DEPARTMENT OF CONSERVATION
AND LAND MANAGEMENT

SILVICULTURE SPECIFICATION 7/89

TREEMARKING AND SILVICULTURAL TREATMENT IN MULTIPLE USE JARRAH FOREST

This specification supersedes Silviculture Specification 1/87

1. PREAMBLE

The CALM leaflet "Treemarking and Silviculture in the Forest" (1987) provides the foundation for this specification and should be read concurrently.

The aim of jarrah silvicultural practice is to maintain and develop forest structures which satisfy goals relating to water, timber production, landscape, wildlife conservation and other values. This specification primarily deals with practices relating to timber production and is modified by reference to detailed specifications concerning other values. (eg 5/89 Maintenance of Habitat for Hole Nesters in Timber Production Operations in the Jarrah Forest).

This specification is to be applied in areas of jarrah forest which are dieback free and where timber production is a major objective.

2. OBJECTIVES

2.1 Stand Objective

To provide for sustainable production of high quality timbers and other forest values by developing and enhancing a grouped forest structure with silvicultural objectives appropriate to the stage of development of each group.

2.2 Silvicultural Objectives

a. If a tree is to be removed from a stand it should be done to achieve one of the following:

SHELTERWOOD: (Establishment of regeneration) Seedlings will be encouraged to establish and develop into ground coppice by reducing competition. A forest canopy is maintained to provide a continuity of forest values until ground coppice is developed.

GAP CREATION: (Release of established regeneration) Jarrah regeneration will be encouraged to develop unimpeded into saplings, poles and mature trees by the removal of competition.

THINNING: To promote growth in retained trees.

b. Where groups of trees are retained or established, they must be of a size where external competition and felling damage will have a limited effect on growth. The ideal minimum diameter of a group is 100 metres (4 times tree height).

c. In any group only one silvicultural objective will be pursued at any one time.

d. Fragile, unproductive and environmentally-sensitive areas. No trees will be harvested from these areas,.

3. ASSESSMENT PRIOR TO CUTTING

A broad appraisal of each coupe is required to forearm the forester with the objectives to be applied. This can be achieved by aerial photographic interpretation, site-type maps and field reconnaissance. Detailed surveying may be required in a small proportion of the area. This assessment does not aim to accurately map sites of different treemarking objectives, rather to provide an indication of the range of stand conditions which may be encountered.

3.1 Areas to be excluded from cutting

In addition to specific reserves and buffer zones nominated in the Manual of Hardwood Logging Specifications site-types of very low productivity should not be cut as they are often difficult and expensive to regenerate. These include:

Northern Jarrah (Havel 1975) - A, G, J (with *Banksia attenuata*),
B (if ground coppice is inadequate)

Southern Jarrah (Strelein 1988) - R, B, F, A

Sunklands - Mc Cutcheon Soil Type 6

3.2 Areas to be left as uncut strips

Where cutting is confined to a portion of a coupe due to landscape, water or other requirements and must be separated by uncut strips, the site-types in 3.1 and those following should be preferred in locating such strips:

Northern Jarrah (Havel 1975) - R,F, B

Southern Jarrah (Strelein 1988) - X, N, Y

Sunklands - Mc Clutcheon Soil Type 4

3.3 Areas available for cutting

Through records of cutting history, API types and reconnaissance, assess the coupe for the types present. Site-type maps and aerial photographs will give a good indication of the presence of areas likely to require shelterwood treatment. The following may be used as a guide:

Northern Jarrah site-types (Havel 1975)
- B, F, J - likely to have poor regeneration
- D, E, Z - may be poor locally particularly on sandy soils
- H, P - frequently with dense Sheoak
- S - occasionally with dense *Banksia grandis*

Southern Jarrah site-types (Strelein 1988)
- X, N, Y - likely to have poor regeneration
- K (with karri understorey) may be poor locally
- S, Q, I, P (with dense scrub and/or sands)

3.4 Advance Burning

Advance burning 12-18 months prior to cutting greatly improves visibility of ground coppice and the accuracy of regeneration assessment.

