FUEL MOISTURE CALCULATION PROCEDURES

Moisture Content in tables is based on percent Oven Dry Weight of fuel

SURFACE MOISTURE CONTENT (SMC)

Note: (i) Maximum SMC applies to value at about 0800 hrs;

(ii) Table values apply to fuels within northern jarrah forests. The S.M.C's for other major forest types are derived in Table 5.

Tabulation Order

1. Use TABLE 1 to derive today's maximum SMC if rain recorded up to 0800 hrs. See Columns 8, 9 and 10

2. Use TABLE 2 instead of Table 1 if no rain has fallen before 0800 See Columns 8, 9 and 10

3. Use TABLE 3 to obtain the Basic Drying Unit (B.D.U) for use in Table 4. See Column 6

4. Use TABLE 4 to derive today's minimum SMC following day drying. See Columns 11, 12, 13 and 14.

5. Use TABLE 5 to derive maximum and minimum SMC for other fuel type based on northern jarrah SMC. See Columns 15 to 20.

6. SMC values for times between 0800 and 1500 hrs can be derived from the nomogram. (Figure 1)

PROFILE MOISTURE CONTENT (PMC)

Note: (i) PMC calculations are only required for southern forest types or where fuel bed depths exceed 15 mm.

(ii) PMC table values apply to fuels of Karri Scrub Types 4 and 5. The PMC's for other southern types are derived in the right hand side of Table 6.

1. Use TABLE 1 to derive today's maximum PMC if rain recorded up to 0800 hrs. See Columns 23 and 24.

2. If no rain recorded up till 0800 hrs, let yesterday's minimum PMC be today's maximum PMC (i.e no PMC change overnight). See Columns 22 and 24.

3. Use left side of TABLE 6 to derive today's minimum PMC following drying. See Columns 25 and 26, or 27 and 28.

4, Right side of TABLE 6 provides adjustments for derivation of PMC for other southern forest types.

AVAILABLE FUEL FACTOR (AFF)

Use Table 7 to derive the AFF from the calculated SMC and PMC values for each particular forest type. See Column 29.

Daily Moisture Content Record Sheet

Station

Year 19......

No.	Section	Item	For/Act or Max/Min	Table							
1		Date,(Month. Day)									
2	8 am Read-ing	Rain (mm) or Dew									
3	8 am Read-ing	Overnight RH count									
4		Max. temp. °C	For / Act								
5		Min. RH%	For / Act								
6		Basic Drying Unit	For / Act	T.3							
7	N.Jarrah Surface MC%	Fuel Type			Nth Jar	Nth Jar	Nth Jar	Nth Jar	Nth Jar	Nth Jar	Nth Jar
8	N.Jarrah Surface MC%	Min. SMC Yesterday									
9	N.Jarrah Surface MC%	Rain or o/night RH Count Correction		T.1 or T.2							
10	N.Jarrah Surface MC%	Max. SMC at 8 a.m									
11	N.Jarrah Surface MC%	Drying Correction	For. / Act.	T.4							
12	N.Jarrah Surface MC%	Min. SMC % at 3 p.m	For. / Act.								
13	Southern Fuels SMC %	S. Jarrah	Max / Min	Table 5							
14	Southern Fuels SMC %	Karri 3&6	Max / Min	Table 5							
15	Southern Fuels SMC %	Karri 4&5	Max / Min	Table 5							
16	Southern Fuels SMC %	Karri 1&2	Max / Min	Table 5							
17	Southern Fuels SMC %	Slash	Max / Min	Table 5							
18	Karri 4&5 Profile MC%	Fuel Type			Kar 4&5	Kar 4&5	Kar 4&5	Kar 4&5	Kar 4&5	Kar 4&5	Kar 4&5
19	Karri 4&5 Profile MC%	Min. PMC % Yesterday									
20	Karri 4&5 Profile MC%	PMC % Rainfall Correction		T.1							
21	Karri 4&5 Profile MC%	Max. PMC % at 8 a.m									
22	Karri 4&5 Profile MC%	PMC Drying Correction	For / Act	T.6							
23	Karri 4&5 Profile MC%	Min. PMC % K 4&5 at 3 p.m	For / Act								
24	Other PMC%	Min. PMC % S. Jarrah		T.6							
25	Other PMC%	Min. PMC % Karri 3&6		T.6							
26	Other PMC%	Min. PMC % Karri 1&2		T.6							
27	Avail Fuel Fact	S. Jarrah		Tabl							
28	Avail Fuel Fact	Karri 3&6		Tabl							

