BOORARA FIRE REPORT.

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22/28

THE BOORARA FIRE 7th to 12th MARCH, 1969.

A REPORT PREPARED FOR THE INVESTIGATION OF 21st to 23rd APRIL 69 by MANJIMUP FIRE RESEARCH.

1. INTRODUCTION.

The Boorara fire started in a farmers paddock (Loc 12077) at 1015 hrs on 7th March 1969. It was about ¾ mile from Boorara tower so detection was almost immediate. The fire started from sparks during blasting operations, and spread rapidly from the paddock into adjoining forest.

The despatch of suppression forces on the 7th and the build up on succeeding days has been discussed in section 6, but it seems that the initial dispatch was not rapid enough and the headfire was never completely controlled either on the 7th or on succeeding days.

The spread of the headfire has been discussed in section 4 but it was generally in an eastwards direction and finally reached the Nornalup Highway, about 15 miles away, at 1600 hrs on the 9th. Here the headfire was stopped by a deep 1967 aircraft control burn.

Rates of forward spread of the headfire were extremely rapid, especially on the afternoon of the 9th, and during the 3 day period the rates ranged from 1.25 chains per hour to 177 chains per hour. Spot fires in front of the headfire were common and maximum throw distances ranged between ½ and about 3 miles.

The Boorara fire finally reached 17,900 acres in size and crown damage varied from apparently undamaged forest with green crowns to defoliation (section 7). The fires perimeter reached approximately 42 miles and on the 10th ~~and~~ involved 16 gangs and 14 bulldozers on suppression (sections 5 and 6).

2. WEATHER FORECASTS AND FIRE DANGER.

In this section the 0745 hrs weather forecasts will be listed for each day between the 7th and 12th March. The estimated fire danger indexes are listed with these forecasts.

In the second part of this section actual fire danger ratings for karri have been graphed, at two hourly intervals on each day to the 10th March, and weather data on temperature, relative humidity, wind direction and strength, and on jarrah fire danger ratings listed in Appendix 1.

a. Weather forecasts.

The 0745 hrs karri weather forecasts for Pemberton were:

7th March.

Fine and hot with NE-N winds at 4-7 mph and a NW-SW afternoon sea breeze. EMT 99°, EMRH 20%, F.H. Dangerous F.D. jarrah-brown, karri-red.

8th March.

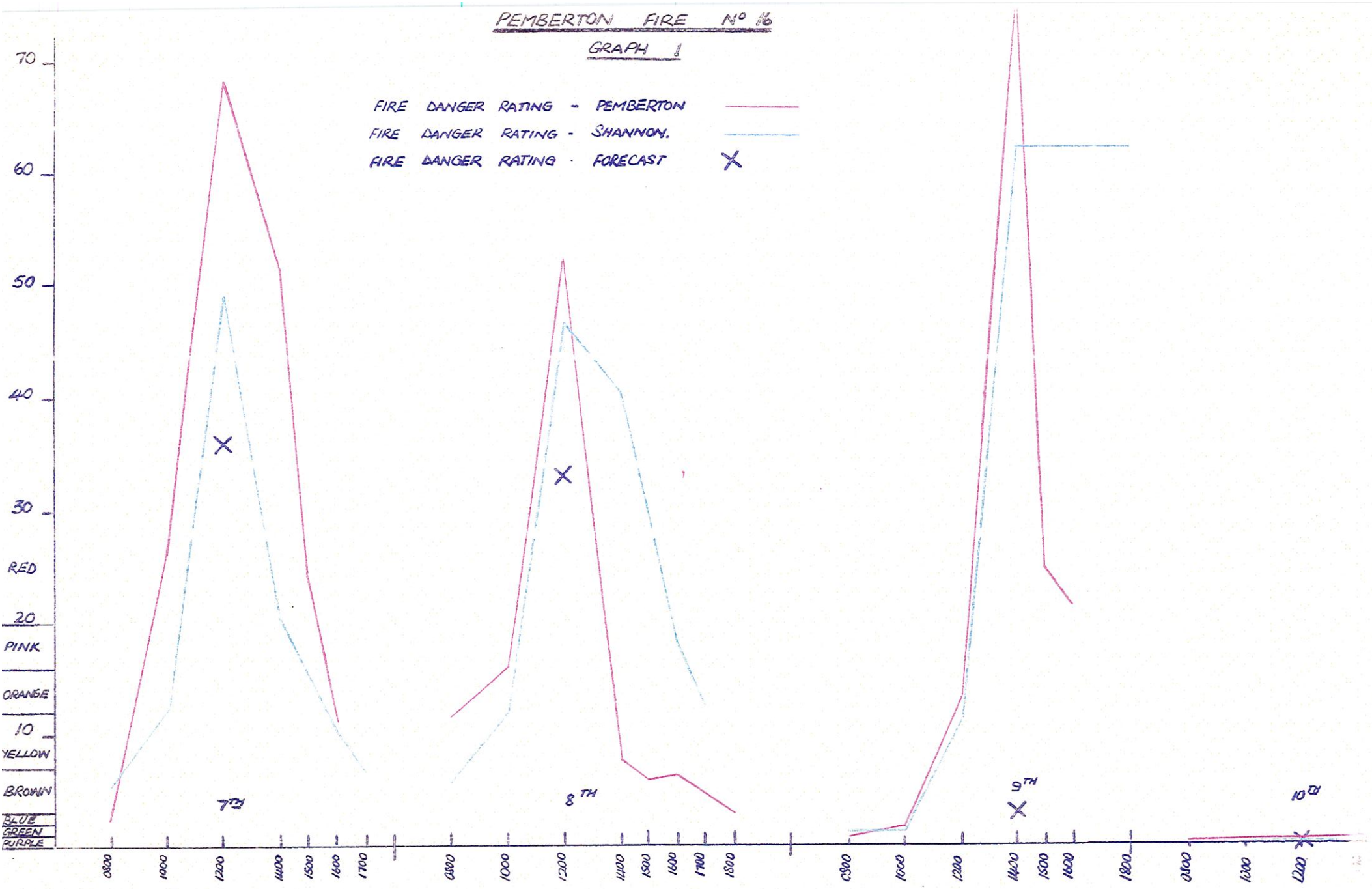
Hot at first but becoming cooler during the day with NE-N winds at 8-12 mph backing NW and W during mid-morning and increasing to 15 mph. EMT 93°, EMRH 20%, F.H. severe F.D. jarrah-mid-brown, karri-red.

9th March.

Cloudy and mild with some isolated showers and NW to W winds at 4 mph increasing to 10-15 mph during the day and backing SW late pm. EMT 74°, EMRH 64%, F.H. Low, F.D. jarrah mid purple, karri low blue.

PEMBERTON FIRE Nº 16

GRAPH 1



10th March.

Cool and cloudy with further light showers and SW winds at 10-15 mph with gusts to 19 to 24 mph. EMT 69°, EMRH 60%. F.H. Nil or Low. F.D. jarrah and karri white.

11th March.

Mild with variable cloud and NW winds at 1-3 mph settling early in the W-SW and increasing to 10-15 mph. EMT 70° EMRH 50%, F.H. Low, F.D. Jarrah mid-purple, karri high white.

12th March.