3.5 Coupe plan

Prepare a broad coupe plan showing:
- limitations on extent of cutting
- areas excluded from cutting
- preferred areas for uncut strips
- likely shelterwood areas

4. TREEMARKING

4.1 General

Marking may begin when the forester is familiar with the stand objectives that may be required in the coupe and the products which will be available from it.

The first task in marking a group of trees is to determine which objective should be applied and whether its boundaries are apparent. The process for making these decisions is outlined in "Treemarking and Silviculture in the Jarrah Forest" (1987).

Individual trees can then be marked to meet that objective.

4.2 Marking for thinning

Selection of crop trees.

A thinning aims at increasing the growth of selected crop trees. A crop tree is one with the capacity to grow vigorously into high value products.

The key characteristics to look for are:

- an existing or potential for a well-developed crown
- a bole capable of producing a minimum high-quality product

Appendix 1 details the criteria for crop tree selection.

Thinning intensity.

The desirable retained density of crop trees varies with their size, When crop trees are smaller the aim is to grow individual trees rapidly to sawlog sizes. Once crop trees are of sawlog size, the aim is to maximise the growth of sawlog volume per hectare - therefore a higher basal area is retained.

Thinning regimes for different crop tree sizes are detailed in Table 1.

Technique.

Mark to retain the desired density of crop trees (Table 1), and fauna habitat trees. Where there are a surplus of crop trees, those of a commercial size need not be marked for retention.

The retained basal area must be regularly checked with a 2-factor prism.

Partially-stocked stands.

Where the stocking of crop trees is less than specified in Table 1 but greater than $5m^2/ha$, all crop trees must be retained.

4.3 Marking for gap creation

Regeneration release by gap creation should only be sought where there are insufficient crop trees to merit thinning and where the stocking of ground coppice and saplings will adequately regenerate the gap.

Technique

- Where it is evident that insufficient crop trees exist to enable a thinning, check that the stocking of ground coppice/saplings is adequate, determine the boundaries of the gap and mark fauna habitat trees (in clumps) in gaps over 1 hectare in size. Sub-merchantable crop trees with very good growth potential may also be marked if they can be fully protected during logging and burning operations.
- Where harvesting will leave a high density of culls ($>12m^2/ha$), all cutting should be deferred until more produce is saleable.

Gap size

- Where the gap would exceed the maximum dimension (10ha), strips of uncut forest are required to confine the gap to that maximum. Uncut strips should be at least 100 metres across.

TABLE 1
JARRAH THINNING INTENSITY

Mean DBHOB of best 150 stems/ha at first thinning	Crop Tree Basal Area (m^2/ha)	Schedule
Less than 20cm	N/A	release 200 jarrah stems/ha from overtopping and crown abrasion. The objective is to maintain healthy crown development on future jarrah crop trees without promoting a permanent low crown break.
20-25cm	*10m^2/ha	this will usually be a non-commercial thinning. It will leave more than 150 stems/ha but ensures that the stand is not left under-stocked. A further thinning will be required before the crop trees reach 50cm dbhob.
25-30cm	*10m^2/ha	This is likely to be both a commercial and non-commercial thinning. The remaining trees are capable of reaching 50cm dbhob without the stand becoming overstocked (50 years). More conservative thinning in the future will maximise sawlog volume/ha.
40cm	18m^2/ha	thin again when crop trees reach 50cm dbhob. Above comments apply.
50cm	20m^2/ha	

* An additional 5m^2/ha of the following may be retained if they will be removed within the next 20 years:

- trees within 5cm of becoming an SEC pole or sawlog,
- sheoak crop trees
- second grade sawlogs in areas which will have followup non-commercial thinning.

A further 1 sq.m/ha of potential pit props may also be retained where appropriate.

4.4 Marking for shelterwoods

The shelterwood overstorey is retained to provide seed for regeneration and a continuity of forest values until ground coppice is capable of rapid growth following release. It is applied when there is inadequate stocking of crop trees for thinning and where there is insufficient ground coppice available for immediate release.

Technique

- Mark to retain 15m²/ha of overstorey in a relatively even spacing. Preferred species is jarrah, with trees which will grow vigorously for the next 20 years. The treemarker must endeavour to retain a stand which will support a harvesting operation in the future.

