PROPOSALS TO AMEND THE 1987 FOREST MANAGEMENT PLANS AND TIMBER STRATEGY

AND

PROPOSALS TO MEET MINISTERIAL CONDITIONS ON THE REGIONAL PLANS AND WACAP ERMP

FORMAL ASSESSMENT UNDER PART IV OF THE EPA ACT

by the Department of Conservation and Land Management

February 1992

FORMAL ASSESSMENT OF PROPOSALS BY THE DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT TO ALTER FOREST MANAGEMENT STRATEGIES SET OUT IN THE 1987 FOREST REGION MANAGEMENT PLANS AND TIMBER STRATEGY, TO IMPROVE FOREST MANAGEMENT AND MEET MINISTERIAL CONDITIONS ON THE REGIONAL PLANS AND WACAP ERMP

Calling for submissions

The Environmental Protection Authority (EPA) and the Department of Conservation and Land Management (CALM) invite people to make submissions on this proposal.

Why write a submission?

A submission is a way to provide information, express your opinion and suggest a course of action or alternative approach. A formal submission ensures that your thoughts are accurately conveyed.

All submissions received will be acknowledged. A summary of submissions received will be prepared by the EPA and a response to your comments made by CALM. These will be used in the development of the report and recommendation to Government by the EPA. Submissions will be treated as public documents and may be quoted in the report unless confidentiality is requested.

Developing a submission

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- Attempt to list points so that the issues raised are clear.
- Refer each point to a chapter number and sub heading (or page number) in the draft document.
- If you discuss different sections of the draft document, keep them distinct and separate, so there is no confusion as to which section you are considering.
- Attach any factual information and give details of the source.

Remember to include:

- Your name or the name of your organisation
- Address
- Date

The closing date for submissions is 5 May 1992.

Submissions should be addressed to:

The Chairman
Environmental Protection Authority
Westralia Square
38 Mounts Bay Road
PERTH WA 6000
(Attention: J Malcolm) OR

The Executive Director
Department of Conservation and Land Management
PO Box 104
COMO WA 6152
(Attention: Forest Strategy Project Officer)

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PREFACE

This document proposes a number of changes to forest management in Western Australia.

It is one of a series of four documents which have been prepared concurrently and should be read in conjunction with one another. The related documents are

- A Nature Conservation Strategy for Western Australia;
- Management Strategies for the South West Forests of Western Australia, a Review;
- National Estate Values in the Southern Forest Region, South West Western Australia, a joint report by CALM and the Australian Heritage Commission.

These four documents fulfil obligations resulting from conditions imposed by the Minister for the Environment when approving the 1987 Forest Region Management Plans and Timber Strategy and the WACAP ERMP; in addition it proposes a range of amendments to the Regional Management Plans, principally to do with the conservation reserve system in the forest, and amendments to the Timber Strategy relating to sustainable wood yield levels.

All of the above documents have been released in draft form for a period of three months from 5 February 1992 and comments from the public are sought. Comments on the Nature Conservation Strategy and Review of Forest Management Strategies should be sent to the Executive Director of the Department of Conservation and Land Management.

Comments on the CALM/AHC report can be sent direct to the AHC or to the Executive Director, CALM.

Syd Shea
EXECUTIVE DIRECTOR

1. INTRODUCTION

Shortly after its formation in 1985 the Department of Conservation and Land Management (CALM) undertook a review of forest management in Western Australia. This review culminated in the release of Regional Management Plans for the three forest regions of the south west and a Timber Strategy for Western Australia. The Regional Management Plans set out the proposed land tenure and classification system in forest areas and specified management strategies. The Timber Strategy dealt with the supply of logs and the management of the timber industry in the south west.

At about the same time an Environmental Review and Management Program (ERMP) was submitted to the Environmental Protection Authority (EPA) by the West Australian Chip and Pulp Company (WACAP) as part of the process of gaining approval for renewal of their woodchip export licence.

The three Forest Regional Management Plans and Timber Strategy were released for public comment in April 1987; the WA Chip and Pulp ERMP was released for public comment in July 1987.

In December 1987 the EPA published their report and recommendations on the three management plans and Timber Strategy, and in July 1988 the report on the WACAP ERMP. The West Australian Minister for the Environment approved implementation of the Regional Management Plans, Timber Strategy and the WACAP project subject to a number of conditions.

Some of these conditions require CALM to undertake further studies and to make further submissions to the Environmental Protection Authority. The relevant conditions are:

No. 3 *No logging shall occur in existing Road, River and Stream Zones until the Department of Conservation and Land Management has developed, in consultation with the public, a detailed proposal for those zones and the Environmental Protection Authority has assessed and accepted the proposal.*

No. 4 *(1)* *The Department of Conservation and Land Management (as part of the review and development of a detailed proposal for Road, River and Stream Zones required in condition 3), shall identify within old growth State forest:*

- *additional areas of high value old growth forest meriting special treatment in the sense that they should be managed and harvested flexibly rather than be subject to broad-scale clearfelling; and*
- *areas which should be excluded from harvesting to protect their exceptional scenic, faunal, and other amenity values.*

(2) *Within the constraints imposed by the Timber Production Strategy on the volume of sawlog timber, the Department of Conservation and Land Management shall prepare and implement a scheme of management for these special areas.*

No. 5 *Any proposal to harvest wood from the salt risk zones of the Central and Northern Forest Regions, by more intensive methods than selection cut harvesting shall be referred to the Authority for assessment.*