Cloudy and mild with some showers during the day and NW winds at 13-18 mph with gusts to 25 mph backing WEST - SW during the day, EMT 70°, EMRH 60%. F.H. Nil or Low F.D. Jarrah high purple, karri low green.

b. Fire danger Ratings.

Figure 1 shows karri fire danger ratings at two hourly intervals for each day between 7th and 10th March. These ratings are for 12+ fuel and both Shannon and Pemberton readings using Burnside tower winds. This procedure was followed for all readings except the afternoon of the 9th where Burnside's low velocities were not representative of reports received from the fire. For this period reported velocities of 50 mph by officers at the fire were accepted.

Shown with the actual fire danger ratings on Figure 1 are the forecasted values for Karri. These were reliable on all days except the 9th.

Karri fire danger was used as the basis for Graph 1 because this forest type surrounded the origin of the fire. Later the fire burnt into a mixture of jarrah karri and flats but karri fire danger was retained as the standard for this demonstration of daily rise and fall.

From Graph 1 it is quite apparent that fire danger was high on the 7th, 8th and 9th in each case the peaks were well into Red, hence it is not surprising that headfire attacks during the day could not be made. It was also apparent that fire danger ratings over the whole area at that time were high as there was very little difference between Pemberton and Shannon.

The fuel plan (wall demonstration 3 FUELS plan) is a 40 scale A.P.I. showing the areas of jarrah, karri and flats within the fire's perimeter. Most of the area had not been burnt for many years and fuel quantities approximated 13 to 14 tons per acre of karri litter and 9 to 10 tons of jarrah litter.

The areas of the three main fuel types were:

Karri 7,852 acres.
Jarrah 4,984 acres.
Flats 5,032 acres.

Total fire acreage 17,868 acres.

These total acreages were divided into the two main sections of the fires area, east and west of Deeside Rd. (refer plan).

The fuel acreage in the fire area west of Deeside Rd were:

The fuel acreages in the fire area west of Deeside Rd were:

Karri	5172	acres.
Jarrah	2,570	acres.
Flats	2,528	acres.
TOTAL	10,270	acres.

The fuel acreages east of Deeside Rd were:

Karri	2,680	acres.
Jarrah	2,414	acres.
Flats	2,528	acres.
TOTAL	7,598	acres.

The fuel plan also shows recent controlled burning. In the aircraft controlled burnt area (spring 1967) east of the Nornalup highway, flats and jarrah re-lightings were completed and some of the karri was burnt. The aircraft burn to the south of the fire area was mainly in flats and very little karri had been burnt under. In this season the final karri lightings for these areas were not completed. The flats were variable in type, but generally in the main path of the Boorara headfire they appeared to be heavy ti-tree 10 to 15 feet high.

SECTION 4

FIRE BEHAVIOUR.

The rate of spread plan (enclosed) shows the approximate position of the fires perimeter during the 7th, 8th and 9th March.

The perimeter positions are estimates only and not very accurate, especially the headfire positions on the afternoon of 8th. They were compiled from fire boss and aircraft reports and the most accurate observations seemed to be on 7th and aircraft reports of spot throw distances on the afternoon of 9th.

Table 1 below lists rates of forward spread of headfire, rates of perimeter increase and spot fire throw distances for the development period of the Boorara fire.

Rates of spread varied between 1.25 chains per hour on the night of the 7th to 177 chains per hour on the afternoon of the 9th. Similarly rates of perimeter increase varied between 14 and 513 chains per hour. From the observations in section 6 it seems that one gang and bulldozer in a six hour period should handle a rate of perimeter increase in karri fuel and red fire danger of about 7 chains per hour and handle about 26 chains per hour under white.

There were few recorded observations of flame height; the aircraft report flames 10 to 15 feet high on the north flank during the afternoon of 7th.

On the afternoon of the 9th, during the main run of the headfire, the aircraft reported the height of the convection column to exceed 10,000 feet.

A headfire rate of spread in the order of 177 chains per hour is one of the highest recorded in W.A. forests and was well above that predicted by the karri fire danger tables, even using 50 m.p.h. winds. Graph 1 is shown below with the actual rates of spread graphed each day.

There was good correlation between predicted and actual rates on 7th when the fire was burning in karri fuels and spot fire throw distance was limited.

Similarly on the morning of 8th correlation was reasonable but poor that afternoon when spot fire throw distances increased, and in any case the headfire position was only poorly estimated.

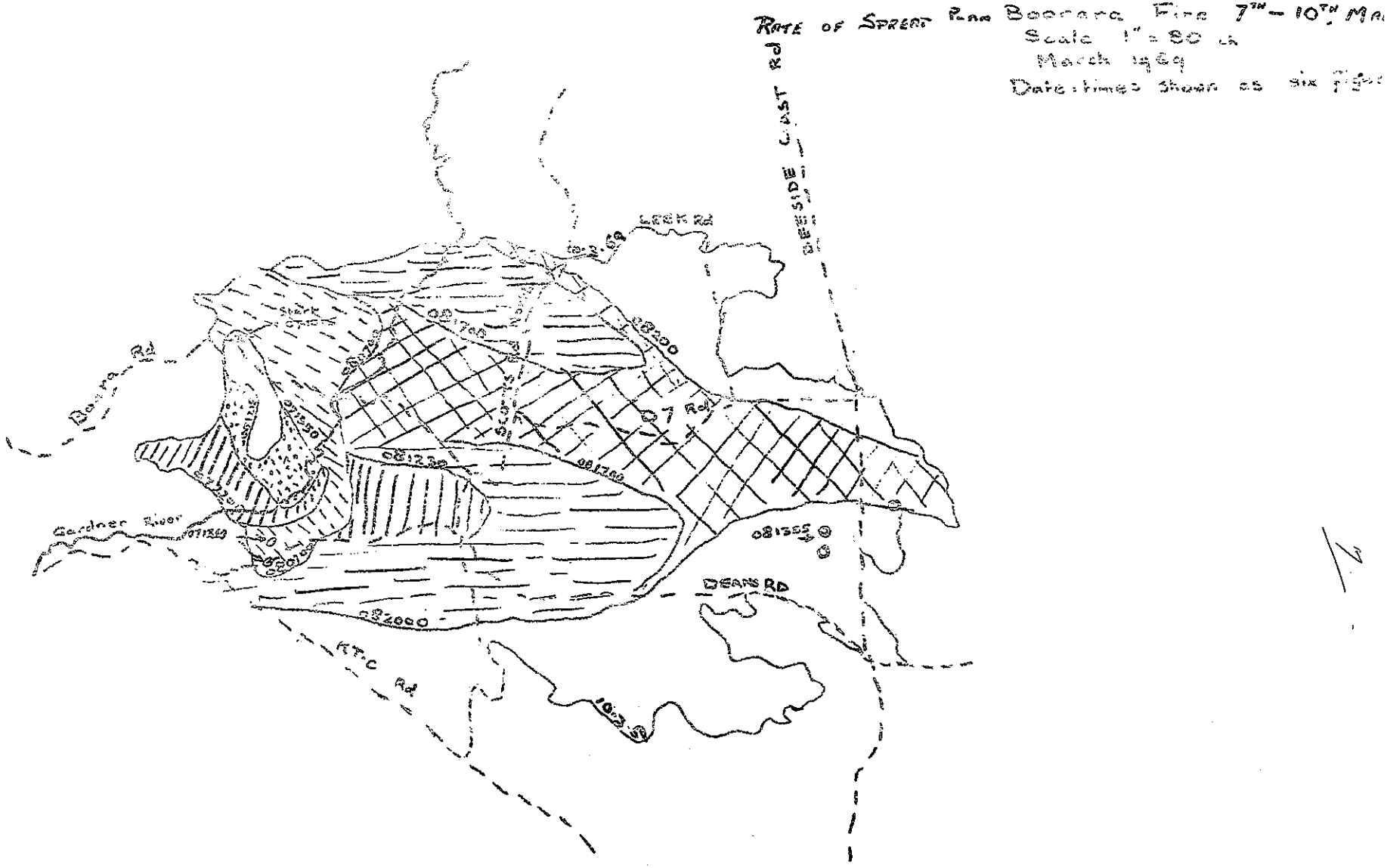
On the 9th there was again reasonable correlation up to 1400 hours when the headfire started its main run with long distance spotting. After that there was no correlation, probably due to spotting and the fast rates of spread up flats, where open wind velocity would be an important influence.