Group size

- Where adjacent to a gap, a shelterwood group should be at least 100 metres in diameter. This may be achieved by not regenerating in a portion of the gap.

4.5 Marking in stands with small groups

Frequently existing stand structure consists of gaps and groups of thinnable forest, each below the minimum desirable size (i.e. 100m diameter). In these stands the treemarker should attempt to push the group/gap towards the desirable size. For example, this may be achieved by:

- Where crop trees are of commercial size and numbers are low, small groups of crop trees may be felled to enhance gap size.
- where gaps are small and cannot be extended without considerable loss of crop trees, retain all crop trees and do not create a gap.

Gaps as small as 50 metres in diameter (2 times tree height) can be created where trees on the boundary are not leaning into the gap.

5. HARVESTING OPERATIONS

This phase involves the removal of all unmarked merchantable trees.
Contractors are required to protect all marked trees during falling and skidding operations, and remove debris larger than 7.5cm diameter to at least 1 metre away from marked trees. Where trees are wanted but not marked, contractors cannot be expected to protect them.
Some silvicultural treatments (eg soil disturbance, Section 6) may be better carried out during harvesting than as a separate operation.

6.FOLLOW-UP SILVICULTURAL TREATMENT

These operations assist in developing the stand to meet the treemarking objectives. Unless a stand is fully marked to record the objective, interpretation for follow-up treatment will be difficult.

6.1 Timing

Silvicultural treatments required in gaps and thinning groups should be carried out after tops burning (Section 7). Shelterwood disturbance must be done before tops burning. All treatments should commence within 2 years after the completion of harvesting. Where significant quantities of merchantable produce remain, do not treat until harvesting is completed.

6.2 Treatment of gaps

The object is to encourage regeneration by the removal of competing culls. This can be done either by:

- immediately removing all culls after harvesting, or
- initially removing sufficient culls to allow regeneration to develop into saplings, and then in 20-25 years removing remaining culls and releasing saplings to grow into poles.

Gap size 0-2ha

Remove all unmarked trees and mature *Banksia grandis*, except potential crop trees which have not been damaged during harvesting.

Gap size over 2ha

As for gaps 0-2ha, except only remove the following unmarked culls:

- DBH > 40cm, all cull trees.
- DBH 20-40cm if within 15 metres of other trees, including crop or habitat trees or other remaining culls
- DBH 10-20cm if within 7 metres of other trees.

Consider trees <3metres apart as one tree.

See figure 1 for interpretation.

On all gaps remove all mature *Banksia grandis* by felling or pushing down and do not treat within 5 metres of fauna habitat trees.

Where the density of culls is high (>12m^2/ha) treatment should be deferred until more produce has been removed.

Technique

Where stump coppice is needed, fell saplings (DBH <15cm) close to ground level. Remove all unwanted stems by machine or by notching with an approved herbicide (See Herbicide Manual, Technical Instructions).

6.3 Treatment of thinning groups

Fully-stocked stands

Remove all unmarked trees, mature *Banksia grandis* and sheoak by notching with an approved herbicide (See Herbicide Manual, Technical Instructions), except those trees which appear to share a common root system with adjacent crop trees. These are to be felled. Culling by felling may only be used where landscape values are high. Do not treat culls within 5 metres of fauna habitat trees.

Partially-stocked stands

Treat as for fully-stocked stands, but only individually release crop trees by removing competing trees for a distance of 4 metres and all vigorously-growing culls over 50cm DBH.

Do not individually release around retained trees which are not of crop tree standard.

6.4 Shelterwood treatment

Competition removal and soil disturbance

Remove competing understorey in swathes at least 3 metres wide and not more than 8 metres apart. Preferably use a tracked machine with a rake blade. Also remove mature *Banksia grandis* and unmarked sheoak. Do not establish swathes within 5 metres of retained trees.This work must be done in dry soil conditions. Instal erosion barriers at the appropriate intervals. (See Hardwood Logging Specifications)

Figure 1: Treatment of culls in gaps over 2ha.