No. 6 *Marri resource in the salt-risk zones of the Southern Forest Region shall not be supplied to WACAP until an Environment Management Programme for these zones has been prepared to the satisfaction of the Environmental Protection Authority. The Management Programme shall give prior details of salt risk areas to be harvested, harvesting methods and safeguards to be applied, monitoring techniques proposed and feed-back mechanisms which would be used to modify management, if salt impacts were found.*

No. 13 *These conditions apply to the use of wood for woodchips from the State Forest in the North, Central and Southern Forest Regions.*

The Northern, Central and Southern Forest Region Management Plans, Ministerial Conditions

No. 3 *Management Plans that will be prepared for those proposed Nature Reserves and Conservation Parks related to the existing Dalgarup, Lennard, Mullalyup, Preston, Noggerup, Mowen and Dardanup MPAs shall include detailed management proposals for those portions of the MPAs which have the capacity for direct interaction with the reserved area and will remain within State Forest, to ensure protection of the ecological values within the Nature Reserves and Conservation Parks.*

No. 5 *Noting that: CALM is now preparing a review of road, river and stream zones, including an analysis of results of research on logging in trial areas:*

The existing area and purpose of the system of road, river and stream zones in the Southern Forest Region shall not be altered (in accordance with the proponent's commitments) and no logging shall occur in these zones, until the proposed review by the proponent has been completed and the EPA has reported on them. This review should include consideration of silvicultural practices within the zones.

Action Taken

The resolution of these Ministerial conditions required a substantial program of new research and public consultation. In order to answer critical questions about harvesting in the salt-sensitive zones and development of a revised road, river and stream zone system it was necessary for detailed information to be obtained from a new jarrah forest inventory which was initiated in 1988 and successfully concluded in 1991.

Other work included a major computer hardware upgrade and further development of the Department's computerised Geographic Information System, further analysis of research studies, particularly those associated with forest hydrology and nature conservation, and extensive field trials of new approaches to jarrah and karri silviculture. New silvicultural prescriptions were developed during 1991.

In addition, a comprehensive review of the adequacy of the conservation reserve system was undertaken using additional criteria to those considered previously.

CALM and the Australian Heritage Commission

Paralleling the above, CALM has undertaken a major study of National Estate values in southern forests in conjunction with the Australian Heritage Commission.

The Australian Heritage Commission is a statutory body established by the Australian Heritage Commission Act 1975. The Commission was set up to advise the Commonwealth

Government on the protection of the National Estate and to compile and keep a register of all places which are included in the National Estate.

The National Estate is defined as "those places, being components of the natural environment of Australia or the cultural environment of Australia, that have aesthetic, historic, scientific or social significance or other special value for future generations, as well as for the present community".

In 1990 the Australian Heritage Commission (AHC) visited Western Australian and inspected forest areas nominated for the National Estate. At the conclusion of that visit an agreement was reached with CALM to conduct a joint evaluation of data to determine National Estate values for the whole of the southern forest of Western Australia. This evaluation also serves to address Ministerial condition No 4 from the WACAP ERMP relating to high value old growth forest.

The evaluation was completed for the southern forests in November 1991, and the results of the joint study are reported in "National Estate Values in the Southern Forest Region, South West Western Australia" (CALM/AHC 1992).

The New Nature Conservation Strategy and Review of Management Strategies for South West Forests of Western Australia

During 1991 a new Nature Conservation Strategy was drafted and a review of native forest management in Western Australia was carried out. These are intended to provide the philosophical and policy basis for management by the Department of Conservation and Land Management, in particular for the management of forests.

The Nature Conservation Strategy and the Review are the basis for all changes to the Forest Regional Management Plans and Timber Strategy proposed in this document, and should be referred to for all background information and rationale for new proposals.

2. NEW MANAGEMENT OBJECTIVE FOR NATIVE FORESTS

Objective

Forest management objectives for Western Australia must incorporate the legislative requirements of the CALM Act (1984) and the Wildlife Conservation Act (1950), the principles of ecologically sustainable development and the Government's specific goals and policies.

Arising from amended legislation, the new Nature Conservation Strategy and the Review of Management Strategies for South West Forests carried out during 1991, a new overall objective for the management of public native forests in Western Australia has been developed. This is:

> *To manage the native forests of the south west of Western Australia, in consultation with the community, so that they provide the values required by society while sustaining indefinitely their biological and social diversity.*

Implementation

The above objective will be put into effect through the following devices.

Firstly, through the development of issue plans attached to and approved with the Regional Management Plans (eg, the Timber Strategy) which are put into effect using regulations under the CALM Act.

Secondly, through incorporation in the management plans for the forest regions. This will provide the land tenure base for the conservation reserve system and multiple use forest areas.

Thirdly, by development of area management plans for individual parks and reserves.

Fourthly, by development of wildlife management programs and recovery plans for selected flora and fauna taxa.

Fifthly, through the development of departmental policies and prescriptions (eg, for disease control or silviculture) which apply on all forests managed by CALM and are implemented by CALM staff in regions and districts.

Sixthly, through the development of an annually updated five-year research plan which directs the priorities for research by CALM.

3. PROPOSED CHANGES TO FOREST MANAGEMENT TO ADDRESS MINISTERIAL CONDITIONS ON THE 1987 MANAGEMENT PLANS AND WACAP ERMP

3.1 Road, River and Stream Zones

A system of road, river and stream zones was developed for southern forests during the early 1970s. The objective was to provide corridors and strips of undisturbed forest adjacent to areas being harvested for sawlogs and woodchips. The system comprised a network of varying widths along selected major roads, rivers and some streams. Along selected streams 100 metres of forest either side of the stream was protected; this width increased to 200 metres either side of rivers. Along selected roads 200 metres either side of the road was designated. In practice up to 400 metres either side was actually retained.