For. = Forecast   Act. = Actual

TABLE 1 JARRAH RAINFALL CORRECTION TABLE

Use this table only if rain recorded at 0800 hrs. otherwise use Table 2

Yesterday's Minimum Moisture Content %	Rainfall amount recorded at 0800 hrs (mm)									
	0.1 to 0.3	0.4 to 1.0	1.1 to 2.0	2.1 to 3.0	3.1 to 6.0	6.1 to 8.0	8.1 to 18.0	18.1 to 35.0	35.1 to 50.0	50.1 plus
	Moisture Content Addition %									
5 - 20	10	16	27	38	55	80	95	115	135	145
21 - 40	8	12	20	30	45	70	85	105	125	135
41 - 60	5	8	15	23	35	55	75	95	110	120
61 - 80	2	5	10	17	25	45	60	80	100	110
81 - 120	0	3	6	11	18	30	45	65	80	90
121 - 160	0	0	3	6	10	20	35	50	65	70
161 +	0	0	0	3	6	12	25	35	45	55

1. Calculate rainfall correction % from rain amount (mm) and Yesterday's minimum moisture content % (Y.M.C). Record in column 9
2. Add correction to Y.M.C. to give today's Maximum Moisture content %, and record in column 10
3. Go to Table 3.

TABLE 2 JARRAH SURFACE MOISTURE CHANGE DURING RAINLESS NIGHTS

Yesterday's Minimum S.M.C. %	Overnight Relative Humidity Count (Read at 0800 hrs)					
	0-20	21-40	41-60	61-80	81-100	101+, or Dew
	Overnight SMC Change %					
3 - 7	+ 3	+ 6	+ 9	+12	+15	+17
8 - 12	0	+ 3	+ 5	+ 9	+13	+14
13 - 17	- 2	+ 1	+ 5	+ 8	+11	+13
18 - 22	- 3	0	+ 3	+ 6	+ 9	+11
23 - 27	- 5	- 2	+ 1	+ 4	+ 7	+ 9
28 - 33	- 8	- 5	- 1	+ 2	+ 5	+ 7
34 - 40	-10	- 7	- 4	- 1	+ 3	+ 4
41 - 50	-16	-12	- 8	- 4	- 1	+ 2
51 - 60	-21	-17	-13	- 9	- 5	- 1
61 - 80	-27	-23	-19	-14	-10	- 6
81 - 100	-33	-29	-24	-19	-14	-11
101 - 120	-38	-33	-28	-23	-18	-15
121 - 150	-43	-38	-33	-28	-22	-19
151 +	-48	-43	-37	-32	-26	-23

1. Calculate overnight surface moisture change %, from overnight RH count and Yesterday's minimum SMC % (Y.M.C) Record in column 9
2. Apply correction to Y.M.C to give today's maximum S.M.C % and record in column 10.
3. If the overnight RH count reading is not available then:
   (i) add by 5 percent if YMC is less than 40 percent,
   or (ii) subtract by 20 percent if YMC is greater than 40 percent
4. Go to Table 3.

TABLE 3 BASIC DRYING UNIT (B.D.U)

B.D.U. is a measure of day drying effect.

