THE LAKE MUIR FIRE (MANJIMUP FIRE 7)

1) INTRODUCTION

The Lake Muir fire burned on the 24th and 25th January, 1977 and covered an area of 7100 Ha. of State Forest, Flora and Fauna Reserve, Vacant Crown Land and private property. The fire was actually a result of a hopover from a previous wildfire (Fire 6) which has been deliberately lit on Sunday 16th January. (Section 2). The fire had been controlled by a F.D. gang in Flora and Fauna Reserve and handed over to Fisheries and Wildlife for the construction of firebreaks and the mop-up. However this operation was not done satisfactorily with the result of a hopover in very old fuel (approximately 15 year old) led to the initation and development of Fire 7.

The fact that this fire was burning in Flora and Fauna Reserve and that other fire suppression committments existed in Manjimup and Pemberton Divisions led the Forests Dept. to minimise its involvement in the morning of the 25th January.

On the morning of the 25th a firebreak had been constructed on all sections except the NW. However 3 or 4 hopovers from small unburnt pockets within the fire perimeter occurred at 1100 hours and these could not be contained by the small forces in attendance.

Fire behaviour experience on the 24th and 25th January were some of the most severe observed. Constant surveillance by spotteraaircraft on these days provided an unequalled opportunity to study the extreme fire behaviour.

Three major fire runs were experienced. The first occurred between 1400 and 1830 hours of the 24th when the fire driven by strong SW winds peaked at 3500 m/hr with flame height of 20 metres. The second run between 1110 and 1400 hours on 25th January began from 3 or 4 hopovers on the SE sector of the fire. Under the influence of a strong NW wind, fire spread rates reached peaks of 6000 m/hr with flames of 30-35 metres. Much defoliation of JB and JC forests resulted during the period. This run ended when the fire ran into one year old fuels in Hiker Block east of the Frankland River. The third run began soon after with the SW wind change at 1430 on the 25th. The fire at this time had an 8 km wide headfire and spread rates peaked at 5000 m/hr with flames of 30 metres. After 1830 the headfire ran into cleared private property south of Muir Highway where it was stopped under cool conditions and in barren paddocks. The construction of safe firebreaks mop-up of edges tood another 3 days to complete. The final perimeter reached 48 km and involved up to 7 F.D. gangs, 5 dozers, 25 BFB personnel and several farm implements and a grader.

2) DETAILS OF FIRE 6

Fire 6 was one of two fires deliberately lit on Sunday 16/1 and first detected at 1710 hours. The first of these, lit in B.F., was contained at 1930 hours. The second fire (Fire 6) was lit in Flora and Fauna Reserve (Ref. HT 105-63) Jarrah swamps fuels estimated to be about 15 years old. This fire was contained by a F.D. gang at 2300. Arrangements with the Fisheries and Wildlife were that the job of firebreak construction be done by contract dozer under the supervision of Fisheries and Wildlife. Except for regular aerial surveillance no further F.D. involvement occurred until the 24th January.

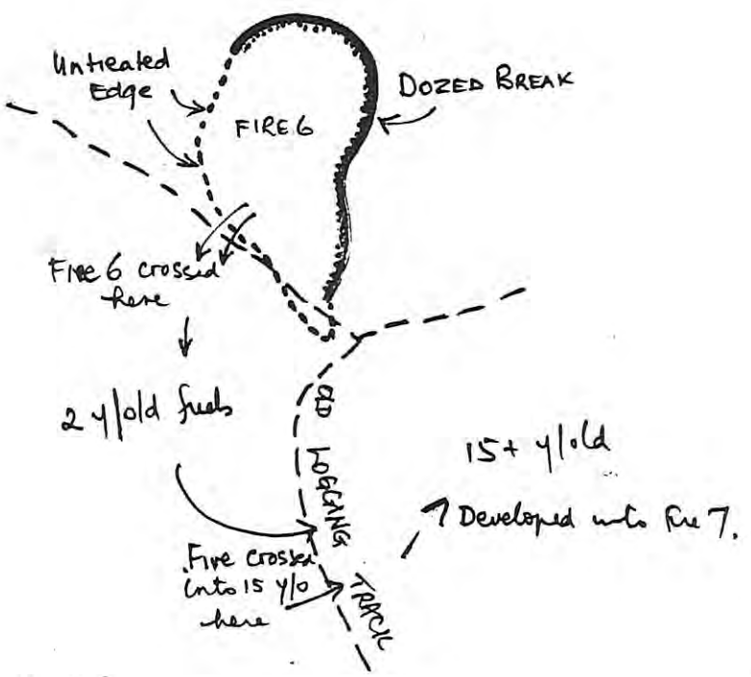
On this day, Fire 6 crossed over its SW perimeter under the influence of a hot NE wind. This was first detected by Walpole spotter at 1315 hours and again by the Manjimup spotter at 1330.

