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FORESTRY DEPARTMENT
OPERATIONS MANUA

PRESCRIBED BURNING IN
EXOTIC PINE PLANTATI S

FORESTRY

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PRESCRIBED BURNING – SLASH PINE PLANTATION

*** INTRODUCTION ***

The first experimental burning in slash pine plantation was carried out at Toolara in 1967. Work since then has been directed at assessing the effects of burning on the plantation and at developing fire behaviour tables to be incorporated into a burning guide. All experiments have been consistent in the finding that there is no increment disadvantage caused by burning except where crown scorch occurs. Growth loss due to scorching is directly related to the proportion of the crown which is defoliated by scorching. Properly supervised and conducted, prescribed burning can be done with a minimum of scorch, and whereas scorch may be undesirable and it must remain the objective to keep it to a minimum, its only significant effect is a short-term reduction in growth. Approximately 3500 hectares of slash pine and caribaean pine were burnt at Tuan, Toolara, Beerburrum and Byfield during the winter of 1975, and with the exception of a few compartments where bad scorch occurred, results were excellent. In almost every instance where scorch occurred, inexperience on the part of the lighting crew was responsible rather than selection of inappropriate burning conditions by the officer supervising the operations. It is the purpose of this manual to correct some of the deficiencies in burning techniques which were apparent in routine burning operations during the 1975 winter.

* * * PRINCIPLES OF PRESCRIBED BURNING * * *

Prescribed burning may be carried out for a variety of management objectives.

(1) To establish a system of burnt buffer strips throughout the larger plantation areas, supplementing the existing protection system.

(2) To protect small isolated plantations such as Luttons, Gatton, which are outside the normal protection system of the manned forest stations and where both the unit cost of protection and the fire risk is high.

(3) To strengthen the external firebreak system in those sections where maintenance is difficult or expensive due to the existence of swamps etc.

(4) Hazard reduction in high risk areas e.g. along main roads, railways, access routes to spots popular with the public for recreational purposes such as fishing, camping etc.

(5) Reduction in tending costs, particularly in areas subject to infestation by lantana.

(6) To eliminate the risk in clearing and burning included areas.

(7) To improve access in the plantation to facilitate carry-up pruning and thinning.

* * * SELECTION OF AREAS * * *

The first principle in the location of buffer strips is obviously to locate them such that the maximum fire protection benefit will be obtained from them. Plantation age need not be considered in the design stage, but will determine when the buffer might actually be burnt. It is preferable to select locations which will provide the maximum length of buffer strip per unit area burnt by choosing narrow compartments where possible. Design should attempt to include the compartments on both sides of a major access road such that each side may be burnt alternately.

Areas which should be avoided where possible include –

(1) Compartments which contain experiments which are to be protected. This adds considerably to the cost and organisational difficulty of the burn.

(2) Compartments which contain hoop pine underplanting.

(3) Areas difficult or costly to isolate from adjoining swamps or young plantation.

(4) Areas of poor site index, low stocking.

(5) Areas which contain difficult fuel types unless there is a particular requirement for fuel/understorey reduction in such areas.

All burning proposals should be submitted to Head Office on 169/3/2 District in sufficient time to allow the Fire Protection Officer and/or Fire Research Forester to inspect the areas where necessary before approvals may be issued.

* * * FUEL TYPES * * *

The fundamentals of fire behaviour in slash pine fuel types are little different from those in any other fuel type, and the influence of climatological and meteorological factors can be modelled quite successfully. The effect of fuel type is not so readily demonstrated, and because of the heavy fuel quantities involved and the more precise nature of burning operations in plantation compared with burning in native forest, definition of broad fuel types and the influence they exert on fire behaviour is consequently very important.

Fuel typing has been based on structural characteristics, mainly litter suspension and species composition of the associated understorey vegetation. Five fuel types have been defined.

Fuel Type 1. – Fuel suspension on less than 50% of the area.