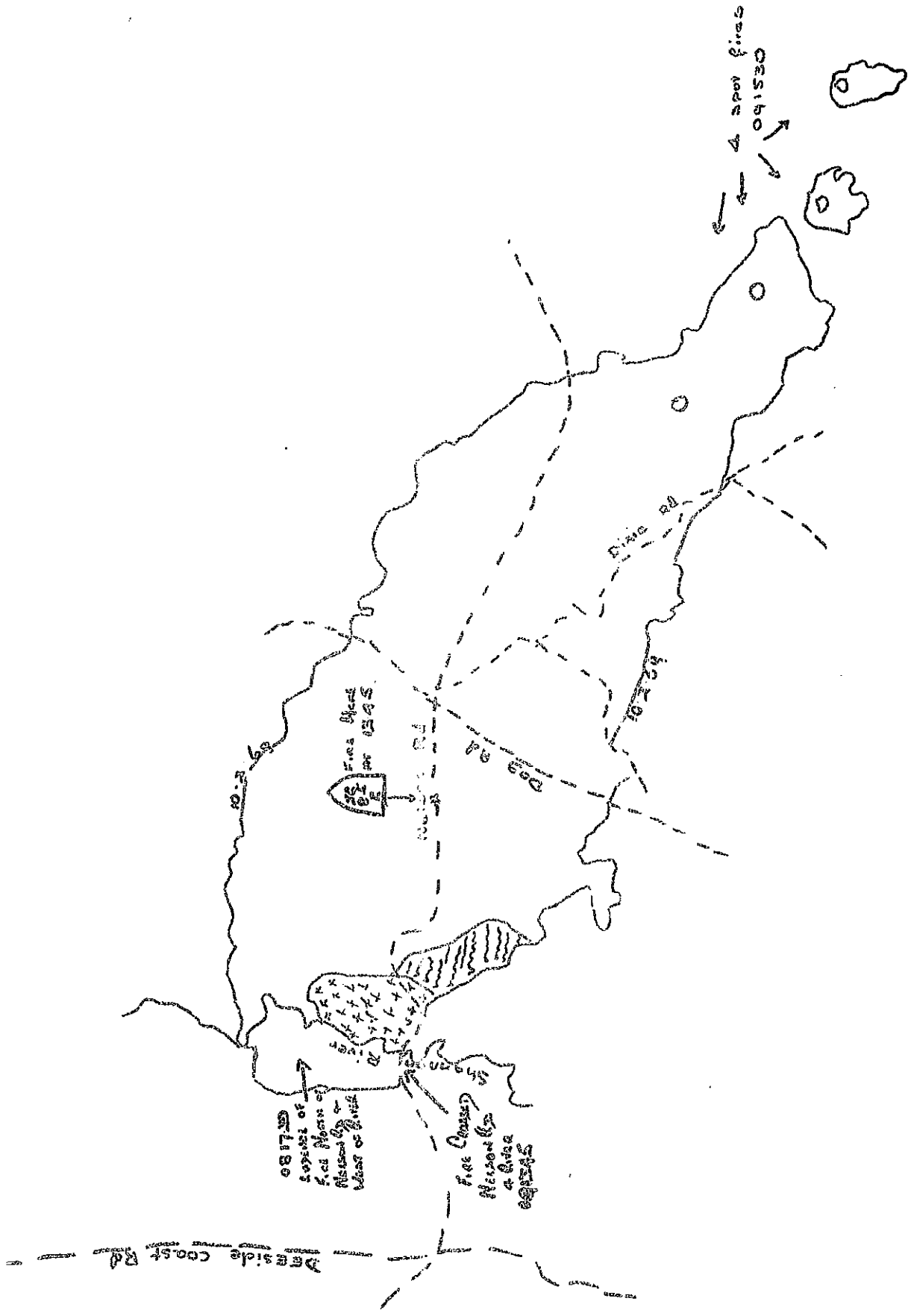
TABLE 1

FIRE BEHAVIOUR - BOORARA FIRE

1015 on 7th March to 1600 on 9th March.