2 2/...

Details of the escape were reconstructed after a post fire inspection. As indicated in Figure 1, the bulldozed break was constructed on only 2/3 rds of the fire perimeter, leaving the west and SW edge without a break. On the dozed break, very little pushing in of logs and stumps was evident and edge fuels observed to be burning fiercely on the night of the 16th had not been touched by the dozer. As a result, the hot NE winds on the morning of the 24th January caused the fire to cross its SW edge and burn south in the 2 year old fuels (the result of a previous wildfire in January 1975) until it crossed the logging track and moved into the heavy fuels east of this track. From then on the fire rapidly incfeased in speed and intensity and had started to crown with the influence of the SW wind when the first F.D. Officer arrived at 1510 hours.

FIGURE 1

OF FIRE 6



(3) FUELS AND LAND TENURE OF FIRE 7 AREA

Figure 2 illustrates the land tenure within and adjacent to the fire area. The age of the fuels are indicated by the legend. . On a broad basis they show that fuels north of the S.F. boundary are 15 year old, including the square area of S.F. enclosed V.C.L., and private property. The bulk of the area of S.F. burnt was 5 year old. However field reports indicated that large pockets of swamps and gullies in this block (Chitelup) were in fact much older then 5 (probably 10 year old) having been missed in the last aerial prescribed burn.

(4) WEATHER DETAILS AND FIRE DANGER

In this section, the Bridgetown weather forecasts and actual weather experinced are listed for the 24th, 25th and the 26th January. In the second part of this section the estimated fuel moisture content, the Fire Danger Index and the predicted R.O.S. are salulated for these same days.