The objectives of this system were:

- To provide zones of undisturbed vegetation between water courses and logging areas so as to minimise the risks of stream sedimentation or salinity.
- To provide vistas of undisturbed forest for tourists travelling on major roads.
- To provide corridors of mature vegetation which would provide habitat for wildlife and a reservoir of species which could recolonise maturing regrowth forests in the harvested areas, and which would interconnect major conservation reserves.

When this system was developed in the early 1970s the best information available at the time on forest hydrology and nature conservation was used. However, it was recognised that more information was required, and several research programs were initiated. Specifically, it was necessary to determine objective methods of optimising water resource protection, conserving fauna at the local level and managing the visual resource. It was also recognised that the original system was distorted by the unnecessarily excessive width of some road protection zones, where 400 metres was set down, although 200 metres was specified.

The extensive research and public consultation programs undertaken since the 1970s indicated that the objectives of the original road, river and stream zone system remained valid, but the allocation of forests to these zones could be made more effective.

In addition, CALM has developed a Geographic Information System which can analyse a variety of options for meeting the specific objectives of the road, river and stream zone system. The GIS was used to determine the most effective river, stream and road zone system.

The proposed system is based on the results of research into forest hydrology and nature conservation, and on a quantitative assessment of forest visual resource values.

The results of hydrological and ecological research on this issue are discussed in the Review of Management Strategies for South West Forests. The principal findings from this research were:

(i) Small, local and transient reductions in water quality associated with timber harvest and regeneration in some areas can be avoided by retaining a zone of undisturbed vegetation adjacent to streams and rivers (see Water Authority, 1987).

(ii) The retention of undisturbed streamside zones also helps to protect nature conservation values in forests from which timber is being harvested, through the provision of mature habitat and of linkages to other undisturbed areas; these undisturbed streamside zones are also themselves areas of high ecological diversity (Wardell-Johnson *et al.*, 1991).

(iii) Roadside forests can be managed to avoid or minimise disturbance to the highest scenic values by the application of visual resource management procedures (Revell, 1991).

In addition to these scientific studies, the Lands and Forest Commission conducted a public workshop on the designation and management of road, river and stream zones in southern forests at Manjimup in 1991. Proceedings of the workshop were published (Lands and Forest Commission, 1991)..

The existing system of road, river and stream zones does not optimise wildlife, water resource and aesthetic values. The review of research findings and of public input concludes that the priority must be protection of riparian zones in the forest, while aesthetic values along roadsides can be maintained by the applicataion of visual resource management strategies.

A new system for road, river and stream zones is proposed. The proposals are shown for roads (or "Travel Routes" because a tramway and a walking path are included) in Table 1, and for rivers and streams in Table 2.

Table 1

A proposed new travel route zone system for West Australian forests

- The entire forest will be mapped into three scenic quality zones (A, B or C).
- Travel routes throughout the forest will be surveyed and classified as Level 1, 2, 3 or 4 according to patterns of use and viewer sensitivity. Level 1 routes are those which meet the highest criteria for visual resource values.
- In southern forests where clearfelling is the method of timber harvest and regeneration, 200 metres of undisturbed forest will be retained on either side of all travel routes classified as Level 1, and 100 metres will be retained on either side of all travel routes classified as Level 2. (See below for a list of roads in the Southern Forest Region classified as Level 1 or Level 2.) Level 3 and Level 4 travel routes do not require buffers.
- No logging of mature forests will take place in these zones. Even-aged regrowth forests will be thinned; dangerous trees may be felled and utilised if these pose a hazard to human life.
- In central and northern forests and in jarrah stands adjacent to Level 1 roads in southern forests, harvest gap size will be modified depending upon whether the area is

classified as Scenic Quality A, B or C. Allowable gap sizes will be spelt out in silvicultural specifications (see Table 7).

- Prescribed burning for fuel reduction or habitat regeneration will take place from time to time in these zones.

- New roads may be constructed which cross these zones but they will be designed to minimise impacts on the values which are being protected. Forest produce generated during legitimate road construction will be utilised.

Level 1 travel routes in the southern forest are:

Big Tree Road*
Beardmore Road
Boat Landing Road
Boorara Road*
Burma Road
Centre Road*
Channybearup Road
Chesapeake Road
Chindalup (Tone) Trail*
Collins Road
Coronation Road
Cosy Creek
Diamond Tree Road*
Davidson/Graphite Road
Deeside Coast Road
Dog Road*
Donnelly Mill Road
Donnelly Drive*
Eastbourne Road*
Eastbrook Road*
Glauders Road*
Kin Kin Road*
Kurandra Road*
Middleton Road
Middlesex Road*
Mockedillup Road*
Mordalup Road
Mt Frankland Road
Muir Highway
North Pemberton Road*
Nornalup Road*
Orchid Road
Pemberton-Northcliffe Road
Pemberton-Northcliffe Tramway*
Perup Road
Pine Creek Road*
Peppermint Grove Road*
Ralph Road*
Ritter Road*
River Road*
Rainbow Trail*
Sears Road
Seven Day Road
Smith Road*
South West Highway
Spencer Road*
Stirling Road
Thompson Road
Tramway Trail
Vasse Highway
Wheatley Coast Road

Level 2 travel routes in the southern forest are:

Boronia Road*
Boyup Brook/Cranbrook Road
Corballup Road
North Walpole Road
Pozzi Road*
Seaton Ross Road*
Grays Road
Lewis Road*
Malimup Track*
Scott Road*
Weld Road*
West Palgarup Road*

* Roads which were not included in the previous road zone system.