Understorey species cover less than 50 percent of the area. Fuel consists of a moderately compacted litter layer forming a continuous fuel layer which produces very uniform fire behaviour. Fuel quantity may exceed 18 tonnes per hectare. Surface needles dry out fairly quickly after rain but the lower profile of the fuel bed is much slower drying because of the compressed litter. Fuel consumption in burns carried out soon after rain may be as low as 20 to 30 percent, yet still give 100 percent burn coverage. The type is a simple one to burn owing to the uniform nature of the fuel, and flaring is not a problem. This type may become invaded with wild passion vine, couch grass or rain forest species such as Smilax, Austromyrtus etc. which delays drying even further, and such fuel types often remain as unburnt patches after an otherwise perfect burn.

Fuel Type 2. – Fuel suspension on 50 to 80% of the area.

Understorey species cover 50 to 80 percent of the area, creating a suspension of litter to a depth ranging from 15 cm to 45 cm. Fuel quantity may vary from 10 t/ha in areas where kangaroo grass (Themeda) predominates to 17 t/ha in areas where grass tree (Xanthorrhoea) predominates. This type dries fairly rapidly after rain, particularly grassy sub-types or on exposed edges. Some flaring occurs, but fire behaviour is quite uniform in this fuel type and it presents little problem. Fuel type 2 is the most common fuel type in most slash pine plantations, and the fire behaviour tables are based on observations made in this average fuel condition.

Fuel Type 3. – Fuel suspension on 80% or more of the area.

Heavy understorey of grass tree or sedges occurs on 80% or more of the area and fuel quantity normally exceeds 16 t/ha. Litter is suspended for an average depth of 45 cm, but may exceed 100 cm in very heavy fuels. Drying is usually rapid on exposed edges where sedges predominate, but is often quite slow in sub-types where a heavy cover of grass tree occurs, as the heavy vegetation cover blankets the fuel layer and delays the normal drying process. Burning normally presents some problems in Type 3 fuels, firstly because of the variable drying rates, and secondly because flaring is quite common, particularly on junction zones between merging fires. Fuel quantity is greater than on other fuel types, and when the type is sufficiently dry to burn, fuel consumption is usually very high (often in excess of 80%) as distinct from fuel type 1. Because of the fuel structure, wind has a greater influence on type 3 fuels than on types with a smaller percentage of fuel suspension.

TYPE I - FUEL SUSPENSION ON 0-50% OF AREA

TYPE II - FUEL SUSPENSION ON 50-80% OF AREA

TYPE III - HEAVY SEDGE

TYPE III - FUEL SUSPENSION ON MORE THAN 80% OF THE AREA

TYPE IV - HEAVY BLADY GRASS

TYPE V - HEAVY LADER FUELS

Fuel Type 4. – Dense blady grass.

Understorey of blady grass and/or bracken fern over 80 percent or more of the area. This type normally occurs on plantation edges where light conditions favour the blady grass, but may be more extensive in areas of low crown density (low site index or poor stocking). This type dries out rapidly following rain and is prone to flaring, particularly on exposed edges subject to wind influence. Although this type does not occur in any great proportion of the total plantation area, fire behaviour characteristics are significantly different, and burning in this type should be approached with a measure of caution.

Fuel Type 5. – Intermediate understorey (ladder fuels) present.

This fuel type is virtually a type 3 fuel with the addition of an intermediate understorey in the 1 to 5 m stratum, usually tea-tree (Leptospermum, Baeckea etc.) and cutty grass, Casuarina, Lantana or blueberry ash. This type is very slow to dry out following rain and is prone to cause severe flaring when it will burn.

* * * FUEL TYPING * * *

All compartments selected for burning should be inspected and a fuel type map prepared where necessary. Most compartments are quite uniform in fuel characteristics and most type changes can be related to the location of swamps, creeks etc. Consequently, fuel mapping can be achieved simply by sketching the types directly onto a work map of the compartment. Inspection can usually be limited to driving slowly around a block, making a few stops to inspect the situation where type changes appear to occur. Any compartment which obviously contains a mosaic of different fuel types should be stripped at 100 m (40 row) intervals. A simple coding system may be used to record fuel types on the strip sheet and fuel map. e.g. A coding of 3XS represents a type 3 fuel in which Xanthorrhoea and Sedges are the dominant understorey species. A coding of 2GB1 represents a type 2 fuel in which grasses and blady grass are dominant species. All relevant information such as exposed plantation edges, included swamp or failed area, poor site index, heavy fuel patches, firelines to contain the burn, areas to be excluded from the burn such as experiments or underplantings and any adjoining young plantation should be clearly marked on the work map of the compartment. A map scale of 1:10 000 is ideal for the purpose. Marking of row direction on the map is an invaluable aid in organising edge burning, ignition pattern and patrol requirements on the actual day of the burn. Row direction is best shown as a series of parallel lines on the map corresponding to a 100 m strip interval. It is an excellent guide during lighting of strip length and number of strips per compartment, and allows the supervisor a clear picture of where the ignition crew is at any stage of the burn. An example of a fuel map is shown in Figure 1. A few photocopies of each map should be prepared for issue to overseers etc. in charge of ignition crews.