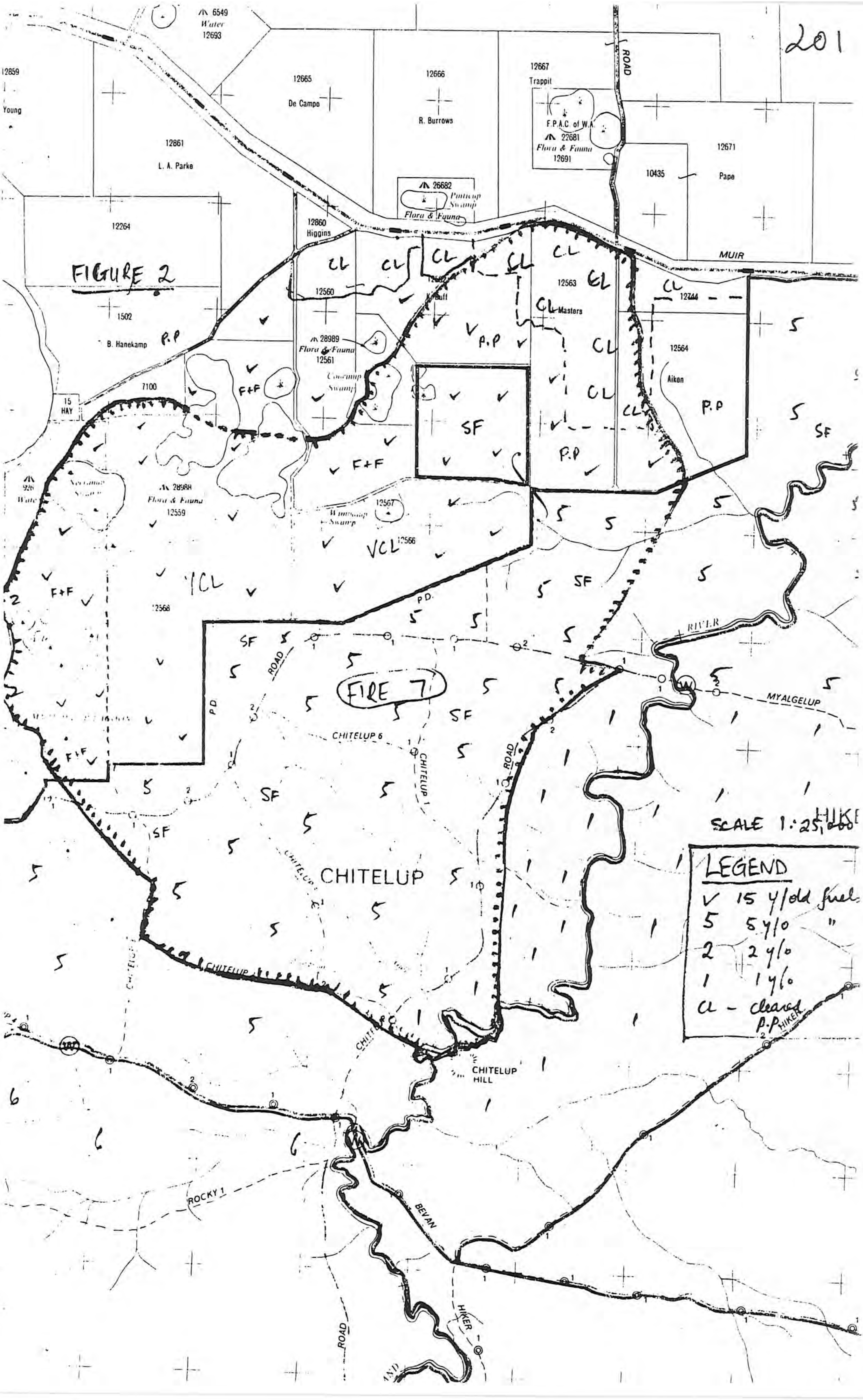


FIGURE 2
6549
Water
12693
12659
Young
12665
De Campo
12666
R. Burrows
12667
Trappit
F.P.A.C. of W.A.
22681
Flora & Fauna
12691
ROAD
12861
L. A. Parke
26682
Pinticup Swamp
Flora & Fauna
12671
Pape
10435
12264
12860
Higgins
MUIR
CL
12560
12562
Huff
12563
Masters
12744
1502
B. Hanekamp
P.P
28989
Flora & Fauna
12561
Coramup Swamp
12564
Aiken
7100
15
HAY
F+F
SF
926
Water
28988
Flora & Fauna
12559
12567
Wimmup Swamp
12566
VCL
12568
PD.
ROAD
RIVER
FIRE 7
MYALGELUP
CHITELUP 6
CHITELUP 1
CHITELUP
SCALE 1:25,000
HIKER
LEGEND
✓ 15 y/old fuel
5 5 y/o "
2 2 y/o
1 1 y/o
CL - cleared
P.P
CHITELUP HILL
ROCKY 1
BEVAN
ROAD
HIKER

4.1 Weather Forecasts (Bridgetown)

The 0745 hourweather forecast for Bridgetown were as follows:-

Monday 24th January Fine Outlook Little Change

Expected Maximum Tem (EMT) = 34°C Expected Min R.H. (EMRH) = 20%

Winds NE @ 25 kph in a.m., E to SE @ 20 kph in p.m.

Actual Maximum Temp = 34°C Min RH = 24%

Actual Winds NNE @ 20 kph (a.m.), SSW @ 20 kph (p.m.)

Tuesday 25th January Fine, becoming humid.

Outlook Cooler EMT = 36°C EMRH = 24%

Winds NW @ 10 kph (a.m.), SW @ 15 kph (p.m.)

Actual Maximum Temp = 37°C Min RH = 29%

Actual Winds NNW @ 15-30 kph (a.m.), SSW @ 10-30 kph (p.m.-

Wednesday 26th January Fine and party cloudy

Outlook Little Change EMT = 27°C EMRH = 42%

Winds South all day at 15-20 kph.

Actual Maximum Temp = 27°C Min RH = 20%

Actual Winds S@ 5-20 kph (a.m.), WSW @ 5-20 kph (p.m.)

4.2 Fuel Moisture Content and Fire Danger Rating

The surface M.C. for N. Jarrah were calculated using the Bridgetown forecasts but including adjustments of + 3°C and -5% R.H. for the fire area which is 50 km inland from Manjimup. The S.M.C.'s and F.D.R. were calculated for each significant period of the fire. The F.D.I. was calculated using a 2:1 wind ratio. This low ratio was considered necessary to account for the low nature of the forest, swamps and flats prevalent in the fire area. The F.D.I. was adjusted for fuel quantity by applying a factor of 3.0 for the heavy fuels north of S.F. boundary, and a factor 1.0 for the 5 year old S.F. fuels.

Table 1 Calculated S.M.C., F.D.I. and Adjusted R.O.S.