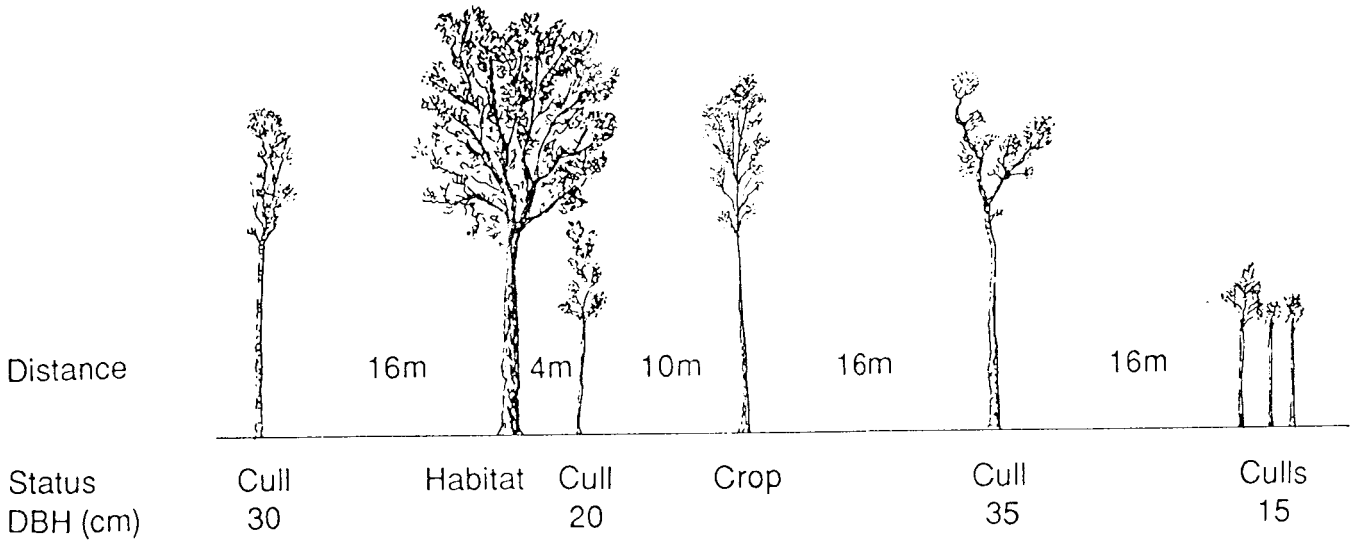

Figure 1A: Gap containing 2-3m²/ha culls which are widely spaced and do not require treatment.