* * * BREAK PREPARATION * * *

It is essential that all compartments to be burnt should be contained by a freshly graded fireline, as most roads carry a thin layer of needles which is quite capable of carrying a fire into the adjoining compartment. It may be possible to schedule normal road maintenance with the burning requirements, but if not, a single sweep with the grader on the road edge is sufficient. Rotary slashing of roads is not effective and in some situations actually increases the chance of the fire crossing the road. It is considered desirable (though not essential) to isolate any included forest or swamp from the plantation to be burnt. Although it is quite unlikely that such areas will burn under the conditions prevailing during the plantation burn, there is always some risk of relights under drier conditions and the included area may burn quite severely. Each case should be considered on its merits; if the plantation is to become part of a buffer strip system and is to be burnt regularly, then the cost of preparing a fireline around an included forest area would be justified, as on future burns the track would merely require minor maintenance.

* * * EDGE BURNING * * *

There are three reasons why fires burn more intensely on compartment edges than in the remainder of the block.

(i) Because of the improved light conditions, there is a heavier understorey of species such as bracken, blady grass.

(ii) Exposure on edges results in more rapid drying following rain. This effect is most pronounced on northern edges and western edges late in the day.

(iii) Exposure to wind influence. Rate of spread and fire intensity increase as the square of wind velocity. Fires burning in plantation are not affected by wind velocity to anywhere near the extent as fires in native forest due to the canopy density which reduces the wind by approximately 80% i.e. a 20 km/h wind in the open is reduced to 4 km/h under dense canopy. The plantation edges, particularly on exposed external firebreaks, experience little reduction in wind velocity, and hence fire behaviour is much more active. The nett result is that edges will burn far too severely when the balance of the compartment will burn within prescribed limits of intensity. It is possible to organise the grid ignition of a compartment such that some of these edge effects are eliminated e.g. allow spot fires to back-burn out to exposed windward edges; back-burn dry northern and western edges immediately prior to grid ignition, provided wind direction is appropriate. It is desirable, however, to complete all edge burning immediately following rain such that the main job of grid ignition can be carried out as rapidly as possible when conditions are ideal. The inherent risk in edge burning is that relights may occur when conditions become too dry for safe burning if any compartments are not burnt out by the grid lighting crew while conditions are suitable. Edge burning is absolutely necessary in some situations, but carried out to excess, can cause a lot of problems with relights. It is often possible to conduct any essential edge burning on the day of the main burn by commencing early in the day, before conditions have warmed up for the main burn. Edge burning days in advance of the main burn should be strictly controlled; the following guidelines should apply.

(1) It is most important that edge burning be limited to the capacity of the ignition crew to complete the burn-out in all compartments before conditions deteriorate to the stage where it is too dry to burn safely. It is undesirable to have uncompleted compartments at the onset of the weekend, particularly at the middle or latter end of suitable drying conditions.

(2) Top priority should be given to edge-burning northern edges, particularly where adjacent to 30 m or 60 m firebreaks. Such areas usually burn soon after rain because of the rapid drying conditions. Western edges should receive second priority.

(3) Most burning in autumn and winter is carried out with a southerly wind component, either south-east or south-west. It is unwise to pre-edge burn southern edges because relights under deteriorating conditions would then result in active headfires burning the full length of the compartment.

(4) Any plantation edge bordering on young plantation should be edge burnt under mild conditions to ensure the security of the burn.

(5) Edge burning of included swamps or failed areas, or areas of poor site index should be restricted to back-fires on the morning prior to the main burn.