Date/Time	Min SMC	Wind Speed & Direct	F.D.I (2:1 ra)	Fuel Type & Correct. Factor	Adjusted ROS (m/hr)
24th Jan 1315 to 1830 Hrs	7%	SW @ 20 kph	278	15+y/old 3.0	834
24/25 Jan 1830 to 1100 Hrs	13%	SW @ 5-8 kph	24	15+y/old 3.0	72
25 Jan 1100 to 1400 Hrs	5%	NNW @ 15-30 kph	700	5 y/old 1.0	700

25 Jan 1400 to 1900 Hrs	4%	SSW @ 10-30 kph	1000	1.0 3.0	1000 3000
25/26 Jan 1900 to 0900	12%	SW @ 10	36	1.0 3.0	36 108
26 Jan 0900 to 1700	4%	SSW @ 5-20 kph	610	1.0	610

* This value required extrapolation from Jarrah R.C.S. Table (6-7).

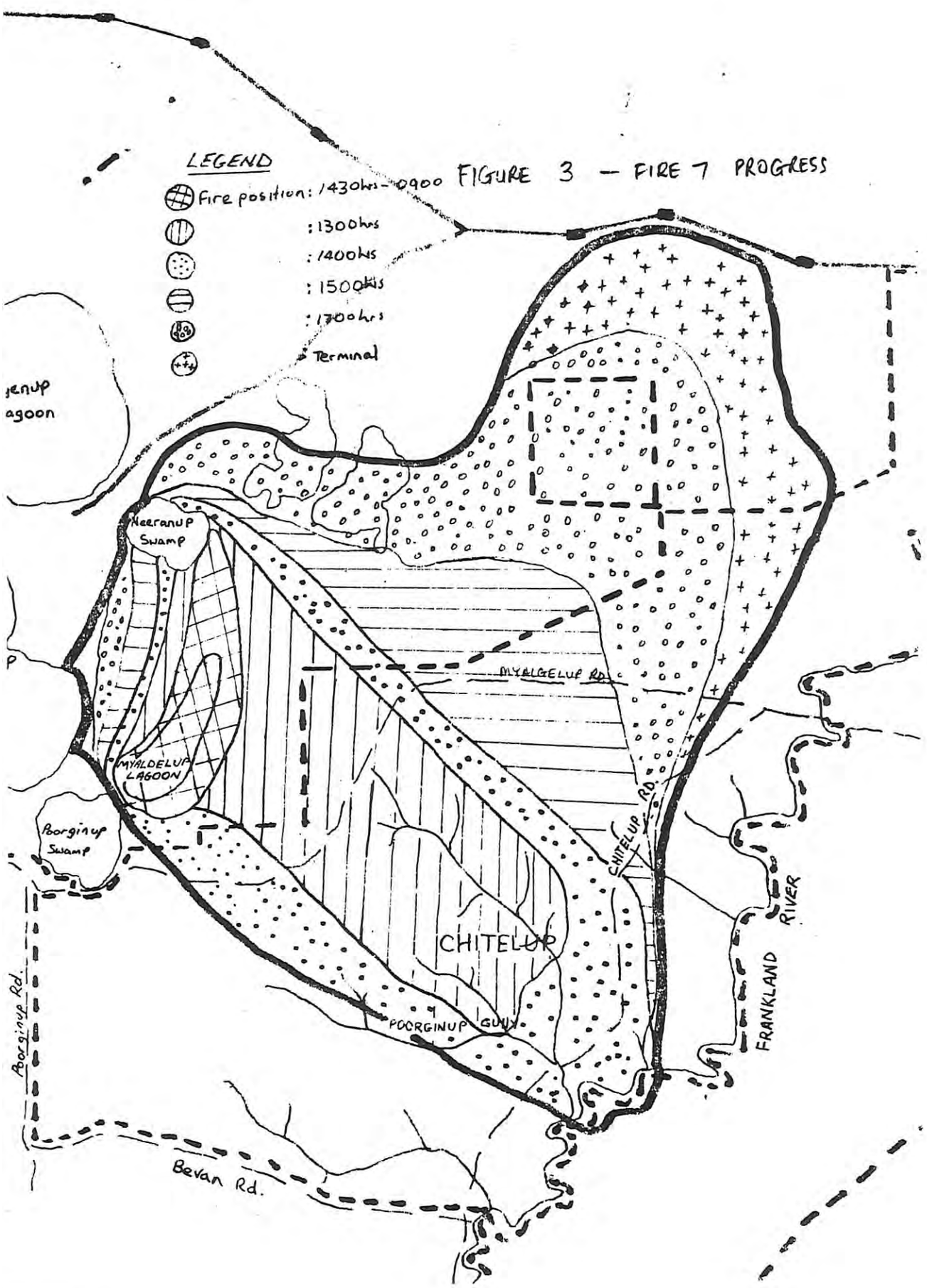


FIGURE 3 – FIRE 7 PROGRESS

5. FIRE BEHAVIOUR

In this section the fire behaviour observed from aircraft and the ground are given for each significant period of the fire. The rates of spread observed are then compared with the predicted R.O.S. calculated in the previous section.