Max. Temp. °C	Minimum Relative Humidity (%)														
	90	80	70	65	60	55	50	45	40	35	30	25	20	15	10
8	1	3	4	5	6	7	8	8	9						
10	2	4	6	6	7	8	9	9	10						
12	3	5	7	8	8	9	10	11	12						
14	5	6	8	9	10	10	11	12	13						
16	6	8	10	11	11	12	13	14	14	15					
18	7	9	11	12	12	13	14	15	15	16	17	18			
20	9	10	12	13	14	14	15	16	17	18	18	19	20	21	
22	10	12	14	15	15	16	17	17	18	19	20	21	21	22	23
24		13	15	16	16	17	18	19	19	20	21	22	22	23	24
26			16	17	18	18	19	20	21	22	22	23	24	25	25
28				18	19	20	20	21	22	23	24	24	25	26	27
30				19	20	21	22	23	23	24	25	26	26	27	28
32				21	22	22	23	24	25	26	26	27	28	29	29
34				22	23	24	24	25	26	27	27	28	29	30	30
36					24	25	26	27	27	28	29	30	30	31	32
38					25	26	27	28	28	29	30	31	32	32	33
40						27	28	28	29	30	31	32	32	33	34

1. Calculate BDU from max. temperature and min RH% and record in Column 6.
2. Apply the BDU in Table 4 below

TABLE 4 JARRAH SURFACE MOISTURE DAY DRYING CORRECTION

Today's Max (0800 hrs) SMC %	Basic Drying Units							
	1-4	5-8	9-12	13-16	17-20	21-24	25-28	29 +
	Day Drying Correction %							
7 - 11	+6	+4	+2	+1	-1	-3	-4	-6
12 - 16	+3	+1	-1	-2	-4	-6	-8	-10
17 - 21	+1	-1	-3	-5	-6	-8	-10	-12
22 - 27	-1	-3	-5	-7	-9	-11	-13	-15
28 - 33	-2	-5	-7	-9	-11	-13	-15	-18
34 - 40	-4	-6	-9	-11	-13	-15	-18	-20
41 - 60	-7	-9	-12	-14	-16	-19	-21	-24
61 - 80	-10	-12	-15	-18	-20	-23	-25	-28
81 - 120	-15	-17	-20	-23	-25	-28	-31	-34
121 - 160	-21	-24	-27	-30	-33	-36	-38	-42
161 +	-30	-34	-37	-40	-44	-47	-50	-54

1. Calculate SMC day-drying correction % using the BDU and Today's max. SMC%. Record in Column 11 or 13.
2. Deduct or add correction to today's max. SMC % to give the min SMC (Jarrah) today. Record in Column 12 or 14.