*** GRID LIGHTING ***

A good working rule for calculating grid interval is to double the spread rate indicated by the fire behaviour tables in the burning guide. e.g. Predicted rate of spread is 25 m/h, grid interval is 50 m. (Eight rows is approximately 20 m).

Having selected an appropriate grid interval, lighting commences on the lee or downwind edge of the compartment. The entire lee edge is spot-lit at the appropriate spacing (regardless of row direction) and may be done some hours prior to the main burn if the edge conditions warrant it. This prevents a spot fire lit in the block burning out to the lee edge, accelerating and flaring on the edge. The remainder of the compartment is then lit at the selected spacing by stripping **always along the rows**, and working progressively into the wind. It is virtually impossible to control grid spacing rigidly unless the rows are followed, and the problem is accentuated when the understorey of eucalypt etc. is thick and the lighting crew cannot keep one another in sight. Under no account should any lighting be carried out directly on a windward edge except under the very mildest of conditions. The final spot fire on any strip line should be a minimum of one grid interval from the windward edge, and in very exposed situations, well in excess of one grid interval.

Having selected a grid spacing and instructed the ignition crew of your requirements, it is advisable to adhere to the spacing for the entire compartment, even though the burn may be patchy in some fuel types or sections of the block. It is far easier to return to the block at a later stage and relight the unburnt sections more intensively. Under very mild conditions, or scrubby fuel types along creeks etc., it may be necessary to strip light (light on a face) to get a satisfactory result. Strip lighting should never be used when fires will spread satisfactorily from spot fires lit on a grid pattern.

If a patch of heavy fuel, swamp or failed area occurs in the middle of a block, the grid ignition should be kept flexible such that the area is allowed to burn out from a single spot fire, ensuring that no junction zones between fires occur in the area or fire intensity may be very high, causing severe scorch around the periphery of the flare-up.

*** USE OF BURNING GUIDE ***

The primary objective in prescribed burning is to obtain a satisfactory level of fuel reduction without obtaining crown scorch. If a burn results in poor fuel reduction, it is simply a matter of carrying out a repeat burn under slightly drier conditions. The reverse does not apply; if a burn is too hot, scorch will occur and the result cannot be corrected. Therefore the most important consideration in developing a burn prescription for any compartment is to define a maximum fire intensity which must not be exceeded if scorch is to be avoided. Scorch is a function of flame height and height to green crown level in the particular compartment, which can be expressed by compartment age and site index. Maximum recommended flame height is shown on the guide in the following form.

Site Index (m)	AGE (years)					
	10	12	14	16	18	20
18	0.5 m	0.7 m	0.8 m	0.9 m	1.1 m	1.2 m
21	0.6 m	0.8 m	1.0 m	1.1 m	1.2 m	1.4 m
24	0.8 m	1.0 m	1.1 m	1.2 m	1.4 m	1.5 m

Burning should never be attempted unless a minimum of 7 mm of rain has been registered on the burn area. Under high drought index conditions, considerably more rain is required. If the plantation to be burnt is any distance from headquarters, a portable rain gauge should be set up in a suitable clearing in close proximity to the block. This is particularly important when rain is being produced by scattered shower activity as the registrations vary enormously over quite short distances. The pine litter should be quite saturated by 7 mm or more of rain, with free moisture in the lower layer of the fuel bed. Because fuel quantities are so great in slash pine plantation, burning can only be carried out safely during the drying period following rain when the upper profile of the fuel layer is sufficiently dry to burn but the lower layer remains quite wet, otherwise fuel consumption will be total and fire intensity in excess of the prescribed limits. Burning in strict accordance with this principle is the single most important fundamental of burning in slash pine fuels. Always inspect fuel prior to burning to ensure that the lower fuel profile is wet.

Drying rate depends on the temperature and relative humidity, wind velocity and exposure to direct sunlight, temperature being the greatest influence of these factors. e.g. Drying is more than twice as rapid when the daily maximum temperature averages 30°C than it is at 20°C. Mean monthly maximum temperatures for south Queensland, central Queensland and north Queensland are shown in the drying tables to allow use of a monthly average drying rate in preference to actual daily means. Actual temperature should be adopted when unseasonal temperatures are experienced.