The previous road zone system in the Southern Forest Region included Bevan Road, Bunnings Log Road, Dean/KTC Road, Distributor Road, Kingston Road, Nelson Road, North Road, Springdale Road and Westbourne Road. When evaluated using visual resource criteria, these roads did not rate as Level 1 or Level 2 travel routes.

Table 2

A proposed new river and stream zone system for Western Australian forests

- This proposal will apply to all State forests.
- All rivers and streams within the publicly-owned forest of the south west will be classified as first, second, third, fourth or fifth order and a protective zone of undisturbed vegetation will be designated. (Note: Stream order numbers are based on a geneological approach. A first order stream is the smallest at the top of the catchment. Where two first orders meet a second order is formed and where two second orders meet a third order is formed. Fifth order streams are generally rivers.)
- On all first, second and third order streams a zone of between 20 metres and 30 metres of undisturbed vegetation will be retained on either side of the stream. The width applied will depend on the location of the riparian zone, as determined by ecological and topographical characteristics.
- On all fourth order streams a zone of between 50 metres and 75 metres of undisturbed vegetation will be retained on either side of the stream. The width applied will depend on the location of the riparian zone, as determined by ecological and topographical characteristics.
- On all fifth order streams and above (ie, rivers) a zone of between 100 metres and 200 metres of undisturbed vegetation will be retained on either side of the river, the width depending on the adjoining ecological and topographic situation.
- Prescribed burning for fuel reduction or habitat regeneration will take place from time to time in these zones.
- New roads may be constructed which cross these zones but these will be designed to minimise impact on the values which are being protected.
- Forest produce generated during legitimate road construction and trees removed because they present a danger to human life will be the only utilisation in these zones. No logging for the sole purpose of generating forest produce will be permitted.

Comparison of 1975 road, river and stream zone system and proposed new system

The following tables compare the original road, river and stream zone system which applied only to the woodchip licence area and the proposed road, river and stream system which will apply to all south west forests.

Roads/Travel Routes

Table 3: Area of forest (ha) in existing and proposed road zones in the Southern Forest Region

Forest Type	ROAD ZONES Existing System	Proposed (within WLA)*	Proposed (outside WLA)	Total (proposed)
Jarrah	27 100	10 385	530	10 915
Karri				
Even-aged regeneration	2 000	830	5	835
Mature karri	8 900	4 430	5	4 435
Other forest	-	70	0	70
Other	3 400	1 360	540	1 900
Total	41 400	17 075	1080	18 155

* WLA = "Woodchip Licence Area"

Rivers and Streams

Table 4: Areas of forest (ha) within existing and proposed river and stream zones in the Southern Forest Region.

Forest Type	RIVER AND STREAM ZONES Existing System	Proposed (within WLA)*	Proposed (outside WLA)	Proposed Linkage Zones and Corridors	Total (proposed)
Jarrah	14 200	22 700	2 540	-	25 240
Karri					
Even-aged regeneration	1 000	3 600	-	-	3 600
Mature karri	12 300	15 560	200	3 200	18 960
Other forest	200	250	-	-	250
Other	3 100	9 920	8 270	-	18 190
TOTAL	30 800	52 090	11 010	3 200	66 300

* WLA = "Woodchip Licence Area"
Note woodchip licence area no longer has any legal status.

The river and stream zoning system will also be extended to the native forest in the Central Forest Region and the Swan Region. This will result in the allocation of a further 91 400 hectares to protected riparian zones.

There has been some controversy surrounding the road, river and stream system in the southern forest. It has been suggested that the existing system will be reduced to

compensate for new forest reserves to be created elsewhere. In fact, if the above proposals are implemented:

- the area in the road, river and stream zone system in the southern forests will be increased from 72 200 hectares to 84 455 hectares (see Table 5 for details);
- the area of mature karri forest in this system will be increased from 21 200 hectares to 23 395 hectares;
- the area of road, river and stream zone system in all native forests will have been more than doubled (see Draft Forest Strategy Review, page 159); and
- visual resource management principles will be applied to the management of roadside forests adjoining all major travel routes through the forest.

Table 5: Comparison of areas (ha) of forest (by forest type) within existing and proposed systems of road zones, river and stream zones and linkage zones - Southern Forest Region

	FOREST TYPE					
	Jarrah	**Regrowth Karri**	**Mature Karri**	**Other Forest**	**Other**	**Total**
Existing System (Woodchip Licence Area only)						
River and stream zones	14 200	1 000	12 300	200	3 100	30 800
Road Zones	27 100	2 000	8 900	-	3 400	41 400
Total	41 300	3 000	21 200	200	6 500	72 200
Proposed System (Woodchip Licence Area only)						
River and stream zones	22 700	3 660	15 560	250	9 920	52 090
Road zones	10 385	830	4 430	70	1 360	17 075
Linkage zones	-	-	3 200	-	-	3 200
Total	33 085	4 490	23 190	320	11 280	72 365
Proposed System (Entire Region)						
River and stream zones	25 240	3 660	15 760	250	18 190	63 100
Road zones	10 915	835	4 435	70	1 900	18 155
Linkage zones	-	-	3 200	-	-	3 200
Total	36 155	4 495	23 395	320	20 090	84 455

3.2 High Value Old Growth Forest

The need to preserve representative and viable areas of high value, old growth forest is widely recognised, and is a feature of the conservation reserve system which has been established in WA forests and which it is proposed to further expand (see part 4 of this document).

