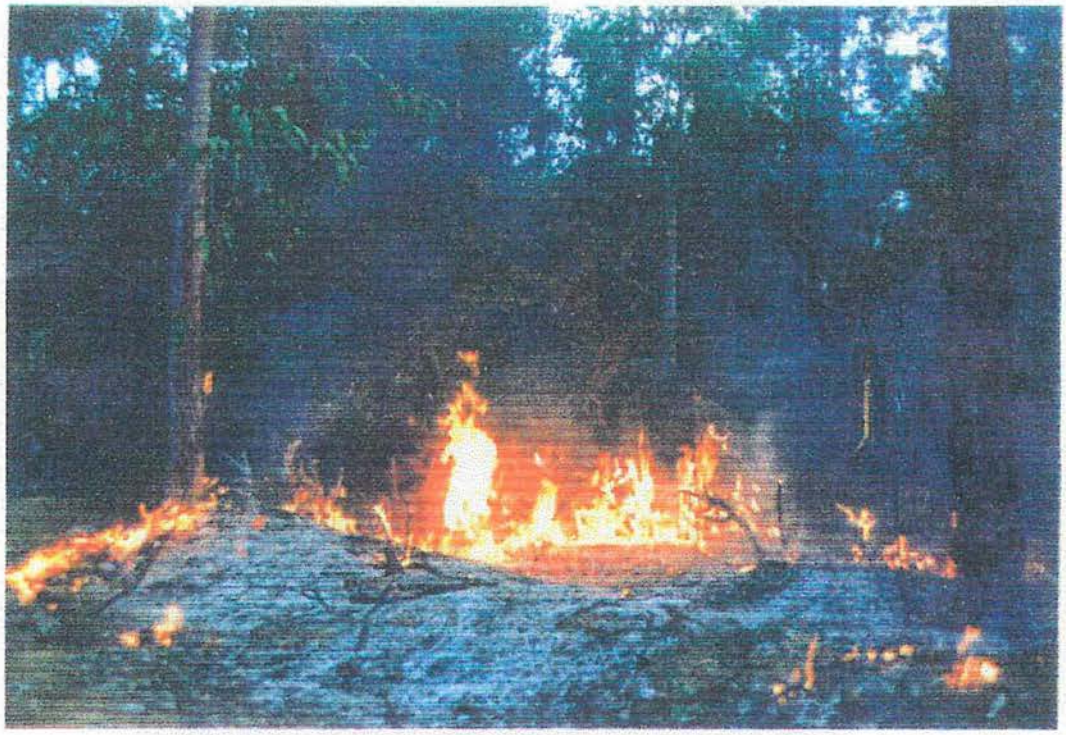


1800 HOURS FIRE BEHAVIOUR -
WEST SIDE OF BURN.
FIRST SITE LIT.

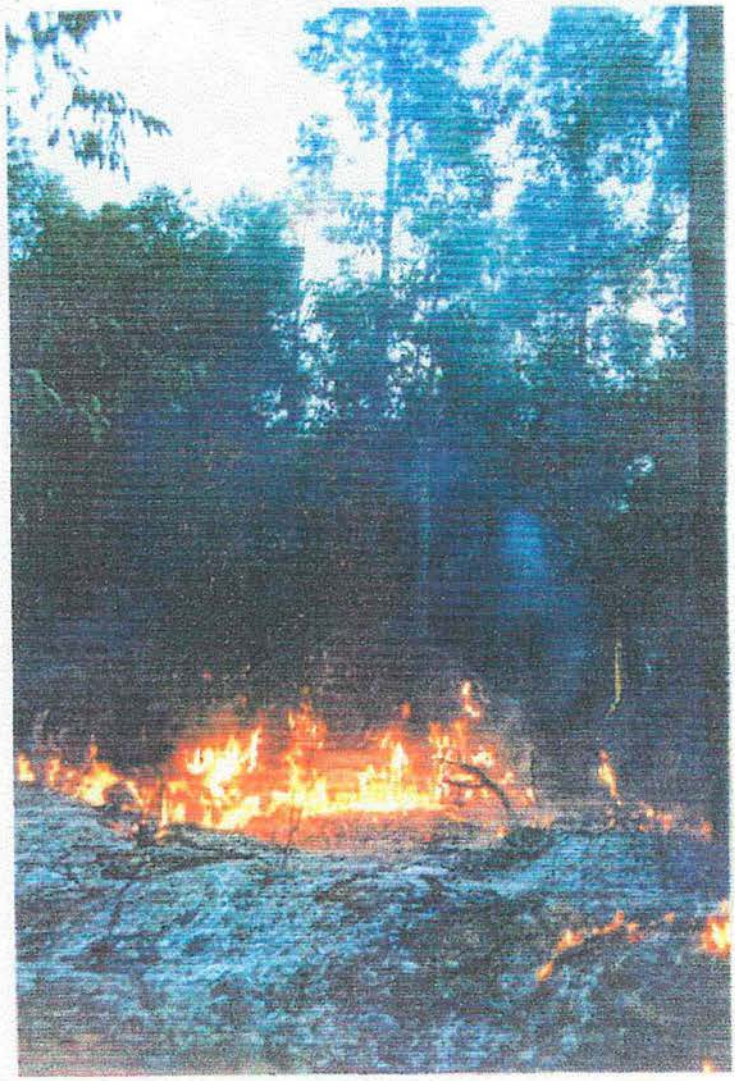
1830 hours fire behaviour -. near fuel sampling point 6
2 hours 40 minutes after ignition.



1900 hours area of first ignition now burnt out note: the clear sky.
3 hours 10 minutes after ignition.



Fire behaviour just on dusk



Night time fire behaviour