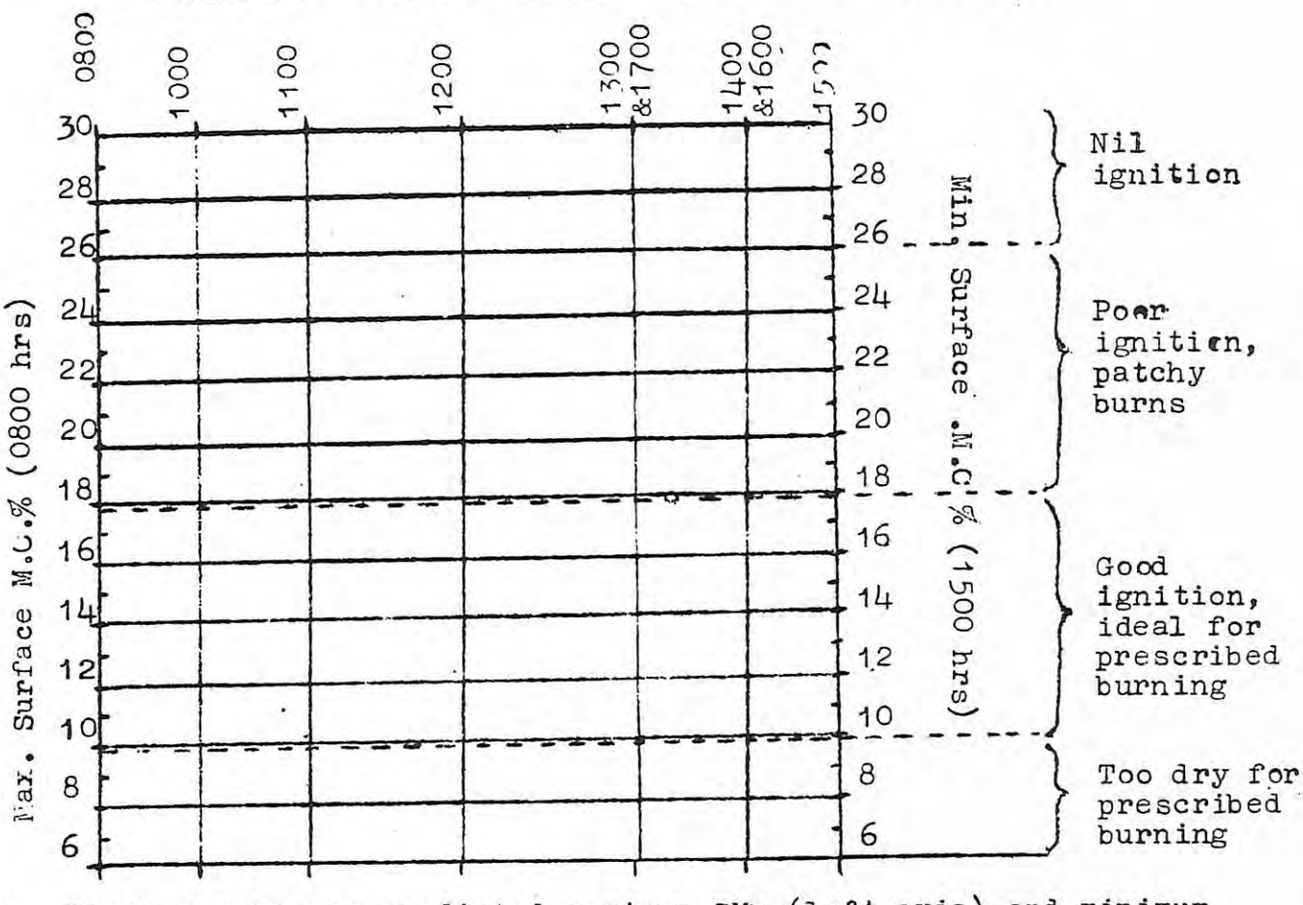
2 If Min. SMC is Less Than 3% [illegible]

TABLE 5 SURFACE MOISTURE ADJUSTMENTS FOR OTHER MAJOR HARDWOOD FUEL TYPES IN MC %

Nth Jarrah SMC (%)	S.Jarrah J, JM	Karri 3&6 KM, KMJ	Karri 4&5 KM, K dom.	Karri 1&2 K. dom.	Open Slash
		Surface Moisture Content Adjustments %			
4 - 6	+1	+2	+3	+5	0
7 - 9	+1	+2	+4	+7	-1
10 - 12	+1	+3	+6	+8	-2
13 - 15	+2	+4	+7	+10	-3
16 - 20	+2	+5	+9	+13	-5
21 - 30	+3	+6	+13	+17	-7
31 - 40	+4	+7	+19	+23	-10

1. Enter Table 5 with max. or min. Northern Jarrah SMC % and obtain SMC adjustment % for appropriate fuel types.
2. Make adjustment to N. Jarrah SMC % to yield SMC % for particular fuel types. Record these in Columns 15 to 20.

NOMOGRAM: SURFACE MOISTURE CONTENT DURING DAY %



1. Place a ruler on predicted maximum SMC (left axis) and minimum SMC (right axis)
2. Read off the expected SMC at the intersection of the ruler at the required time(s) during the day, or read off the time of day that SMC will be suitable for prescribed burning.