The requirement to look beyond the reserve system to identify and appropriately manage additional areas of high value old growth forest was hampered for some time by disagreement about what constituted "high value" and "old growth" forest.

CALM has adopted the system developed by the Australian Heritage Commission in its definition of National Estate forests as the basis for identifying high value old growth forests on a regional basis in WA. A major joint study between CALM and AHC staff has examined the southern forests, and agreement has been reached on the designation of National Estate areas for this region, and their management (CALM/AHC, 1992). This study will be continued in central and northern forests in 1992.

Under this system, high value old growth forests will be protected in the conservation reserve system; in the road, river and stream zones; in additional areas of forest which will link stream and road zones and conservation reserves; and in other areas where management prescriptions will apply to ensure the maintenance of National Estate values on a regional basis.

Proposals are set out in Table 6.

Table 6

Proposals for identification and management of high value old growth forests in WA

- The criteria developed by CALM and the AHC to identify forests with National Estate value will be used to identify areas of high value old growth forest. These areas will be nominated for the Register of the National Estate.
- A secure and representative conservation reserve system has been identified and established and is proposed to be further enhanced. In these areas there will be no timber harvesting, thereby allowing old growth values to be retained or to develop over time.
- Old growth forests within designated river and stream zones will not be harvested for timber. In zones adjacent to travel routes classified as Level 1 and Level 2 in the southern forests, old growth forests will not be harvested for timber.
- Within State forests an additional 3200 hectares of mature karri forest will be designated to link reserves and roadside and streamside zones or to encompass patches of mature forest, or areas of special ecological, cultural or recreational value. These areas will not be harvested.
- In areas listed on the Register of the National Estate which are outside the conservation reserve system, outside the road, river and stream zone system or outside the additional areas designated to link reserves, logging and regeneration prescriptions will be applied which ensure that National Estate values are maintained on a regional basis. Where temporary losses of National Estate values are unavoidable, these losses will be minimised. Management procedures are detailed in new silvicultural specifications for the jarrah and karri forests (see Appendix A), and in guidelines within the CALM/AHC report.

- The multi-aged structure of the jarrah forest will be maintained. Mature trees will be retained on all areas harvested for timber. This will provide old growth values throughout the jarrah forest. (See Table 7 and Appendix A.)

- Areas of regrowth karri forest have been identified which will be grown on until they develop old growth characteristics. These include 25 per cent of all pre-1940 regrowth stands and all regrowth stands regenerated between 1940 and 1975 occurring in patches of less than 200 hectares in size. A further 50 per cent of all stands regenerated after 1990 will be grown on until they develop old growth characteristics. Approximately 40 per cent of the karri forest will always contain old growth characteristics.

3.3 Swan (formerly Northern Forest and Metropolitan Regions), Central and Southern Forest Regions: Management of Jarrah Forest Types

Jarrah forests managed by CALM fall into two broad categories: those within nature reserves, national parks and conservation parks (which are managed primarily for nature conservation and recreation); and those within State forests (which are managed for multiple uses, including nature conservation, recreation, and timber and water production).

In State forests the management objective is to sustain, in a whole of forest context, all forest values indefinitely. This will be achieved by the use of silvicultural techniques which develop or maintain a forest structure that delivers fundamental requirements for nature conservation, timber production, water resource conservation, heritage and landscape values; and by the application of protection programs which minimise damage to the forest from fire, disease and pests.

The fundamental requirements are considered to be:

- To maintain biodiversity at the genetic, species and ecosystem level throughout the jarrah forest.
- To maintain or restore populations of all taxa so that use of the forest does not lead to loss of biodiversity at the local level.
- To protect and conserve taxa or communities which are threatened, rare or uncommon in the forest.
- To manage the forest so as to sustain an efficient timber industry.
- To maintain the quality of water from forest catchments and to enhance the yield of water within harnessed catchments.
- To maintain, enhance and improve the scenic quality of the forest.
- To minimise the occurrence and damage caused by wildfires in the forest.
- To prevent the spread and to minimise to intensification of forest diseases and to minimise the damage caused by insect pests.

The principal device used to translate these objectives into operational practice in areas where timber harvesting takes place is the silvicultural specification. This is a document which provides detailed rules and guidelines for field staff responsible for planning and supervising timber harvest and regeneration. Silvicultural specifications are updated from time to time as policy is amended or new research findings are incorporated.

Because silvicultural specifications deal with parameters such as gap size, stand density, retention of habitat trees or patches, cutting cycles and rotation lengths, they are the primary mechanism by which forest structure is managed. In turn, forest structure determines the provision of forest values.

During 1991 the silvicultural specification for the jarrah forest was reviewed and substantially modified. The new approach provides a practical mechanism for meeting nature conservation, timber production, water resource conservation and heritage and landscape objectives for jarrah forests in the Swan, Central and Southern Forest Regions.

The new proposals for silvicultural practice in jarrah forest are detailed in Appendix A. Principal changes are summarised in Table 7. (Note: New silvicultural proposals for karri forest have also been developed and are discussed in Section 3.5 of this document and page 167 of the Draft Forest Strategy.)