It is difficult to produce an accurate drying table for exposed areas because of the varying degree of exposure. As a general rule, though, moisture conditions suitable for effective burning of exposed areas will occur one to two days earlier in the drying cycle than indicated by the drying tables. Similarly, the drying tables relate to an average fuel type (type 2) with 50 to 80% fuel suspension. Certain type 3 fuels with a dense cover of Xanthorrhoea will dry more slowly;

conversely, type 2 fuels with a heavy grass component will dry more rapidly. Type 1 fuels as a general rule dry out on the surface fairly rapidly because of the absence of understorey, but the fuel layer as a whole dries more slowly. Therefore the amount of fuel available for combustion will be less than is indicated by the tables, and the percentage fuel consumption may be quite low. All things taken into consideration, it is best to observe the drying tables as to when conditions are too wet or dry, but make compensation for such fuel types as regards the amount of fuel available for burning.

You will soon become familiar with the drying characteristics of the fuels in your area.

The fire behaviour tables in the second section of the burning guide predict rate of spread (m/h) and flame height (m), from an input of relative humidity, wind velocity and drying stage. This predicted fire behaviour should be compared with the prescribed limits before deciding to proceed with the burn.

There is insufficient temperature variation in the experimental fire data collected to date to analyse the influence of temperature on fire behaviour. This is not meant to infer that temperature does not influence fire behaviour in slash pine fuels. Fires burning in Eucalypt fuels under conditions similar to those which apply in plantation burns will increase in spread rate by approximately 50% if temperature increases from 20°C to 30°C. It is probable that the increase in fire intensity in slash pine fuels for a 10°C rise in temperature is of a similar magnitude.

★ ★ ★ BURN REPORT ★ ★ ★

Assessment of burn results by compartments should be on the following basis.

Burn Class	Assessment
I	**Too Mild** - Relighting required
II	**Marginally Mild** - Reasonable burn results but some unburnt patches.
III	**Good** - Negligible scorch, good burn cover.
IV	**Marginally Hot** - Good burn, but some scorch patches on junction zones and edges.
V	**Too Hot** - Definable areas of scorch.

Burn reports should include a summary of essential information as follows.

Cpt.	Area	Date Burnt		Approx. Time of Day	Burn Result Assessment
		Edges	Main Burn		

Weather information should be provided for any days on which burning took place or was attempted. This should include –

Antecedent rainfall
Drought index
Temperature and relative humidity (3 pm and max.)
Wind (9 a.m. and 3 p.m.)

A **scorch map** should be prepared for any compartments where significant patches of scorch occurred. The following scorch categories should be mapped.

Scorch Class	**Description**
I (Red)	Severe. 0 – 2 m of green tip remaining
II (Yellow)	Moderate. 2 – 4 m of green tip
III (Green)	Nil. Nil or negligible scorch

In addition to local and district office requirements, a copy should be forwarded to head office for the fire protection officer, and a copy direct to the fire research forester at Gympie. Any requests for inspections and/or advice should accompany the reports. All correspondence should be on 169/3/2 District.

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DRYING TABLES

(Figures indicate weight of fuel (tonnes per ha) available for burning)

Where the effect of one rain period is superimposed on that of another, all rain registered should be taken into account.

30°C

No. Days Since Rain	Rainfall (mm) 2.5	7.5	12.5	25	40
1	18	12		TOO	WET
2		18	12	12	
3			18	18	12
4	TOO	DRY			18
5					

28°C

No. Days Since Rain	Rainfall (mm) 2.5	7.5	12.5	25	40
1	18	12		TOO	WET
2		18	12		
3			18	12	12
4	TOO	DRY		18	16
5					18

26°C

No. Days Since Rain	Rainfall (mm) 2.5	7.5	12.5	25	40
1	12			TOO	WET
2	18	12	12		
3		18	16	12	8
4			18	16	12
5	TOO	DRY		18	16
6					18
7					

24°C

No. Days Since Rain	Rainfall (mm) 2.5	7.5	12.5	25	40
1	12				
2	16	12		TOO	WET
3	18	16	12		
4		18	16	12	8
5			18	16	12
6	TOO	DRY		18	16
7					18