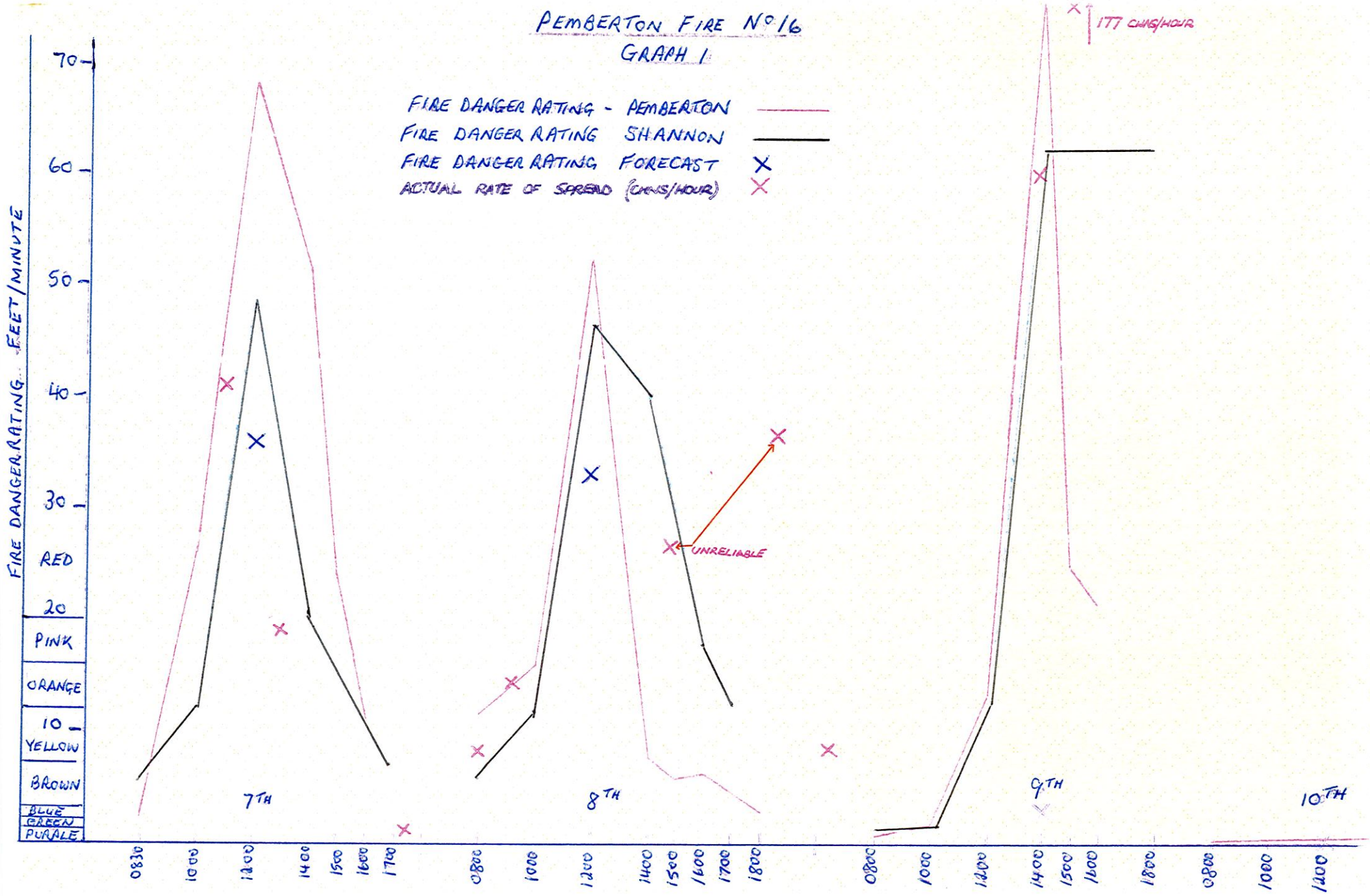
Date	7th March			8th March				9th March		
Fire Behaviour	to 1015 1215	1215 1350	1350 2200	2200 0700	0700 1230	1230 1700	1700 2000	2000 1300	1300 1400	1300 1600
Total distance travelled by headfire chains.	80	30	10	75	80	120	116	145	60	530
Rate of forward spread of headfire chains per hour.	40	19	1.25	8.3	14.5	26.7	36.7	8.5	60	177
Total perimeter length miles	2.3	3.3	4.8	7.3	10	18	15	31	33	42 - 50
Perimeter increase miles	2.3	1.0	1.5	2.5	2.7	8	0	15	2	19
Rate of perimeter increase chainspper hour.	95	50	14	22	40	142	-	72	180	513
Spot fire throw distances chains.		30				to 180 210			120	380


RATE OF SPREAD Ram Boorara Fire 7TH – 10TH Ma
Scale 1" = 80 ch
March 1969
Date: times shown as six figs
BEESIDE COAST Rd
LEEK RD
Boorara Rd
Gardner River
DEANS RD
KT.C Rd
081200
081300
081330
081400
082000
082200


Beeside Coast Rd
Fire Observer Station & Radio Aerials
Fire Observer Station & Radio Aerials
Dirac Rd
Dirac Rd
Dirac Rd
Dirac Rd
Fire Observer Station & Radio Aerials

PEMBERTON FIRE N°16

GRAPH 1



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Sect 5

DIARY OF EVENTS FOR THE BOORARA FIRE

7th to 12th MARCH - 1969.

In this section the events during the Boorara fire will be dealt with briefly day by day. These events will be discussed under these headings, suppression forces, the sectors for which they were responsible, and the tactics employed for suppression.

DAY No. 1. Friday 7th March.

At 1045 hrs Boorara tower located a fire in location 12077 approximately ¾ mile away. Subsequent investigation showed that this fire started in a cleared paddock from sparks during blasting operations. The fire danger index at the time (Pemberton) was red for karri and brown for jarrah.

The table below shows the dispatch action which followed the fire report. (TABLE 1A/5)

TABLE 1A/5.

INITIAL DISPATCH BOORARA FIRE 7th March.

Time	Event and Report.	Officers (ARRIVAL AT FIRE)	Gangs	pumpers	Bull-dozers.
1045	Fire in Location 12077				
1045	Fire boss and two officers dispatched. Three gangs, pumpers, and one bulldozer dispatched.				
1115	Aircraft spotted fire but no investigation.				
1150	Fire 2 chains north of Boorara Rd at JE 77 57	3 (including Fire boss)			
1200		1	3	3	1
1210	Aircraft dispatched to report.				
1230	Control point at JE 77 89. 'Boorara Control'. Two bulldozers dispatched.				
1305	Aircraft report: fire 1½ miles long with headfire moving south and over Gardner R. Two spot fires south of Deans Rd (ref RCS plan)				
1330		1	1	1	1
1350	Fire reached location 9990.				
1430 to 1620		2	4	3	5
	TOTAL Suppression force at 1620	7	8	7	7

2. Tactics.

In the early stages of this fire the north- and east flanks were attacked, and also the spot-fires south of Deane Rd. At this time there was no attack on the main headfire which was travelling southwards.

Later, when the full suppression force arrived, (between 1130 to 1620 hrs) the fire was broken into four sectors and the force divided as shown in Table 1/S. The fire perimeter at this time was about 5 miles long.

TABLE 1/S.

DISPOSITION OF SUPPRESSION FORCES

FROM 1620 on 7th March.

Sector	Flank	Length miles	Officers	No. of gangs.	pumpers	Bull-dozers
1	West	1	1	5	1	1
2	East	2	2	2	2	3
3	North-East	2	2	2	2	2
4	spot fire	?	1	1	1	1
Control point.			1			

This force was within ½ mile of encircling the fire when on the 8th March, rising fire danger caused a break of the headfire to the east.

2nd Day Saturday 8th March.

During the 8th March the headfire moved rapidly eastwards and later that day spot-fires were discovered east of the Deeside coast road, about 1½ miles in front of the main headfire. This development led to a revision of tactics, and at about midnight, a second control point was established on the Deeside Coast Road.

In this section it is intended to describe the suppression forces and tactics as they were on the day of the 8th and to list the changes that occured that night on the 9th.

1. Suppression Forces.

The suppression force for the day of the 8th is shown on Table 2/S

TABLE 2/S.

SUPPRESSION FORCE FOR 8th.

Number.	Type.
2	Pemberton Control officers.
3	Boorara Control officers.
7	Officers 'sector bases and assistants.
10	Gangs
10	Pumpers
5	Bulldozers.

The length of fire perimeter by 2000 hrs was approximately 14 miles. This force was unable to contain the rapid eastwards spread of the headfire.

2. Tactics.

On the morning of the 8th suppression forces on the north, west and southern flanks were mopping up and containing hop-overs and spot fires. On the eastern sector two bulldozers were attempting to control the headfire, one working south from Boorara Rd and the other north from Dennis' Rd. At this time the fire was east of the Gardner River but not spreading rapidly.

By 1300 hrs spot fires were reported east of the Deeside Rd. The tactics adopted were: back burning to the flank fire along the north and south flanks (Leek and K.T.C. Rds) and then to bulldoze breaks eastwards to the Deesdie Rd, back burning behind. Late that night the fires east of Deeside Rd were attacked.

The sectors and distribution of suppression forces are shown on Table 3.

TABLE 3.

DISPOSITION OF SUPPRESSION FORCES ON DAY OF 8th MARCH.