5.1. Description of Fire Behaviour:

Monday 24th January from 1315 to 1830 hours.

When first detected at 1315, the fire was burning in an area of Jarrah and paperbark swamps and flats which had not been burnt for at least 15 years. Fire behaviour up to 1400 was 5 to 8 m flames, spreading at about 200 m/hr. Between 1400 and 1830 hrs, fire behaviour increased rapidly due to the influence of a very strong SW wind. Flame heithts were up to 20 metres, and a maximum spread rate of 3500 m/hr was observed. The average R.O.S. for this period was 1000 m/hr. Spotting was estimated at 200 metres. The fire perimeter increased from 1.5 km at 1400 to 9 km at 1830 hrs.

Monday night and Tuesday morning from 1830 to 100 hrs.

During the cool of the night fire behaviour reduced markedly The R.O.S. on the Jarrah ridges was still up to 100 m/hr, but fire in the flats and swamps had virtually extinguished This fact meant that the idea of burning out of large areas containing flats could not be contemplated at this time as the patchy result would spell danger on the following hot day.

By 0930 hrs, fire had begun to run around in small pockets within the fire perimeter.

Tuesday 25th January from 1100 to 1400 hrs.

At about 1100 hrs, numerous small pockets inside the fire perimeter began to burn fiercely, and driven by a strong NW wind a number of these spotted over the edge. At least 4 hop overs were reported by the spotter on the SE section between 1110 and 1120 hrs. The major hop over occurred at Ref. HT 106-55, and although a D 7 was present here, little could be done to prevent the fire escaping in the very heavy fuels. Flames of 20 to 30 metres high were observed. The hop over soon reached the S.F. boundary into the 5 year old fuels of Chitelup Block. The major hop over made a run of 8km in 3 hours (Av. R.OS. = 2300 m/hr) although at times spreads of 6000 m/hr with flames of 35 meters were observed. Spotting was of the order of 1000 metres. The main run was along the gully and flats of the most north arm of the tributory that runs into the Frankland River near Chitelup Hill. The forward run of the headfire was checked at about 1400 hrs by the deep, one year old fuels in Hiker Block, SE of Chitelup RD. (See figure 2) The fire did hop over the Frankland River near Chitelup Hill, but fire behaviour here was relatively quiet. The fire perimeter up to 1400 hrs was approximately 22 km which meant an increase of at least 13km in 3 hours.

Tuesday 1400 to 1900 hours.

At about 1400 hrs with the onset of a strong (up to 30 kph) SW change, the fire moved on an 8km front in the NE directior During this phase the fire reached its peak intensity as indicated by the remarkable growth of the already large convection column during this time.

In this period, the head fire spread 8km in just over 3 hours and covered an area of approx 4200 ha. The head fire R.O.S. averaged 2500 m/hr although spotter reports gave peak values of up to 6000 m/hr and flames of 35 metres. These values were only achieved in the very heavy fuels north of the S.F. boundary.

At about 1730 hours the head fire had run into the cleared private property south of Muir Highway. As the paddocks were bare and thoroughly broken up by ploughed breaks and sheep pads, the head fire lost most of its sting. Narrow tongues of fire running out of the uncleared areas were rapidly suppressed by the Bush Fires Board and Forest Department forces in the clearings.

The eastern part of the head fire running in 5 year old fuels also slowed after 1800 hrs as conditions cooled. The fire size and shape at 1830 was only marginally smaller than that ultimately achieved.

Wednesday 26th January 0900 to 1700 hours.

The fire was largely contained by the 26th although fire behaviour was observed in large unburnt pockets to be of the order of 500 m/hr .

5.2 Final Area, Perimeter and Damage of Fire:

Table 2 lists the final areas and perimeter achieved in each of the land tenure categories. Also listed is the extent of scorch and defoliation found in each category. Figure 3 illistrates the areas defoliated and scorched.