22°C

No. Days Since Rain	Rainfall (mm) 2.5	7.5	12.5	25	40
1	8				
2	12	8			
3	16	12	8		
4	18	16	12	8	
5		18	16	12	8
6			18	16	12
7				18	16
8					18
9					
10					

20°C

No. Days Since Rain	Rainfall (mm) 2.5	7.5	12.5	25	40
1					
2	8				
3	12	8			
4	16	12	8		
5	18	16	12	8	
6		18	14	12	8
7			16	14	12
8			18	16	14
9				18	16
10					18

5 tonnes per ha = 1 cm of dry surface needles
10 tonnes per ha = 2 cm of dry surface needles
15 tonnes per ha = 3 cm of dry surface needles
20 tonnes per ha = 4 cm of dry surface needles

MEAN DAILY MAXIMUM TEMPERATURE

Locality	March	April	May	June	July	August
South Queensland	28	26	23	21	20	22
Central Queensland	30	28	25	23	23	24
North Queensland	30	29	27	26	25	26

EXPOSED AREAS

Moisture conditions suitable for effective burning of exposed edges will occur one to two days earlier than indicated in the above drying tables.

FIRE BEHAVIOUR TABLES

(These figures refer to fires lit at a single point and allowed to spread. Fires lit on a face or in strips will be approx. 1.5 times as hot.
R · forward rate of spread in metres/h H = flame height in metres.
Figures in brackets apply to exposed areas.)

(1) First Suitable Burning Day After Rain.
(Available Fuel = 8 t/ha, Fuel Moisture Content 30 – 35%)

Relative Humidity	Wind Strength: Force 1 1 – 5 km/h	Force 2 6 – 11 km/h	Force 3 12 – 18 km/h	Force 4 19 – 29 km/h
15%	R = 32 (41) H = 0.8 (0.9)	R = 36 (46) H = 0.9 (1.0)	R = 43 (59) H = 1.0 (1.2)	R = 63 (92) H = 1.3 (1.7)
25%	R = 27 (34) H = 0.7 (0.8)	R = 31 (41) H = 0.8 (0.9)	R = 38 (52) H = 0.9 (1.1)	R = 54 (83) H = 1.1 (1.6)
35%	R = 22 (29) H = 0.7 (0.7)	R = 27 (36) H = 0.7 (0.9)	R = 34 (45) H = 0.8 (1.0)	R = 45 (74) H = 1.0 (1.4)
45%	R = 18 (23) H = 0.6 (0.6)	R = 23 (31) H = 0.6 (0.8)	R = 31 (40) H = 0.8 (0.9)	R = 40 (65) H = 0.9 (1.3)
55%	R = 14 (18) H = 0.5 (0.6)	R = 18 (25) H = 0.6 (0.7)	R = 25 (34) H = 0.7 (0.8)	R = 32 (56) H = 0.8 (1.2)
65%	R = 11 (14) H = 0.5 (0.5)	R = 14 (20) H = 0.5 (0.6)	R = 18 (29) H = 0.6 (0.7)	R = 25 (49) H = 0.7 (1.1)
75%	R = 7 (11) H = 0.4 (0.5)	R = 11 (14) H = 0.5 (0.5)	R = 14 (23) H = 0.5 (0.6)	R = 16 (41) H = 0.5 (0.9)
85%	R = 5 (7) H = 0.4 (0.4)	R = 7 (11) H = 0.4 (0.5)	R = 11 (18) H = 0.5 (0.6)	R = 11 (34) H = 0.5 (0.8)

(2) Second Suitable Burning Day After Rain
(Available Fuel = 12 t/ha, Fuel Moisture Content 25 – 30%)