TABLE 6 PROFILE MOISTURE CONTENT
KARRI PROFILE DAY-DRYING CORRECTION PLUS PMC ADJUSTMENT FOR OTHER SOUTHERN FOREST TYPES

NB. See instruction on calculating Profile Moisture Content

Today's Max.(0800) PMC for Karri 4+5	Basic Drying Units							Fuel Type Adjustment		
	1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30	31 plus	Southn. Jarrah (JM)	Karri 3+6 (KM)	Karri 1+2 (K)
%	PMC Drying Correction %									
5 - 10	+2	+2	+1	0	0	0	-1	- 3	0	+ 3
11 - 15	+1	+1	0	-1	-1	-2	-2	- 4	- 1	+ 5
16 - 20	0	0	-1	-2	-3	-4	-5	- 5	- 2	+ 6
21 - 30	0	-2	-3	-4	-5	-6	-7	- 8	- 4	+ 9
31 - 40	-1	-3	-4	-5	-7	-8	-9	-10	- 7	+12
41 - 60	-2	-4	-5	-7	-9	-10	-12	-15	-10	+18
61 - 80	-3	-5	-7	-9	-11	-13	-15	-20	-15	+20
81 - 120	-3	-6	-8	-10	-13	-15	-17	-25	-20	+25
121 - 160	-4	-7	-10	-12	-15	-17	-20	-25	-20	+25
161 +	-5	-9	-12	-15	-18	-21	-24	-25	-20	+25

1. Calculate PMC day drying correction % for Karri types 4+5, using the Basic Drying Unit and today's max. PMC % for Karri 4+5. Record in Column 25 or 27.
2. Deduct or add correction to today's max. PMC % (4+5) to obtain the minimum PMC % today. Record in Column 26 or 28.
3. Then obtain PMC for other Southern forest types by applying adjustments on R.H.S. of table.

NB Use Table 1 to determine the PMC change following rain (Col.23). If no rain is recorded to 0900 hrs, then Max. PMC is equal to yesterday's Min. PMC.

TABLE 7 AVAILABLE FUEL FACTOR (AFF)

Defines proportion of LITTER fuel available for burning

Litter

Surface Moisture Content (%)	Profile Moisture Content %									
	10-14	15-19	20-24	25-30	31-40	41-60	61-80	81-120	121-160	161 +
4 - 6	B	B	1.0	0.9	0.9	-	-	-	-	-
7 - 9	B	B	1.0	0.8	0.7	0.6	0.5	0.4	0.3	0.3
10 - 12	B	A	1.0	0.8	0.6	0.5	0.4	0.3	0.3	0.2
13 - 15	B	A	1.0	0.7	0.5	0.4	0.3	0.3	0.2	0.2
16 - 18	A	A	1.0	0.6	0.4	0.3	0.2	0.2	0.2	0.1
19 - 21	A	1.0	0.9	0.5	0.4	0.3	0.2	0.1	0.1	0.1
22 - 25	A	1.0	0.8	0.5	0.3	0.2	0.1	0.1	0.1	0.1
26 +	-	-	-	-	-	-	-	-	-	-

1. Enter table with the predicted Surface and Profile Moisture Contents % for the particular fuel type.
2. Read off the Available Fuel Factor (i.e. the fraction of fuel that is available to burn). Record in Column 29.

NB Prescribed burning is most successful when the AFF is between 0.3 and 0.8 inclusive.
Indices A and B equal 1.0 and represent dangerously dry fuel conditions.

67

(5-6 old)

TABLE 15 KARRI RATE-OF-SPREAD INDEX

1. Apply Surface Moisture Content and Tower (or ground) Wind Velocity for appropriate fuel types.
2. Read off the Rate-of-Spread Index for 15-19 tonnes/hectare of Total Available Fuel Quantity.