Table 7

New proposals for silvicultural practice in multiple purpose jarrah forests

- The existing multi-aged structure of the jarrah forest will be maintained.
- Gap size (see glossary at Appendix B for definition) will not exceed 10 hectares and will be varied downward depending on the scenic quality zone in which timber harvest is taking place.
- Strips of undisturbed forest will be retained between gaps until a later cutting cycle. These strips will be 100 metres in width except where gaps are below one hectare in size, where the minimum strip width will be 50 metres.
- Throughout the intermediate and low rainfall zones at least 30 per cent of the forest of any second order stream catchment will be retained uncut for at least 10 years after the cutting and regeneration of the forest on the remainder of the catchment.
- Three large trees will be retained on every hectare to provide habitat for hollow-nesting species; suitable ground habitat (eg., hollow logs) will be retained and protected as far as possible, at a rate of at least one per hectare.
- No rotation length is nominated for the jarrah forest. This concept is no longer relevant. The objective will be to ensure a multi-aged structure of the forest in all areas.
- In the thinning of regrowth stands in the high rainfall zone a minimum of 10 square metres of basal area will be retained per hectare. In the intermediate and low rainfall zones a minimum of 15 square metres of basal area per hectare will be retained.
- Following timber harvest and regeneration a minimum of three age classes will be present in every area of cutover forest: mature trees, intermediate aged trees retained as crop trees and seedling regeneration.
- No harvesting will occur in river and stream zones, except that associated with road construction or the removal of dangerous trees which may threaten human life (see Table 2).

A number of other new measures are also proposed to enhance jarrah forest management in the Swan, Central and Southern Forest Regions. These are shown in Table 8.

Table 8

Other proposals for jarrah forest management

- A review of fire management programs in the forests will be undertaken. This will incorporate the Wildfire Threat Analysis which integrates the risks of fires starting and the factors which influence fire behaviour and suppression, and the results of fire ecology research.
- Diverse fire regimes (incorporating a range of fire intensities, frequencies and season of burning) will be maintained in the forest.
- Habitat regeneration burning will be undertaken in forests where special requirements for threatened or endangered species are identified.
- New fire-fighting resources will be developed by training personnel employed in the timber industry.
- Newly developed fire system analysis and computerised techniques in fire management will be implemented in forest districts.
- Community education programs on the problem of dieback disease will be expanded.
- Populations of *Banksia grandis* (Bull banksia), whose extensive root systems are highly susceptible to dieback fungus, will be reduced in jarrah forests at risk from jarrah dieback disease to lessen inoculum density of dieback fungus, hence the risk to jarrah trees.
- Research into and use of the fungicide phosphorous acid for control of dieback disease in vulnerable species of trees and shrubs will be developed into operational prescriptions.
- The results of research into the life cycle of the causative agent of dieback disease will be used to determine when and where operations will be carried out in the forest.
- Priorities will be developed for the treatment of weeds in the forest and for the control of feral animals.
- A coordinated program for the eradication of foxes from areas of State forest will be developed and implemented. The aim is to achieve at least 20 per cent of the forest fox-free in the next 10 years.

The impacts of forest management practices on forest ecological processes and the flora and fauna are discussed in detail in Chapters 2 and 3 of the draft Review of Management Strategies for the South-West Forests. In summary, research has shown water quality and quantity can be maintained or increased with appropriate practices, there is no evidence for any long-term loss in forest nutrient status, there has been no

loss of any plant or animal species as a result of forest harvesting and regeneration, and fire management regimes are within the known life cycle strategies of plants and animals. Research in all these areas is continuing.

The impact of disease, introduced predators and weeds has the potential for serious adverse effects and management must take account of this.

3.4 Harvesting Marri from the Salt-Risk Zones of the Southern Forests: An Environmental Management Program

Marri sawlogs are harvested throughout the Southern Forest Region, including the "salt-risk zones". Marri chipwood logs are harvested from the intermediate rainfall zone, but not from the low rainfall zone of the Southern Forest Region. This is because there was concern at the time the original Environmental Impact Statement was prepared in 1975 that this may have led to increased stream salinity.

Since that time the Government has stated its intention to phase out chipwood log harvesting from old growth native forests.

Integrated logging operations will continue in these zones during the phase out period so that the Government's timber strategy commitments can be met and proper forest regeneration completed.

Extensive research has been carried out to determine the effects of timber harvesting on water quality in Western Australian forests.

This research has been summarised in a report by the Steering Committee for Research on Land Use and Water Supply (Water Authority of Western Australia, May 1987). The committee concluded its assessment of the implications to forest management with these words:

"Analysis of research results currently available indicates that logging methods involving clearfelling of karri and heavy selection cutting of jarrah have minor effects on stream salinity and sediment concentrations. No major changes to management practice are necessary. However, transient effects on stream salinity and sediment concentrations could be locally significant and could be moderated by refinements to management practice. Such refinements should be progressively developed and implemented." (Water Authority of Western Australia, May 1987.)

The Steering Committee concluded:

"1. In the high and intermediate rainfall zones, logging operations have caused small and temporary increases in stream salinity and/or sediment concentration in many local streams but this presents no significant threat to regional water resources.

2. Further refinement of logging practice is possible to moderate local transient effects on stream salinity and sediment concentration.

3. With appropriate management, there is no significant stream salinity risk from heavy selection cutting in the low rainfall north-east sector of the Woodchip Licence Area."

The results of the hydrological research initiated by the Steering Committee were reviewed in consultation with the WA Water Authority as part of the Review of Native Forest Management (CALM 1992).