Relative Humidity	Wind Strength: Force 1 1 – 5 km/h	Force 2 6 – 11 km/h	Force 3 12 – 18 km/h	Force 4 19 – 29 km/h
15%	R = 38 (49) H = 0.9 (1.1)	R = 43 (54) H = 1.0 (1.1)	R = 52 (70) H = 1.1 (1.4)	R = 76 (112) H = 1.5 (2.0)
25%	R = 32 (41) H = 0.8 (0.9)	R = 36 (47) H = 0.9 (1.0)	R = 45 (61) H = 1.0 (1.3)	R = 63 (101) H = 1.3 (1.9)
35%	R = 27 (34) H = 0.7 (0.8)	R = 32 (41) H = 0.8 (0.9)	R = 40 (54) H = 0.9 (1.1)	R = 54 (90) H = 1.1 (1.7)
45%	R = 23 (29) H = 0.6 (0.7)	R = 29 (36) H = 0.7 (0.9)	R = 36 (47) H = 0.9 (1.0)	R = 47 (81) H = 1.0 (1.6)
55%	R = 18 (23) H = 0.6 (0.6)	R = 22 (31) H = 0.6 (0.8)	R = 31 (41) H = 0.8 (0.9)	R = 40 (72) H = 0.9 (1.4)
65%	R = 14 (18) H = 0.5 (0.6)	R = 18 (25) H = 0.6 (0.7)	R = 25 (36) H = 0.7 (0.9)	R = 32 (65) H = 0.9 (1.3)
75%	R = 11 (14) H = 0.4 (0.5)	R = 14 (20) H = 0.5 (0.6)	R = 18 (31) H = 0.6 (0.8)	R = 25 (58) H = 0.7 (1.2)
85%	R = 7 (11) H = 0.4 (0.4)	R = 11 (14) H = 0.4 (0.5)	R = 14 (25) H = 0.5 (0.7)	R = 18 (50) H = 0.6 (1.1)

(3) **Third Suitable Burning Day After Rain**

(Available Fuel = 16 t/ha, Fuel Moisture Content 20-25%)

Relative Humidity	Wind Strength: Force 1 (1 – 5 km/h)	Force 2 (6 – 11 km/h)	Force 3 (12 – 18 km/h)	Force 4 (19 – 29 km/h)
15%	R = 43 (54) H = 1.0 (1.1)	R = 50 (74) H = 1.1 (1.5)	R = 68 (85) H = 1.4 (1.6)	R = 91 (135) H = 1.7 (2.4)
25%	R = 40 (51) H = 0.9 (1.1)	R = 46 (66) H = 1.0 (1.3)	R = 63 (78) H = 1.2 (1.5)	R = 80 (129) H = 1.5 (2.2)
35%	R = 34 (44) H = 0.8 (0.9)	R = 40 (54) H = 0.9 (1.1)	R = 52 (65) H = 1.1 (1.3)	R = 65 (112) H = 1.3 (2.0)
45%	R = 27 (34) H = 0.7 (0.8)	R = 34 (45) H = 0.8 (1.0)	R = 45 (58) H = 1.0 (1.2)	R = 58 (101) H = 1.2 (1.9)
55%	R = 23 (29) H = 0.6 (0.7)	R = 29 (40) H = 0.7 (0.9)	R = 38 (50) H = 0.9 (1.1)	R = 50 (90) H = 1.1 (1.7)
65%	R = 18 (23) H = 0.6 (0.6)	R = 22 (34) H = 0.6 (0.8)	R = 31 (43) H = 0.8 (1.0)	R = 43 (81) H = 1.0 (1.6)
75%	R = 14 (18) H = 0.5 (0.6)	R = 18 (29) H = 0.6 (0.7)	R = 25 (38) H = 0.7 (0.9)	R = 36 (72) H = 0.9 (1.4)
85%	R = 11 (14) H = 0.4 (0.5)	R = 14 (23) H = 0.5 (0.6)	R = 18 (32) H = 0.6 (0.8)	R = 29 (65) H = 0.7 (1.3)

(4) **Fourth Suitable Burning Day After Rain**

(Available Fuel = 18 t/ha, Fuel Moisture Content 15–20%)