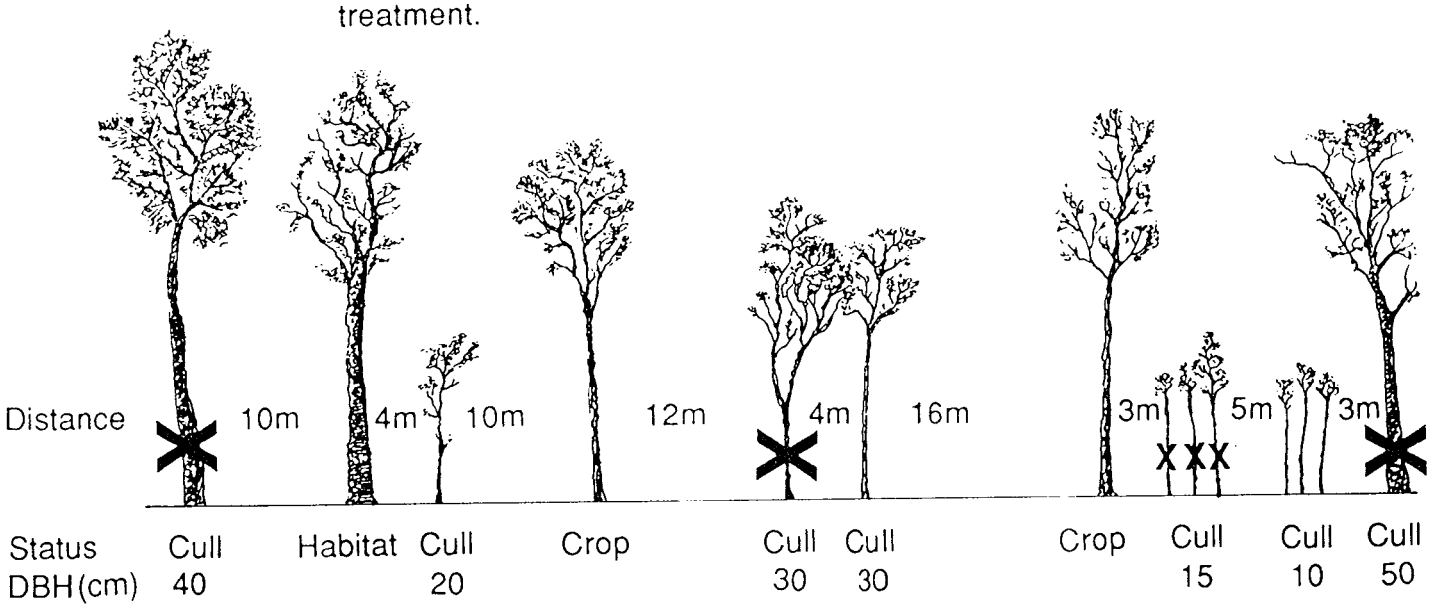

Figure 1B: Gap containing about 8m² /ha of culls, X indicating those to be removed.

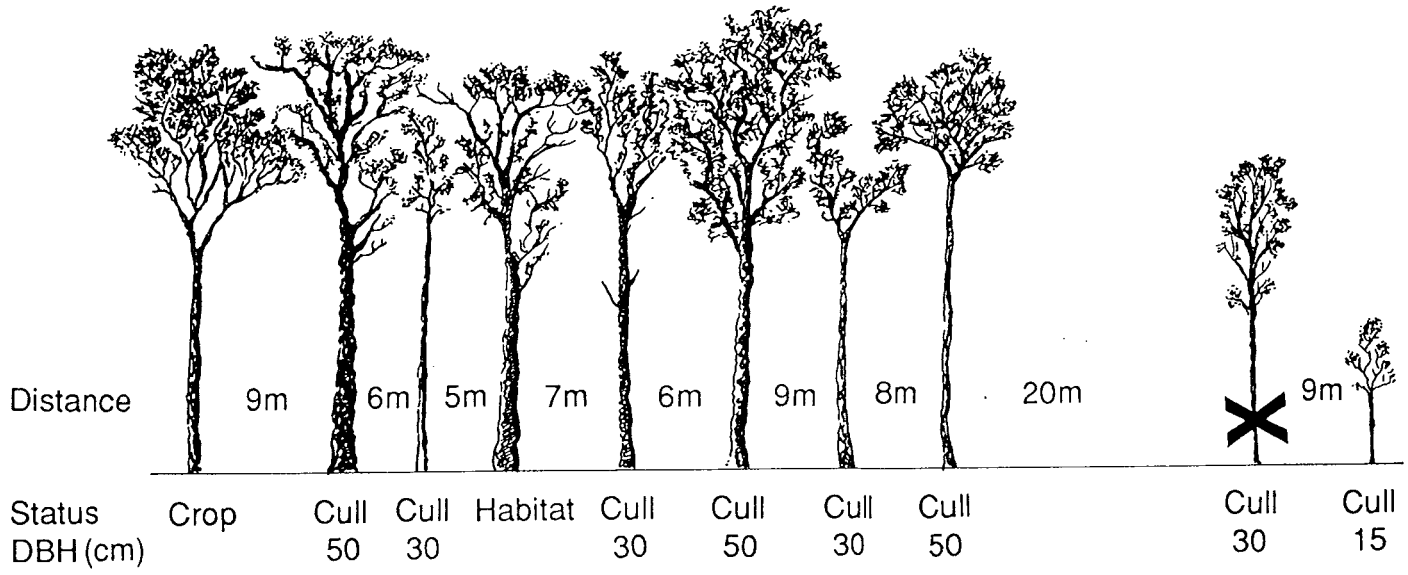

Figure 1C: Gap with a dense group of culls (> 12m²/ha) which should not be treated. Gap at right may be treated if 50 metres in diameter.