TABLE 2:

Land Tenure	Area Burnt Ha	Perimeter Km	% Fuel Scorch	% Defol.
State Forest	3700	20	30	60
Flora & Fauna Reserve	1300	13	60	35
Vacant crown Land	1100	-	60	30
Private Proper.	1000	15	-	-
TOTAL	7100	48	-	-

5.3 Comparison of Actual and Predicted Fire R.O.S.

Table 3 compares the observed fire R.O.S. for each of the significant fire periods with the predicted R.O.S. calculated in Section 4.2.

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TABLE 3 4:

COMPARISONS OF ACTUAL & PREDICTED FIRE R.O.S.

PERIOD	FUEL TYPE	PREDICED R.O.S. M/hr (see table)	M/Hr ACTUAL Mean	M/Hr R.O.S. Max
24th Jan, 1315 to 1830	15 + y/old Flats + Jah	834 M/Hr	1000	3500
24/25 Jan. 1100 to 1400	15 + y/old Jah. ridges	72 M/Hr	80	200 (wind gust)
25th Jan.	5 y/old Jah. Flats	700 M/Hr	2300	6000
1400 to 1900 25th Jan.	5 y/old Jah + flats	1000 M/Hr	1400	2000
	15 y/old Flats + Jah	3000 M/Hr	2500	6000
25/26 Jan. 1900 to 0900	5 y/ old Jah. + flats	36 M/Hr	50	-
	15 y/old Flats + Jah. Swamps	108 M/Hr	80	150
26th Jan. 0900 to 1700	5 y/old Jarrah	610 M/Hr (observed in unburnt pock.)	500	-

The correlation on the 24th January was reasonably good for the mean values, althouth the maximum R.O.S. values observed far exceed the prediction.

On the 25th January up to 1400 hrs, the R.O.S. values prediction for 5 y/old Jarrah was low by a factor of 3 for the mean R.O.S., and low by a factor of about 8 for the max. values. The larger difference may be partly explained by the strong likelihood that the fuels in the gullies in the main run of headfire were much older than 5 years. This possibility is further indicated by the reasonably close correlation between the predicted and actual R.O.S. for the 5 year old fuels in the period between 1400 and 1900 hrs on the 25th. In this case the table underpredicted the measured R.O.S. by less than 30%. In this same period the correlation for mean R.O.S. in the 15 + year old fuels is close although again the maximum R.O.S. was double that predicted by the tables. This difference could be the effect of long range spotting and crowning not taken into account by the tables.

The correlation for the mean R.O.S. during the night of the 25th and during the 26th were reasonably good and within 20% of each other.

5.4 SUMMARY

Given the correct information on fuel age and quantity, and appropriate wind ratios, the jarrah R.O.S. table (6-7) under estimates the observed mean R.O.S. by about 20 per cent. However, the tables badly underestimate the peak R.O.S. values by factors of up to 8 times, and it is obvious that such affects as long range spotting, crowing and the influence of fire winds are not accounted for once the fire moves at speeds of greater than 1000 metre / hour. It is apparent that an additional factor may need to be applied to the final table value which will take these effects into account. One way may be to apply a multiplying factor to the final table value. The multiplier could be obtained from the following hypothetical table.

Final Adjusted R.O.S. (Table value)	Multiplying Factor to Account for Spotting etc
500	1.3
1000	1.5
1500	1.7
2000	2.0
2500	2.3
3000	2.5

Thus for example, if the table prediction is 1000m/hr then apply a factor of 1.5 to give a peak R.O.S. of 1500 m/hr. It is recommended that the Fire Research section look at this problem in further detail.

6) SUPPRESSION TACTICS AND FORCES

This section gives a summary of events, tactics employed and suppression forces used during the 24th, 25th, 26th and 27th January.

Monday 24th January

Initial Despatch

At 1315 Walpole spotter detected a hopover from Fire 6 at reference HT 105-43 in Fisheries and Fauna Reserve. A/F Simmonds was despatched from Manjimup and arrived at 1510. Tone Gang was despatched from M34 (A.C.B.) at 1345 and arrived at 1600. On arrival A/F Simmonds reported that further assistance was required. Consequently one Office plus one gang and the Manjimup D6 were despatched at 1530. The D6 did not arrive till 1830 by which time the fire had made its first major run. Further assistance in the form of 2 gangs and 1 dozer were despatched so that by 2050 the following forces were at the fire:-

Officers	Gangs	Dozers	Others
5	3	2	1 L/L
			1 Tender

An L.F.C. was mounted at about 1800 Hours

Tactics: By the time the gang and H.D. arrived at the fire, fire behaviour was so severe as to prevent any suppression on the headfire or flanks until the dozer arrived. When the Manjimup D6 arrived, it was unloaded on the corner of Myalgelup and Chitelup 5 Roads and sent north along the Reserve / S.F. boundary. From there is was sent west to the fire face where it began to construct a break northwards along the eastern fire sector. This break was continued around the headfire and was tied into Neeranup Swamp at 0300. The Walpole D6 worked on the SE sector and the SW sector near Poorginup Swamp. By 0600 a break running from Tordit-Gurrup Lagoon around to Neeranup Swamp had been completed and only three small unburnt pockets remained to be consolidated. Nothing was attempted on the west sector. A burn out of the area between the eastern fire perimter and the S.F. boundary was considered in the evening of the 24th. However this idea was abandoned as fire would not burn in the flats.