This review confirmed the conclusions of the Research Steering Committee and in particular highlighted the benefit of undisturbed zones of vegetation along streams. In experimental catchments where zones of undisturbed vegetation were retained along streams there has been no reduction in water quality.

The Steering Committee recommended either retention of stream zone vegetation or phased logging as the principal methods to be used to moderate local, transient effects of logging on stream salinity and sediment concentration. They also recommended that a monitoring system be implemented to identify salt-sensitive areas. Once identified it was proposed that stream buffer areas in the intermediate rainfall zone which were not salinity prone would be available for timber harvesting. The Steering Committee proposed that water quality would best be preserved in the high rainfall zone by "the introduction of permanent stream buffers" but noted that this would result "in a loss of valuable timber resources". As an alternative they proposed that phased logging operations be introduced.

It is proposed that restrictions on the harvesting of marri, imposed in the low rainfall zone for salinity control reasons, be removed. The small, local and transient effects of logging on salinity will be avoided by the imposition of stream and river zones of undisturbed vegetation throughout the forest, and phased logging throughout the intermediate and low rainfall zones. It is also proposed that a monitoring system be introduced.

The specific procedures which will be introduced to fulfil the requirements of Ministerial Condition 6 are as follows:

1. The river and stream zone system outlined above in Table 2 will be implemented in the salt risk areas. This means that zones of undisturbed vegetation will be retained beside all streams. No logging, including thinning (other than the removal of dangerous trees where they pose a threat to human life or salvage of forest produce generated by legitimate road construction) will occur in these zones.

2. The 1991 Jarrah Silviculture Specification will be applied to jarrah and jarrah/marri forests in these areas. This specification is at Appendix A. Major features are summarised in Table 7. In essence, the multi-aged structure of the jarrah forest will be retained in all areas; gap sizes will not exceed 10 hectares, within gaps three mature habitat trees per hectare will be retained; all cutover areas will be regenerated.

   The proposed Silvicultural Specification for Karri and for Karri/Marri Forests is outlined in Chapter 4. These changes will be formalised into a CALM silvicultural specification and applied to the appropriate areas on release of the final Strategy document.

3. In the intermediate and low rainfall zones at least 30 per cent of the forest on every second order stream catchment will be retained uncut for at least 10 years after the cutting and regeneration of the forest elsewhere on that catchment. This ensures that logging will be "phased" throughout the intermediate and low rainfall areas.

4. Where stands are thinned in the intermediate and low rainfall zones a minimum of 15 square metres of basal area per hectare will be retained on all areas.

5. A stream monitoring program will be established throughout the intermediate and low rainfall zones.

- All second order catchments will be sampled for a period of five years after they have been logged.
- Total soluble salts will be determined at peak flow and base flow periods.
- Ten unlogged second order catchments will be sampled for the purpose of establishing "control" total soluble salt levels.

6. Monitoring of existing bores and research catchments will continue.

7. The results of the stream monitoring program will be reported annually to the WA Water Authority.

3.5 Management of Areas Adjacent to Existing or Proposed Conservation Reserves in the Jarrah Forest

Ministerial Condition 3 resulting from the EPA's review of the 1987 Forest Regional Management Plans required that management plans for specified conservation reserves in the jarrah forest be prepared. The condition also required that these plans should detail management proposals for areas adjacent to the reserves which would ensure the protection of "the ecological values within the nature reserves and conservation parks".

The following addresses the Ministerial Condition:

- The Review of Forest Management has shown there is no evidence that any existing management practice in areas adjacent to the conservation reserves has any detrimental effect on the ecological values of the reserves. Nevertheless, a new jarrah forest silvicultural specification has been developed which further ensures the protection of ecological values in the forest.
- It is proposed to increase the area of the Lennard, Preston and Noggerup reserves (see Section 5) and create additional reserves.
- It is proposed to apply visual resource management prescriptions (detailed in A Review of Forest Management) to the areas adjacent to the conservation reserves designated in the Ministerial Condition.
- Management plans for the designated reserves will be prepared according to the availability of resources and priorities of the Government and the NPNCA. It is anticipated, however, that these plans will be prepared before the expiration of the Regional Management Plans.

4. PROPOSED CHANGES TO KARRI SILVICULTURE

When timber is being harvested from mature multiple purpose karri and karri/marri forests the following changes to the silvicultural approach spelt out in the 1987 Regional Management Plans and Timber Strategy and the WACAP ERMP are proposed:

- **Gap size** (or coupe size) will not exceed 80 hectares. Gap size and shape will be designed to meet the landscape, wildlife, recreation and heritage values of the site. Gaps may be as small as one hectare. Average gap size is expected to be 30 hectares.

- **Retained mature habitat.** In addition to the road, river and stream zone system an additional 3200 hectares of mature forests will be excluded from harvesting and regeneration and from yield calculations. This area will be distributed to cover "habitat patches" and to provide linking corridors within larger gaps and the river, stream and road zone system, and to encompass special high value ecological or recreational sites. In these areas understorey vegetation and ground components will be kept undisturbed during harvesting and regeneration.

- **Rotation lengths** will vary. No rotation length is nominated for areas being managed primarily for nature conservation and recreation (ie, road, river and stream zones and habitat retention areas). These areas are expected to reach their natural physiological rotation, ie >250 years.

  In regrowth forests regenerated before 1940, 25 per cent will be managed on a 250 year rotation and the remainder on a 100 year rotation.

  In regrowth forests regenerated between 1940 and 1975 where patch size is less than 200 hectares the rotation age will be 250 years. Where the patch size is more than 200 hectares the rotation age will be 100 years.