Fuel Types	Tower Wind Velocity - (Kilometres per hour)									
Sth Jarrah	0-3	4-6	7-10	11-14	15-18	19-22	23-26	27-30	31-34	35+
Karri 3&6	0-4	5-9	10-14	15-19	20-24	25-28	29-32	33-36	37-40	41+
Karri 4&5	0-5	6-10	11-16	17-22	23-27	28-33	34-38	39-43	44-48	49+
Karri 1&2	0-6	7-13	14-20	21-28	29-35	36-42	43-49	50-56	57-63	64+
	Ground Wind Velocity - (Kilometres per hour)									
All Types	0-0.7	0.8-1.5	1.6-2.3	2.4-3.1	3.2-3.9	4.0-4.7	4.8-5.5	5.6-6.3	6.4-7.1	7.2+

SMC%	Rate of Spread (metres/hour)									
27 +	-	-	-	-	-	-	-	-	-	-
26	6	9	12	15	19	24	31	39	50	64
25	7	10	13	16	20	26	34	42	55	70
24	8	10	13	17	22	29	37	46	60	77
23	8	11	14	18	23	31	40	50	66	84
22	9	11	15	19	25	33	43	54	72	92
21	9	12	16	20	27	35	47	59	78	102
20	10	12	17	22	29	38	51	64	86	115
19	10	13	18	24	31	42	55	70	94	125
18	11	14	19	26	34	46	61	78	105	140
17	11	15	21	28	38	50	67	88	118	158
16	12	17	23	30	42	56	75	100	135	180
15	13	18	25	33	46	62	84	110	150	205
14	14	20	27	37	50	69	95	125	175	238
13	15	21	29	40	55	76	105	138	190	265
12	17	23	32	44	61	84	118	155	215	300
11	19	26	36	50	70	96	133	180	250	340
10	21	29	40	57	80	110	155	205	290	400
9	23	33	46	65	90	128	180	240	340	480
8	26	37	53	74	105	150	210	280	400	570
7	30	43	62	88	125	175	250	340	490	700
6	36	52	74	105	150	215	310	420	600	860
5	44	63	90	130	185	265	380	530	760	1150
4	55	80	118	170	245	350	510	710	1000	1500
3	75	110	160	230	340	490	700	1000	1400	2000

White, Purple, Green, Blue, Brown, Yellow, Orange, Pink, Red

TABLE 16 KARRI FUEL QUANTITY CORRECTION

Select known Total Fuel Quantity (include litter, trash and scrub fuels) and the Available Fuel Factor and read off the Fuel Correction Factor.

Total Fuel Quantity Tonnes/ha	Available Fuel Factor 0.1 to 0.2	0.3 to 0.8	0.9 to 1.0	'A'	'B'
6 - 11	0.6	0.7	0.9	1.1	1.3
12 - 17	0.6	0.8	1.0	1.2	1.5
18 - 23	0.7	0.8	1.1	1.3	1.6
24 - 29	0.8	0.9	1.2	1.4	1.8
30 - 35	0.9	1.0	1.3	1.5	2.0
37 - 43	0.9	1.1	1.3	1.6	2.2
44 - 50	1.0	1.2	1.4	1.8	2.4
51 - 57	1.1	1.3	1.5	1.9	2.6
58 +	1.2	1.4	1.6	2.0	2.8

ADJUSTED RATE OF SPREAD = Rate of Spread Index x Fuel Correction Factor

TABLE 10 SLOPE CORRECTION FACTOR

Slope in Degrees	Slope Correction
-10	0.6
- 5	0.8
Level	1.0
+ 2	1.1
+ 4	1.3
+ 6	1.5
+ 8	1.7
+10	2.0
+15	2.8
+20	4.0

To correct the Rate of Spread Index for headfire slope, multiply spread index by slope correction.