Sector	Flank	Length miles	Number of Officers	Gangs	Pumpers	Bulldozers.
1	north	3	2	2	2	1
2	west	2	1	2	2	1
3	south	1½	2	3	3	2
4	east	increasing from 2½	2	3	3	2

3rd DAY SUNDAY 9th MARCH.

At 0400 hrs the Deeside control was established and responsibilities for control of the fires perimeter was divided between this and Boorara.

1. Suppression Forces.

The total suppression forces for the day of the 9th are listed in Table 4.

TABLE 4.

SUPPRESSION FORCE FOR 9th.

Number.	Type.
3	Pemberton control officers
6	Deesdie and Boorara Control officers
24	Officers (sector bosses and assistants)
19	Gangs
8	pumpers
10	bulldozers.

2. Tactics.

On both the north and south flanks dozed tracks were extended eastward with the objective of enclosing the flanks then attacking the eastern headfire. On both flanks gangs were backburning behind the bulldozers.

Once the bulldozer broke through to Deeside Rd the headfire was attacked. One crew started on the north end from Deeside Rd and pushed a eastwards until all spot fires were encircled. This break was then taken southwards, roughly paralleling the Shannon River until it joined with a second crew working from south to north. The area between this break and Deeside Rd would be burnt out that evening under lower fire danger.

Unfortunately this operation was not completed nor were all the spot-fires enclosed by the break. Consequently the fire again broke eastwards on the 9th.

The headfire attack was abandoned after the aircraft reported fire east of the Shannon River at about 1300 hrs. Crews attacking the headfire were withdrawn and moved further east. Before they could do effective work the fire spread south, crossing Nelson Rd (at about 1215 hrs) and at this time fire intensity was too high for headfire attack. At about 1400 hrs a wind change to the west swept the fire to the Normalup highway which it reached at approximately 1600 hrs. There was little control at this time and the rate of spread plan for this period is virtually for free running fire. At this time the fire was throwing spot fires from 4 to 5 miles in front of the headfire.

The headfire was stopped completely at the highway by a deep 1967 aircraft control burn. Charred material was common for at least ½ mile into this burn but no ignitions were reported.

The distribution of suppression forces for the 9th is listed on Table 5/5. The fires perimeter was about 42 miles ~~long~~ that evening so the sector lengths refer to the early part of the day.

TABLE 5/5

DISPOSITION OF SUPPRESSION FORCES ON 9th MARCH.

Sector	Flank	Length miles	Number of Officers	Gangs	Pumpers	Bull-dozers.
Boorara Control						
1	north	2	1	1	2	2
2	north-west	1½	1	1	1	1
3	west	3	2	1	1	1
4 4	south	33	2	3	2	3
Deeside Control						
1	north	5	1	3	2	2
2	east	3	4			1
				Additions from N and S sector		

4th Day MONDAY 10th MARCH.

On this day the suppression force reached its peak in number and all flanks were attacked. As mentioned earlier the headfire had stopped on the normal up highway so it was a flank attack.

On this day the Boorara control was shut down and moved to the Shannon airstrip.

1. Suppression Force.

The total suppression force for the 10th is listed in Table 6/5

TABLE 6/5

SUPPRESSION FORCE FOR 10th MARCH.

Number	Type.
7	Control and support officers (including Shannon sub-control).
6	Deeside and airstrip control officers.
16	Officers (sector bosses and assistants)
16	Gangs
16	Pumpers
14	Bulldozers.

2. Tactics.

The weather on 10th was overcast and fire danger had dropped. Drizzle developed later in the day.

The tactics were to cut breaks around the fires perimeter, rising direct attack method and then to mop-up the edge.

Due to boggy conditions in flats on the south flank this edge was not satisfactorily completed and later broke away on the 21st March running into a patchy 1967 aircraft burn where it was contained.

The distribution of suppression forces is listed in Table 7/5 At this time the fire perimeter was similar to the 9th, about 42 miles.

TABLE 7./5

DISPOSITION OF SUPPRESSION FORCES. 10th MARCH.

Sector	Flank	Length miles	Officers	Gangs	Pumpers	Bull-dozers.
Deeside Control						
1	East	2	2	2	2	1
2	north-west	5½	2	2	3	2
3	West	5		1	mopping up only	
4	south	10½	2	2	3	3
Airstrip Control						
1	south	3	1	1	1	1
2	south-east	3	1	2	2	1

CONT.

Sector	Flank	Length miles	Officers	Gangs	Pumpers	Bulldozers.
4 & 4A	South-East and East Flanks	9½	1	1	1	1
5	South	5	1	2	2	1
6 & 6A	North	4½	1	2	1	1
Control Centres			4			

13th DAY Tuesday 11th March.

The danger had eased considerably with cloudy conditions and showers. The airstrip control was dropped and mopping up was directed from Deeside. The forces listed in Table 9/5 were mopping up and no further comment has been made on this day or 12th regarding sectors.

TABLE 9/5

MOP - UP FORCE ON 11th MARCH.

Number	Type
3	Penberton sector officers
4	Deeside control officers
8	Officers (sector bosses plus assistants)
10	gangs
10	pumpers
5	bulldozers.

This force was engaged on mopping up the final fire perimeter as shown on the R.O.S. plan, a distance of about 42 miles.

14th DAY WEDNESDAY 12th MARCH.

Mopping up on 12th March continued with the force listed in Table 9/5

TABLE 9/5

MOP - UP FORCE ON 12th MARCH.

Number	Type
3	Deeside control officers.
8	Officers (sector bosses and assistants)
11	gangs
9	pumpers
10	bulldozers.

6. USE OF EQUIPMENT.

Table 10 shows the number of gangs and bulldozers working the fire each day and the approximate length of the fire's perimeter late that day. These lengths are very approximate and refer to the shortest distance around the perimeter rather than the length of fire edge, which was unknown.

Table 10 also provides an evaluation of suppression effort by listing the miles each gang and bulldozer must cover if the whole perimeter was to be controlled.

On the 7th March each gang and bulldozer was required to cover about half a mile and in fact the suppression force were within ½ mile of enclosing the fire that night. On the 8th and 9th, with similar peak red fire danger during the day, the length for each gang and bulldozer increased 2 to 3 times so it is not surprising that suppression failed to succeed.

When fire danger dropped to white, on the 10th, each gang and bulldozer were able to handle between 2½ and 3½ miles and suppression succeeded.

The method of attack during the 7th seems to require further investigation. Diagram 1 shown the position of dozed trails on the east flank and the forest type. On both breaks the bulldozers followed karri gullies through dense scrub, presumably along the edge of the fire, and especially on the south break across a steep slope. In both cases jarrah forest lay within half a mile, on high country, where the rate of forward progress of the bulldozer would have increased. It may then be desirable to give more time to the location of dozed breaks in easier forest types early in the attack, and naturally at the same time assess whether the parallel method with back firing will be likely to succeed. When the parallel method was adopted, on flank fire during the 8th, the rate of fire line construction seemed to be improved although this required further comment from the fire bosses involved.

Table 1/6

Date	Length of Perimeter miles.	Number of gangs	Number of Bulldozers	Miles for each gang	Miles for each dozer	Comment.
7th	5	8	7	0.6	0.7	Suppression nearly successful peak F.D. Red.
8	14	10	6	1.4	2.3	not successful peak F.D. Red.
9	18	9	10	2.0	1.8	Not successful
10	42	16	14	2.6	3.3	Successful peak F.D. white
11	42	10	8	4.2	5.2	mop-up.
12	42	11	10	3.8	4.2	mop-up.

a. Despatch.