An aerial inspection at 0600 confirmed that no active fire existed on the south, east, and NE perimeter.

Tuesday 25th January

Because of committments elsewhere in the Southern Region, it had been decided to replace F.D. dozers with two contract dozers hired by the F. & W. These contract machines were to arrive at the fire at 0730 and 0900 hours, but unfortunately, actual arrival times were 0930 and 1330 hours. The F.D. dozers were released from the fire at 0930 and 1000 hours which meant that only one dozer was working on the fire when the first hop-overs occurred at about 1100 hours. F.D. manpower strength on the morning of the 25th were also so greatly reduced. It had been arranged through the B.F.B. that local B.F. Brigades control and patrol the northern and NE sectors. 1 F.D. gang and H.D. were assigned to mop-up the southern and eastern sectors. In light of the threat of hop-overs with the forecast of NW winds, this committment was well below strength as was proven at 1115 with the event of two escapes on the SE sector. It was felt in the field that given an extra two gangs to consolidate the southern and eastern edges, these escapes may never had occurred. As it was, even with the presence of the contract D7 at one of the hop-overs, nothing could be done to prevent the escape in the heavy fuels.

FIG.5 Five year old fuels in Chitelup Blk.

FIG.6 Defoliated jarrah in Chitelup Blk.

Extra F.D. gangs and dozers were recalled to the fire from 1115 so that by 1130 forces despatched ~~and present at~~ to the fire were:-

7 Officers

4 Gangs and H.D.

Approx 20 B.F.B. Members

4 Dozers (2 contract)

D4 Manjimup Shire sent at 1430

TACTICS

With the extremely fierce fire behaviour under the influence of the NW wind, it was not safe to commence suppression on the headfire or flanks until 1430. With the SW wind change at about 1430 suppression of the backfire on Chitelup 2 and Chitelup 3 was initiated. Again, no direct attack could be contemplated until conditions cooled and fire had run into barren clearings in the private property south of Muir Highway. This occurred at about 1800 and effective control of the headfire was achieved by B.F.B. and F.D. forces in locations 12562 - 3 - 4 and 12744. The major effort of the F.D. forces at about 1800 was to control the eastern flank fire north of Myalgelup Road. It was considered most important that fire be contained west of Frankland River as fuels on both sides of the River were at least 5 year old. No suppression was attempted on the SE sector as fuels there were only one year old.

Fireline construction in all other sectors continued throughout the night of 25th-26th Jan and were completed by 0800 hours of the 26th.

Wednesday 26th

Forces and equipment at Fire 7 were:

7 Officers

7 Gangs

5 Dozers

1 Farm Grader

Consolidation of firelines, burning out of pockets and mop-up was conducted on all edges accept the SE sector. Several minor hopovers in the F. & F. Reserve in the north occurred throughout the afternoon but were readily contained.

Thursday 27th and Friday 28th

The long fire perimeter and the heavy fuel types adjacent to most of the perimeter meant that it was necessary to contain a large work force and dozer committment in the mop-up operation. Fire 7 was declared safe at 1500 on Friday 28th

(7) FIRE DAMAGE

A damage assessment of the fire area was carried out from an aircraft two weeks after the fire. The visual assessment recorded damage in 4 categories: defoliated, full scorch, green crown, and flats. The result of this assessment are ploted on an 80 scale plan - Figure 4.