TABLE 18 FUEL-CORRECTED RATE OF SPREAD AND SCORCH HEIGHT

Maximum Scorch Ht. Metres	Total Available Fuel Quantity (Tonnes/ha) 5-9	10-14	15-19	20-27	28-35	36-44	45+
4 m	11 13 14 16 18 Four 19 21	11 12 14 16 18 19 Six 21 23	10 12 14 16 18 20 22 24 26	11 13 15 18 20 22 24 Nine 26	10 12 14 17 19 22 24 26 Twelve 29	10 13 16 18 21 23 26 28 Fifteen 31	10 12 15 18 21 24 27 30 33 36
6 m	22 24 25 27 29 30 32 34 35 37	25 27 29 31 32 34 36 38 40 41	28 30 32 34 36 38 40 42 44 46	29 31 33 35 37 40 42 44 46 48	31 34 36 38 41 43 46 48 50 53	34 36 39 42 44 47 50 52 55 57	39 42 45 48 51 54 57 60 63 66
9 m	38 40 42 Nine 43 45 46 48 50 51 53 54 56	43 45 47 49 50 52 54 56 58 59 61 63	48 50 52 Twelve 54 56 58 60 62 64 66 68 70	50 53 55 57 Fifteen 59 61 63 66 68 70 72 75	55 58 60 62 Twenty plus 65 67 70 72 75 77 79 82	60 63 65 68 70 73 76 78 81 83 86 89	69 72 75 78 81 84 87 90 93 96 99 102
12 m	58 59	65 66	72 74	77 79 81	84 86 89	91 94 96	105 108 112

15 20+

Instructions

1) Enter Table 18 with known total fuel quantity and required scorch height

2) Read off applicable rate of spread range by moving down the fuel column until the desired scorch height is encountered.

3) Transfer this across to the column of the standard fuel type (15-19 tonnes/ha) and read off the corresponding karri Rate of Spread Index.

DEFINITIONS

SURFACE MOISTURE CONTENT - the moisture content based on Oven Dry Weight of the top (5 to 10 mm) of leaf litter.

PROFILE MOISTURE CONTENT - the moisture content (O.D.Wt.) of the entire leaf litter bed above the mineral soil surface.

AVAILABLE FUEL FACTOR - the proportion of the litter bed that is available to burn.
TOTAL AVAILABLE FUEL QUANTITY - the sum of the fuel quantity of the Litter, Trash and Scrub Fuels that is available to burn.

OVERNIGHT RELATIVE HUMIDITY COUNT - represents the area enclosed by the overnight RH trace (to 0800 hrs) and the 70 percent RH level. The area is made up of basic unit squares of 2% RH by 2 hours duration.

BASIC DRYING UNIT (BDH) is obtained from the daily forecasted Maximum Temperature and Minimum Relative Humidity. Thus the B.D.U. is a measure of the day drying effect.

SCRUB STRUCTURAL TYPES - designated by numbers 1 to 6, each of which represents a unique foliage density - height profile.

FUEL TYPES

Northern Jarrah - represents the fuel type common to the Jarrah dominant forests which carries a sparse, low scrub component.

Southern Jarrah (Type 6) represents the fuels common to the Jarrah dominant and Jarrah-Marri associations and usually carries a low (1m) dense understorey.

Karri 3&6 - found in the JM and KM associations and carries a low (up to 2m) dense scrub layer.

Karri 4&5 - found in the KM and K dominant forest types and carries a tall (up to 5m) dense scrub layer.

Karri 1&2 - found in the K dominant forests and usually in wet, gully situations. The scrub type is tall (greater than 5 m) and dense.

FIRE RATE OF SPREAD INDEX - the maximum rate of spread predicted from wind speed and surface moisture content for level topography, 60% crown cover and standard fuel conditions for each forest type namely:

STANDARD FUEL TYPES

Jarrah: Five year old (i.e. five leaf falls) fuel ranging from 7.6 to 8.5 tonnes/ha

Karri: Five year old fuels which carry a total of 30 to 35 tonnes/ha of litter, trash and scrub fuels, or 15-19 tonnes/ha of available fuel.