Natural seedfall
Examine the seed crop in late summer, and where there is viable and plentiful crop aim to burn in autumn. (See Section 7.1)

Artificial seeding
Where there is a poor seed crop or poor success by natural seedfall, it is necessary to broadcast seed. Use a cultivator to lightly scarify the soil along the prepared swathes. Simultaneously seed and fertilise using:

20,000 viable seeds per ha and
450kg No. 1 superphosphate.
Apply seed and fertiliser to disturbed soil during July. (or in late autumn if hygeine restricts access)

Establishment survey
For both natural seedfall and artificial seeding undertake a regeneration survey in the following February.

7. BURNING AND PROTECTION

7.1 Tops burning

Thinning areas
Tops burning is a fuel reduction measure and should be done without excessive scorch. Where advance burnt, burning may be delayed until the normal rotation without excessive build up of fuels.

Gaps
Tops burning is a fuel reduction measure, except where used to re-establish poorly - formed sapling stems as coppice from the base of the stump. As with thinned areas burning may be deferred in stands which have been advanced burnt. Where burning is necessary, it must take place within 2 years of cutting to ensure that regeneration can be burned to ground level rather than damaged.

Shelterwood
Burn during autumn after the seed-bed has been prepared. Where seed is available in the crowns, the burn should be warmer aiming to scorch the lower crown and stimulate seedfall. Where artificial seeding is being used burning does not need to be as warm.

Mixed objectives in one stand
Most cutting coupes will contain a mosaic of objectives each with different burning aims. Where there are mixtures of thinning and gaps, burning is done over the whole area at the standard for thinning.

7.2 PROTECTION

Thinning
Thinning may be included in normal mild prescribed burning regimes. However most thinning areas will contain some regeneration, and as the cost of separating these areas will be high, it is preferable that protective burning is deferred as for gaps.

Gaps
It is essential that once released to grow regeneration is not damaged by fire. These areas should not be burnt until regeneration is at least 6 metres high, usually about 10 years.

Shelterwoods
These areas should be included in normal prescribed burning. If they lie within an area which is not being burnt it will be necessary to mount special prescribed burning operations. See Technical Report 4 for a discussion of the options and trade-offs for burning in these stands.

8. RECORDS

The aim of silvicultural records is to accurately describe the condition of the forest when the operation is completed.
Treemarkers should progressively record the objectives of their marking and enter these on the relevant H.O.C.S. prints.All completed follow-up treatment should also be recorded. Areas to be protected from burning should be recorded on appropriate protection plans.

9. REFERENCES

Bradshaw F.J. (1986) Silvicultural Guidelines for Virgin
Southern Jarrah Forest.
Tech. Rep. No. 4. Dept. of Conservation and Land Management, W.A.

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Havel J.J. (1975) Site Vegetation Mapping in the Northern Jarrah Forest (Darling Range)
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Strelein G.J. (1988) Site Classification in the Southern Jarrah Forest of Western Australia
Res. Bull. No.2 Dept. of Conservation and Land Management, W.A.

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APPENDIX 1

CRITERIA FOR SELECTION OF CROP TREES

Select crop trees to retain using the following consideration:

* Crop tree selection is based on the following species priority:-
    a. Jarrah/Blackbutt (referred to as jarrah in the text).
    b. Marri
    c. Sheoak

* **Eucalypt crop trees** should be in the dominant or codominant level, with a healthy well structured crown. Trees with primary crowns are capable of expansion to take advantage of the space available. Secondary crowns show less capacity for expansion.

Trees with a deep, broad crown grow five times faster than trees with a narrow, shallow crown. Crown vigour is much more significant than bole length.

eg: Original diameter	30cm	30cm
Bole length	5m	10m
Crown condition	Deep,Broad dense	Shallow, Narrow dense
Diameter in 20 yrs	50cm	34cm
Volume on 20yrs	.63cu.m	.5cu.m
Time taken to reach sawlog size (50cm)	20yrs	100yrs

- Crop trees should have a bole free of any defect that would preclude its use for either a sawlog or a pole (minimum defect free bole should be 3m for sawlogs).
- In general, larger diameter trees will increase in diameter faster than smaller ones.

* **Sheoak crop tree** selection should be based on the following criteria:-
- healthy, well structured deep but narrow crown.
- minimum bole length of 1.8m with at least 50% of the diameter defect free.