Figure 2 shows the rate at which officers gangs and bulldozers arrived at the Boorara fire, after its detection at 1015 hrs on the 7th March. As expected gangs and officers arrived faster than bulldozers between 1400 hrs and 1600 hrs the numbers of gangs and bulldozers equalled that suggested by the karri despatcher tables, but for a two-hourly travel period.

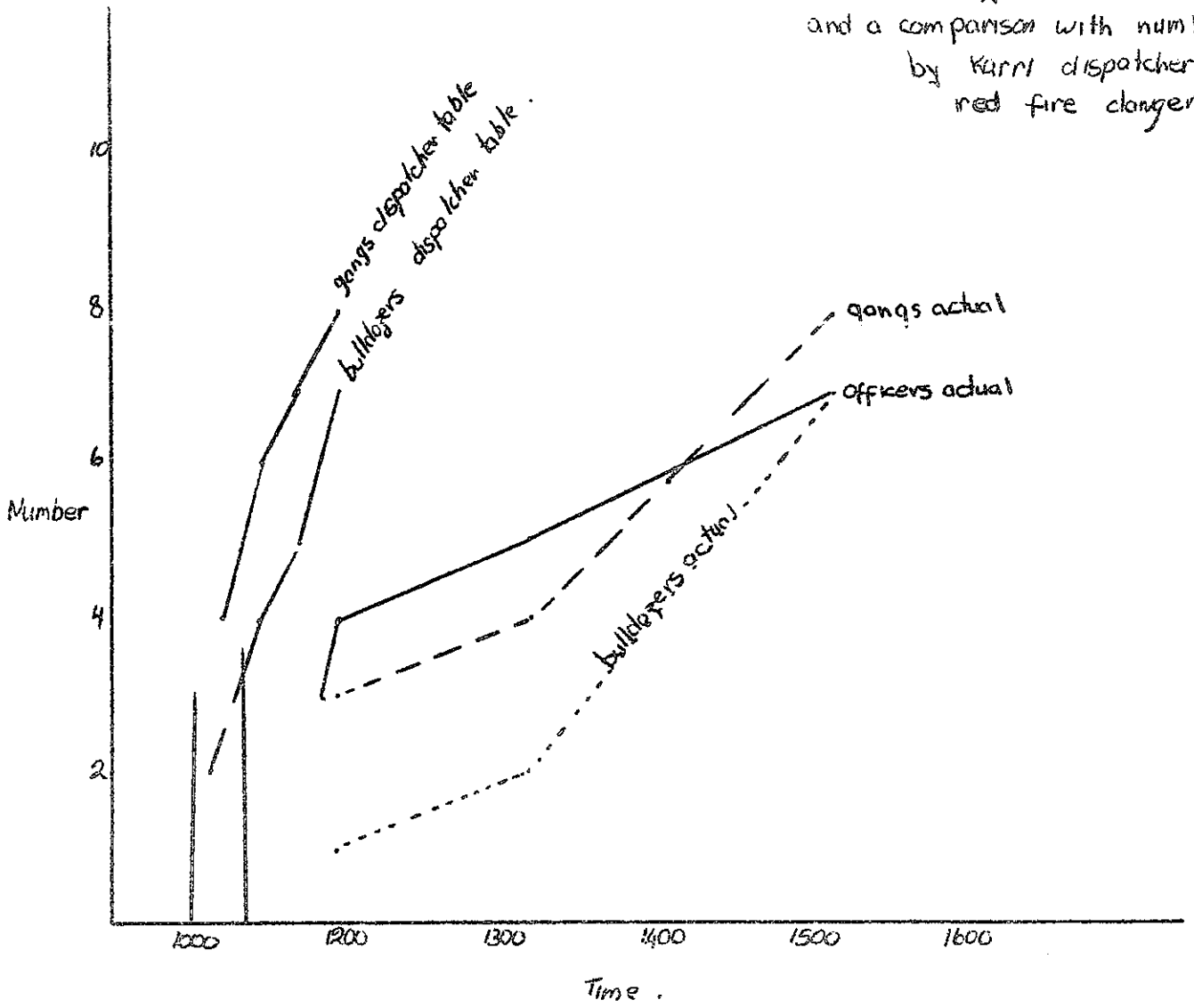
The delay of between 6 and 8 hours before the full force was assembled undoubtably contributed to the fire not being encircled that night. If this meeting feels that a two hourly arrival time is unrealistic for heavy bulldozers the despatcher table should be extended from 2 hours to whatever period is considered necessary.

b. Suppression Forces.

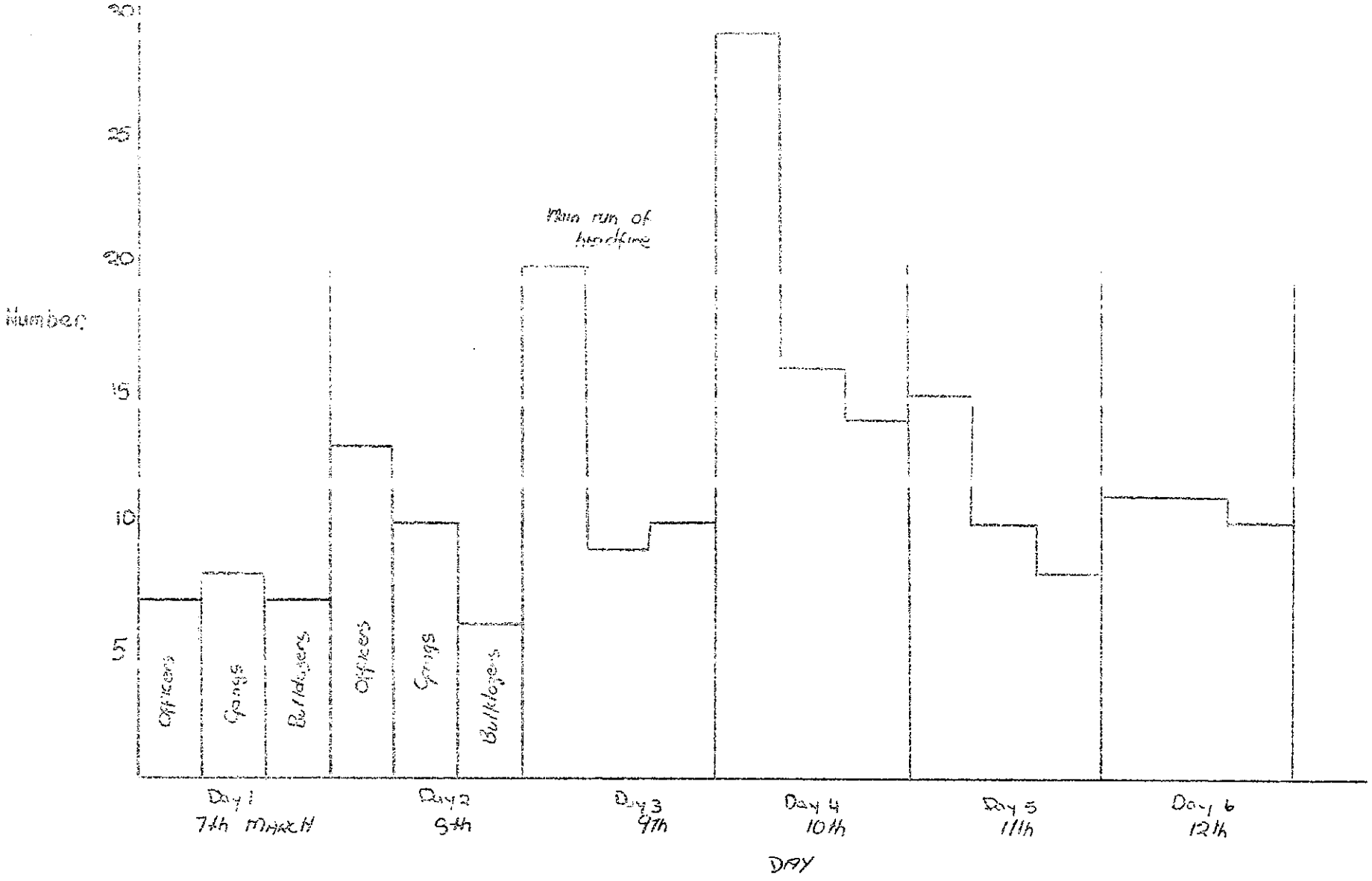
Figure 3 shows the number of officers, gangs and bulldozers on each day during the Boorara fire. The officers numbers include control both field and office. The main point on this table is that there was roughly equal numbers of gangs and bulldozers on the 7th and 9th but on the 8th dozer numbers were 60% of gang numbers, and although the numbers of both were increased on the 10th, successful suppression followed a marked drop in fire danger.