Relative Humidity	Wind Strength: Force 1 (1 – 5 km/h)	Force 2 (6 – 11 km/h)	Force 3 (12 – 18 km/h)	Force 4 (19 – 29 km/h)
15%	R = 50 (61) H = 1.1 (1.2)	R = 59 (83) H = 1.2 (1.6)	R = 76 (99) H = 1.4 (1.8)	R = 99 (153) H = 1.8 (2.6)
25%	R = 43 (54) H = 0.9 (1.0)	R = 52 (72) H = 1.0 (1.2)	R = 67 (85) H = 1.2 (1.4)	R = 85 (137) H = 1.4 (2.2)
35%	R = 38 (47) H = 0.8 (0.9)	R = 47 (61) H = 0.9 (1.1)	R = 59 (74) H = 1.1 (1.3)	R = 74 (124) H = 1.3 (2.0)
45%	R = 32 (40) H = 0.8 (0.9)	R = 41 (52) H = 0.9 (1.1)	R = 52 (65) H = 1.1 (1.3)	R = 67 (110) H = 1.3 (2.0)
55%	R = 27 (32) H = 0.7 (0.8)	R = 36 (45) H = 0.8 (1.0)	R = 45 (58) H = 1.0 (1.2)	R = 59 (99) H = 1.2 (1.8)
65%	R = 22 (27) H = 0.6 (0.7)	R = 31 (36) H = 0.8 (0.8)	R = 38 (50) H = 0.9 (1.1)	R = 52 (88) H = 1.1 (1.7)
75%	R = 16 (22) H = 0.6 (0.6)	R = 25 (31) H = 0.7 (0.8)	R = 32 (43) H = 0.8 (1.0)	R = 45 (79) H = 1.0 (1.5)
85%	R = 13 (16) H = 0.5 (0.5)	R = 22 (25) H = 0.6 (0.6)	R = 25 (38) H = 0.7 (0.9)	R = 38 (72) H = 0.9 (1.4)

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PRESCRIBED BURNING GUIDE
(Slash Pine Plantation) (Mk. III)

FUEL TYPES

The fire behav[illegible] tables used in this guide apply to Slash Pine plantation fuels which have not been burnt previously, and which may exceed 18 tonnes per hectare in weight.

Fuel Type 1. Fuel Suspension on [illegible] 50% of area.
Fuel Type 2. Fuel Suspension on 50-80% of area.
Fuel Type 3. Fuel Suspension on [illegible] 80% of area. Fuel is suspended in dense understorey of Xanthorrhoea, Bracken.
Fuel Type 4. Dense understorey of Blady Grass.
Fuel Type 5. Ladder fuels. Fuel is suspended in dense understorey of tea-tree etc.

Fuel types should be mapped on the above basis prior to the development of the burn prescription.

The Fire Behaviour Tables refer to an average fuel condition. Fires in Type 1 will be milder than indicated in the tables; Fires in types 3, 4 & 5 will be hotter.

DRYING TABLES

Select an appropriate drying table on page 2 on the basis of average maximum temperature of the drying period. Actual temperature should be used for unseasonal conditions, otherwise the mean monthly temperature indicated at the foot of page 2 may be adopted.

WARNING: ***Burning must not be attempted unless a minimum of 7 mm of rain has been registered on the burn area.***

BURN PRESCRIPTION

Any burn prescription must be based on the following maximum recommended flame heights.

Site Index (m)	AGE (years): 10	12	14	16	18	20
18	0.5 m	0.7 m	0.8 m	0.9 m	1.1 m	1.2 m
21	0.6 m	0.8 m	1.0 m	1.1 m	1.2 m	1.4 m
24	0.8 m	1.0 m	1.1 m	1.2 m	1.4 m	1.5 m

LIGHTING TECHNIQUES

(1) **Strip Backfire.** Light on a face or at 20-30 metre intervals along the downwind edge of the block. This is the safest method of burning heavy fuels (types 3, 4) or in poor site index or young stands, or in very exposed sections of a block. Spread rate will be about half, and flame height two-thirds of that indicated in the tables. Use this technique where headfires may be too active, particularly when wind is Force 3-4.

(2) **Strip Headfire.** Light on a face or at 20-30 metre intervals along the windward edge of the block. Use this method when wind speed is low and fuel moisture content too high for backfires to spread, such as burning plantation edges following rain.

(3) **Grid Ignition.** Calculate a grid spacing from the predicted Rate of Spread such that the individual fires will link up in about 2 hours. Spots must never be lit to within one grid spacing of the edge of the edge of the plantation on the downwind side, or half a grid spacing on the windward side.

Grid spacing may be varied to suit changing fuel type or weather conditions. Most areas will be grid lit after burning exposed sections by strip head or back fires.