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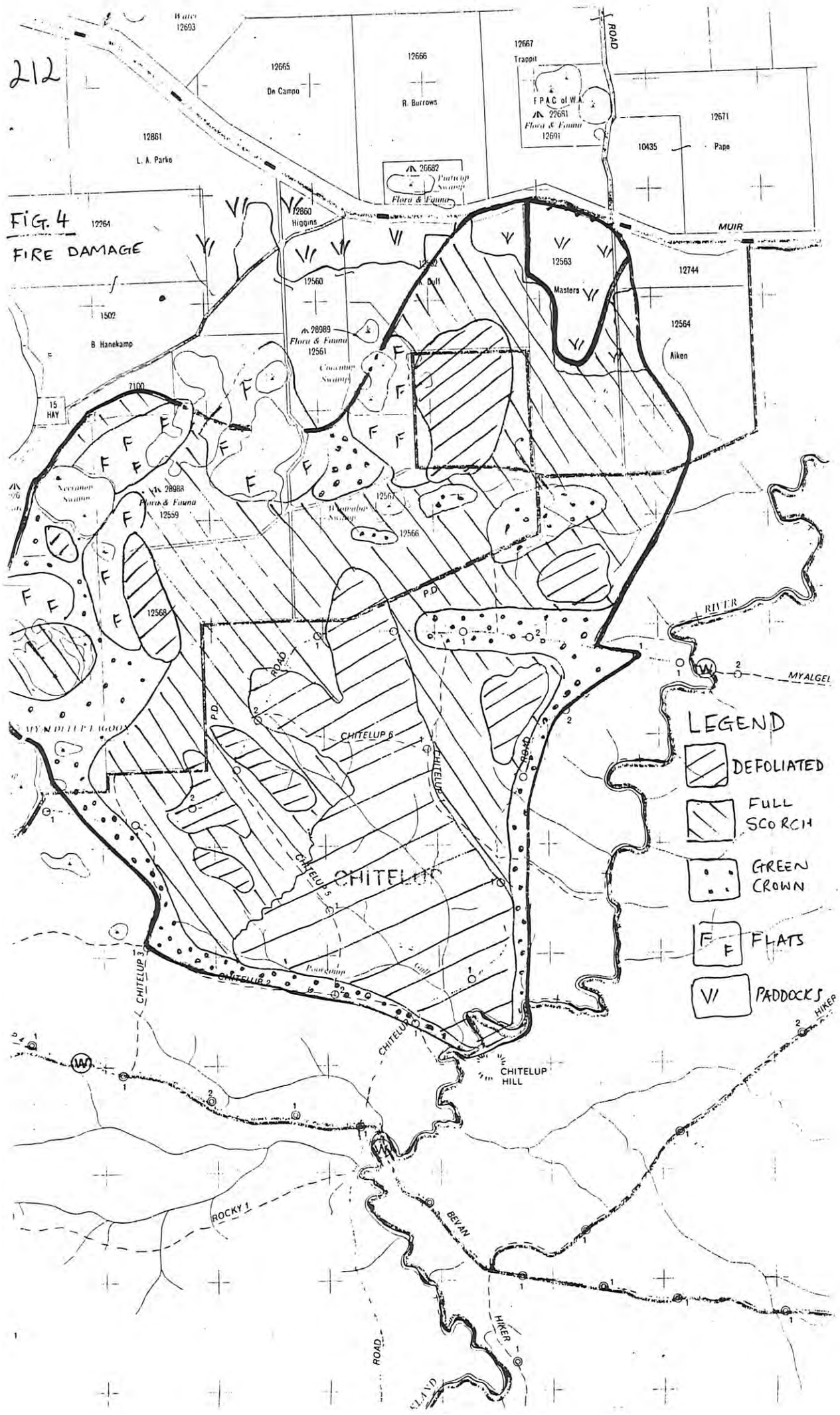
FIG. 4

FIRE DAMAGE



(8) WAGES AND PLANT COSTS

Direct costs incurred by the F.D. for Wages and Plant are listed below. The overhead costs were not taken into account.

WAGES AND PLANT COSTS

Division	Ordinary Time	Overtime	Plant
Manjimup	3003	6077	4207
Pemberton	333	1063	641
Harvey	413	773	692
Walpole	1121	1494	1046
Kirup	319	1759	803
	5189	11166	7389

Total direct costs = $23,744

Fisheries and Wildlife paid for the use of 2 contract dozers.

(9) AIRCRAFT USE

Aircraft spotter facility proved extremely useful during the duration of the fire. It was especially useful in providing information to the Controller and Fire Boss on the problems of the headfire, potential trouble spots, hop-overs etc. The regular 10 to 15 minute reports during the three major headfire runs provided invaluable data on the firebehaviour of this intense wildfire.

From the spotter report it was possible to update suppression action plans every 3 to 4 hours.

The spotter was also used on the early morning of the 26th for photography of the fire. Unfortunately the large smoke and haze accumulation was too much for any clear photographs. However, this facility may prove invaluable in future wildfire suppression actions.

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D.F.O