From these observations it is quite apparent that the size of the suppression force must be related to fire danger and whether one gang can control ½ to 3 miles of perimeter again depends on fire danger. The dispatch tables may need extending beyond 2 hourly travel times if bulldozer movement is to remain as slow as it was during this fire. Following this it should be possible to decide the desirable ratio between bulldozer and gang numbers in these heavy fuels, at present equal numbers seem to be required.

Dispatch to Boorara Fire
7th March
Showing numbers arriving at fire,
and a comparison with numbers suggested
by Kurri dispatcher table for
red fire danger.



Boorara Fire - Suppression force 7th to 12th March.
Officer numbers include Control
Gang and pumper numbers roughly equivalent



Sect 7. FOREST DAMAGE.

Three weeks after the fire, damage assessment was carried out from an aircraft over the Boorara fire area. The aircraft flew 40 chain wide lines north and south, and to observers recorded crown damage at 10 chain intervals along these lines.

The crown damage observations were listed in four classes: Defoliation, fully scorched, green crowns and flats. This information was plotted on 40 scale A.P.P. plans using flat positions as ties along the lines. This assessment was an attempt to produce a crown damage plan similar to that for the Dwellingup fire.

This plan has not been field checked yet so doubt less errors are present, but it should provide a reasonable assessment of the levels of crown damage and the acreages involved.

The acreages of crown damage are shown in Table 1/7 below:

TABLE 1/7.

FOREST DAMAGE IN THE BOORARA FIRE AREA.

Forest Type	Defoliation	Fully Scorched	Green Crowns	Total
Jarrah and Karri.	1706	7792	3338	12836
Flats				5032
FIRE TOTAL				17868

Table 1/7 shows approximately 13 per cent of the forest area as defoliated, 61 per cent fully scorched and 26 per cent retained green crowns.

Assuming that the recovery levels for the Dwellingup fire are reproducible, which is doubtful for karri, 30 per cent of the merchantable volume in the defoliated area should be fire killed and 12 per cent in the scorched area. Although these assumptions are doubtful the information is the best available at this time.

Working Plan's assessments in the area show the average merch volume per acre to approximate 14.9 loads per acre (jarrah and karri). With an area multiplier the total merch volume in the defoliated area should approximate 25,419 loads and that in the fully scorched 116,100 loads.

Reducing these volumes to that expected to be fire killed the volume in the defoliated area amounts to 7620 loads and the volume in the fully scorched to 13,932 loads giving a total of 21,552 loads.

The royalty value in this area is $2.60 per loads as the value of timber damge amounts 21,552 loads x $2.60 = $56,035.

Other investigations have indicated that as fire intensity increases so too does forest damage. In these investigations fire intensity described by I = 6 wr. Evidence from this may not be the case when wind velocity is the main variable affecting rate of forward spread.

In the area fuel quantity was reasonably constant so it has been assumed that 6 w in the above formula is constant.

In each of the spread areas shown on the R.O.S. plan the areas of defoliated, fully scorched, and green crown categories were extracted and expressed as a percentage of the total area in that section of the fire (including flats).

These percentages were plotted against rate of forward spread of headfire in Figure 1/7 below. There was no relationship for defoliation or green crowns but a good trend for fully scorched. This figure shows the percentage area of 'fully scorched' decreasing as rate of spread increased except at the highest and lowest rates recorded during the fire.

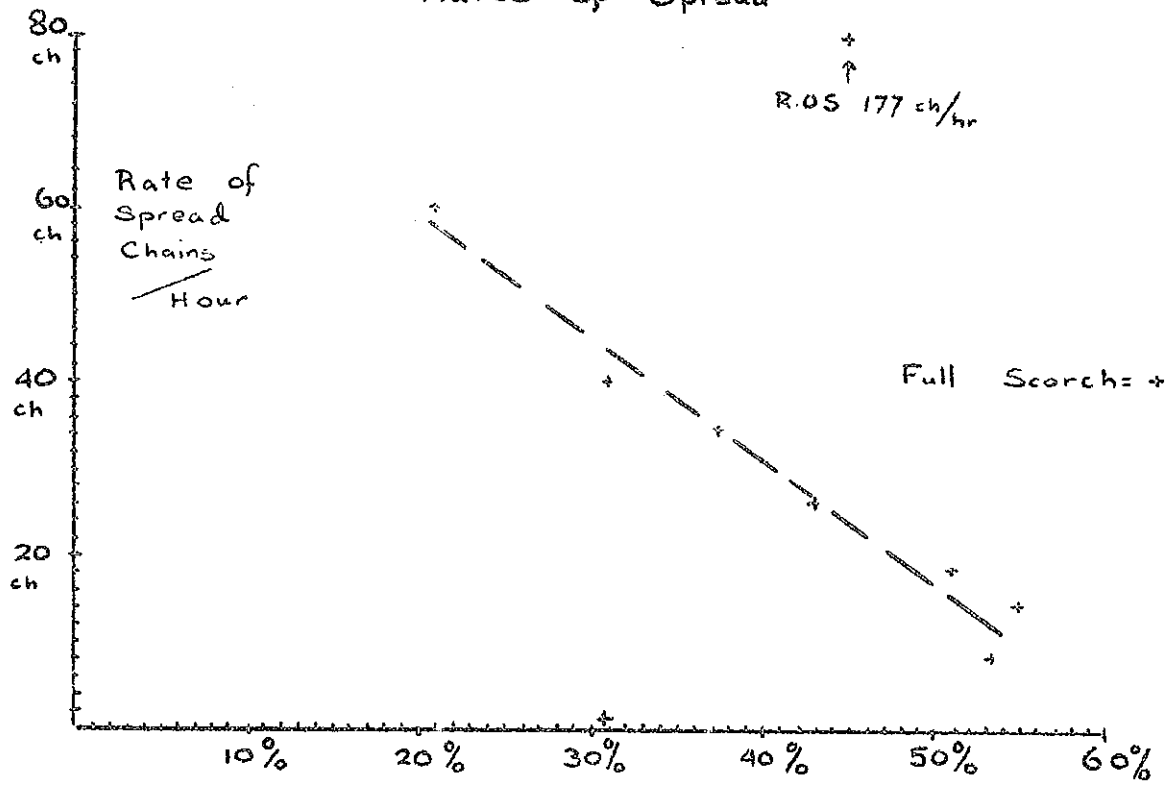
G.B.PEET.

FIRE RESEARCH OFFICER.

GBP:MDF
MANUMUP.
17:4:69

Fig. 1. 22

Percentage of scorch in Relation to Rates of Spread



Percentage of Fire Area Including Flats.

[illegible]

March 7th 8th 9th 10th 11th 1969.

Total Rainfall During Previous 3 Months.

PEMBERTON

JANUARY		FEBRUARY		MARCH	
Date	Amount	Date	Amount	Date	Amount
7	2 Pts	11	4	10	17
9	2	13	3		
13	22	17	1		
15	17	18	4		
17	8				
21	1				
24	6				
27	1				
30	6				
TOTAL	67 Points	TOTAL	12 Points	TOTAL	17 Points.

SHANNON RIVER.

JANUARY		FEBRUARY		MARCH	
Date	Amount	Date	Amount	Date	Amount
7	Trace	8	Trace	10	12
8	5	11	10		
13	10	15	1		
15	10	18	12		
17	2	24	2		
18	Trace				
21	2				
24	8				
27	3				
30	6				
TOTAL	52 Points	TOTAL	25 Points	TOTAL	12 Points

APPENDIX 1.

PEMBERTON FIRE No. 35.

TABLE 2. Pemberton Weather Data:-

March 7th, 8th 9th, 10th, & 11th 1969.

Date	Time	Temp	R.H. %	Basic Fire Hazard.	Adj Fire Hazard.	Winds	'Burnside' Fire Danger Rating 5 p.m. Jarrah	'Burnside' Fire Danger Rating 12+ Jarrah	Fire Danger Rating. 5 p.m. Karri	Fire Danger Rating. 12+ Karri
7/3/69	0800	58	62	3.6	3.6	N 16	0.84	1.34	1.43	2.38
	1000	71	31	8.5	8.5	NNW 12	4.03	12.09	14.30	26.19
	1200	97	18	9.4	9.4	N 20	10.50	31.20	37.80	68.25
	1400	100	14	9.7	9.7	N 10	7.89	23.67	28.40	51.28
	1500	93	22	8.7	8.7	WSW 8	3.68	11.04	13.24	23.92
	1600	83	29	7.7	7.7	SSW 8	2.62	8.03	9.55	17.27
8/3/69	0800	74	28	6.3	6.3	NNE 20	2.68	6.16	6.70	11.26
	1000	87	22	7.9	7.9	NNE 16	3.80	8.72	9.50	15.96
	1200	96	14	9.0	9.0	NW 18	8.04	25.12	28.90	52.20
	1400	82	49	6.1	6.1	W 15	1.81	4.16	4.53	7.60
	1500	80	52	5.7	5.7	SW 20	2.10	5.36	5.87	9.64
	1600	80	55	5.7	5.7	WSW 20	2.18	5.49	5.97	9.82
	1800	75	57	5.1	5.1	WSW 12	1.05	1.48	1.78	2.98
9/3/69	0800	63	90	2.1	2.1	WNW 6	0.28	0.48	0.48	0.78
	1000	70	52	4.7	4.7	WSW 5	0.60	0.96	1.02	1.68
	1200	75	46	5.8	5.8	N 25	4.69	7.50	7.97	13.13
	1400	79	37	6.1	6.1	WNW 35	27.07	43.31	46.01	75.77
	1500	61	82	2.1	2.1	W 30	12.19	19.50	6.85	24.12
	1600	62	94	1.8	1.8	WNW 30	10.35	16.56	7.53	23.06
10/3/69	0800	58	94	1.4	1.4	WSW 15	0.02	0.03	0.04	0.07
	1000	62	78	2.8	2.8	SW 10	0.22	0.35	0.02	0.04
	1200	63	67	3.5	3.5	SW 18	0.50	0.70	0.09	0.25
	1400	64	69	3.5	3.5	WSW 12	0.28	0.45	0.11	0.30
	1500	64	67	3.3	3.3	WSW 10	0.24	0.38	0.09	0.25

Table 2 - Shannon River Weather Data

March 7th. 8th. 9th. 10th. 11th. 1969

Date	Time	Temp°	R.H.%	Basic Fire Hazard	Adjusted Fire Hazard	Winds Burnside	Fire Danger Rating 5 y/o Jarrah	Fire Danger Rating 12 + Jarrah	Fire Danger Rating 5 y/o Karri	Fire Danger Rating 12 + Karri
7.3.69	0800	77	49	5.6	5.6	N 16	1.81	2.89	3.07	5.07
	1000	88	31	7.7	7.7	NNW 12	2.88	6.60	7.20	12.10
	1200	96	23	8.9	8.9	N 20	7.64	22.90	27.50	49.66
	1400	96	37	8.2	8.2	N 10	3.10	9.30	11.15	20.15
	1600	90	41	7.4	7.4	SSW 8	2.40	5.52	6.00	10.10
	1700	86	48	6.6	6.6	SSW 8	1.60	3.68	4.00	6.72
8.3.69	0800	71	49	5.0	5.0	NNE 20	1.93	3.08	3.28	5.40
	1000	84	34	7.0	7.0	NNW 16	2.85	6.55	7.12	11.97
	1200	95	24	8.7	8.7	NNW 18	7.20	21.60	26.00	46.80
	1400	96	25	8.8	8.8	W 15	6.20	18.60	22.32	40.30
	1500	88	37	7.3	7.3	SW 20	4.25	9.80	10.62	17.85
	1700	85	38	6.9	6.9	WSW 16	2.93	6.73	7.32	12.30
9.3.69	0800	67	89	2.5	2.5	WNW 6	0.37	0.59	0.63	1.04
	1000	68	79	3.1	3.1	WSW 5	0.40	0.64	0.68	1.12
	1200	75	56	5.0	5.0	N 28	4.00	6.40	6.80	11.20
	1400	67	46	4.7	4.7	WNW 50	22.20	35.52	37.74	62.16
	1600	NR	NR	NR	4.7	W 50	22.20	35.52	37.74	62.16
	1800	NR	NR	NR	4.7	W 50	22.20	35.52	37.74	62.16
10.3.69	0800					WSW 13				
	1000	62	94	1.8	0.4 K 0.8 J	SW 10	0.09	0.14	0.02	0.03
	1200	64	73	3.0	0.7 K 1.4 J	SW 18	0.46	0.73	0.11	0.14
	1400	64	73	3.0	0.7 K 1.4 J	WSW 12	0.26	0.34	0.07	0.09
	1600	63	78	2.6	0.6 K 1.2 J	SW 6	0.16	0.26	0.02	0.03