  In regrowth forests regenerated between 1975 and 1990 approximately 10 per cent will have a rotation age of 250 years. In the remainder the rotation age will be 100 years, except for some small, understocked or fire-damaged areas which will be harvested and regenerated at age 60 or age 80.

  For 50 per cent of regrowth forests established after 1990 rotation length will exceed 150 years and may exceed 200 years.

- **Gap dispersal.** A minimum of three years will elapse between the harvesting and regeneration of adjacent gaps. Where possible, the distance between areas of retained mature forest will not fall below 400 metres.

These changes will be formalised in a CALM silvicultural prescription when the final Strategy document is released.

5. PROPOSED CHANGES TO THE RESERVE SYSTEM IN SOUTH-WEST FORESTS

The 1987 Forest Regional Management Plans designated the bulk of the forest areas managed by CALM as either national park, nature reserve, conservation park, State forest or timber reserve. The land use designation set out in these plans have been steadily implemented over the last five years.

Since the 1987 plans were approved, more information has become available on the heritage value of southern forests, on the criteria for wilderness and on the presence within the forest of specific plant communities. A new set of principles has been developed which help to define an ideal nature conservation reserve system. These principles (which are dealt with in some detail in the Review of Forest Management Strategies) require that the reserve system incorporates areas which are special, representative, viable, properly managed and have involved the community in their selection.

Changes to the reserve system are therefore proposed.

5.1 Additions to State Forest

The 1987 Forest Region Management Plans identified an area of 283,000 hectares of forest which could be dedicated as State forest. This forest is currently vacant Crown Land, or within various miscellaneous reserves in the south west.

All these areas were re-examined during 1990-91. This review confirmed the value of these areas for multiple-purpose management, so it is proposed to proceed with their dedication as State forests. This will represent the most significant increase to the State forest estate for many decades.

5.2 New Conservation Reserves

A review of the current conservation reserve system in south west forests has revealed that all major forest types are represented in the reserve system. The review indicated that the system could be enhanced by expansion to include some specific vegetation types within forest types, and to incorporate wilderness values.

A substantial increase to the conservation reserve system is recommended. In particular, a major new national park of 78,820 hectares is proposed in the Southern Forest Region, and new national parks are proposed within the jarrah forest in the Central and Swan Regions.

Table 9 and Table 10 summarise all the recommended additions to the conservation reserve system. The location and extent of the proposed reserves is shown on maps included in the Review of Forest Management in the South West of Western Australia.

Table 9 **Recommended additions to the nature conservation reserve system - Swan Region* and Central Forest Region**

Region	District	Area Name	Area (ha)	Vegetation Complexes Represented	Other Features	Current or Proposed (1987) Classification	Proposed (1992) Classification
Swan*	Jarrahdale	Gibbs	5 860	Michibin, Coolakin (L), Williams	Monadnocks; Wandoo forest.	State Forest	National Park
	Dwellingup	George	3 140	Michibin, Coolakin (L), Murray (L/M), Williams	Monadnocks; Wandoo forest; 510 ha virgin forest; Adjoins Lane-Poole Reserve.	State Forest	Conservation Park
Central Forest	Harvey	Clarke	1 165	Lowden, Murray (M/H) Dwellingup (H)	160 ha virgin forest; adjoins Falls Brook Nature Reserve.	State Forest	Nature Reserve
		Stene	1 465	Michibin, Coolakin (L),	580 ha virgin jarrah and wandoo forest; adjoins Lane-Poole Reserve.	State Forest	National Park
	Collie	Gervasse	2 015	Helena (M/H), Murray (M/H), Dwellingup (H), Yarragil (Min Swamps)	Yarri (blackbutt) forest; high scenic values; adjoins other Conservation Parks.	State Forest	Conservation Park
		Lennard	645	Darling, Lowden, Dwellingup (H), Yarragil (Min Swamps)	Virgin jarrah and yarri forest; adjoins existing Conservation Park.	State Forest	Conservation Park
		Roseneath	1 565	Wilga, Lowden, Yarragil (Min Swamps)	Adjoins Goonac Conservation Park.	State Forest	National Park
	Kirup	Preston Hovea Noggerup	3 045	Lowden, Wilga, Dwellingup (H), Williams	Adjoins existing Conservation Parks.	State Forest	National Park
		Camballan	8 695	Wilga, Coolakin (L)	Wandoo forest.	VCL (State Forest)	Conservation Park
		Ryall	260	Lowden, Darling, Dwellingup (H)	Capel River Valley.	State Forest	Conservation Park
		Hester	780	Michibin, Dwellingup (H)	Blackwood River Valley	State Forest	Conservation Park
	Nannup	Beaton	415	Darling, Dwellingup (H)	Virgin jarrah forest	State Forest	Conservation Park

* Note: formerly named "Northern Forest Region"

Table 10 **Recommended additions to the nature conservation reserve system - Southern Forest Region**

Region	District	Area Name	Area (ha)	Land Units Other Represented	Current Features (1987) Classification	Proposed Classification	(1992)
Southern Forest	Manjimup	Keninup	6 740	Jarrah open forest; Wandoo woodland; (low rainfall zone)	5200 ha of virgin Wandoo and Jarrah forest; habitat for six declared threatened mammal species; adjoins Perup Nature Reserve	State Forest	Nature Reserve
		Talling	6415	Jarrah open forest; Wandoo woodland; (low rainfall zone)	2800 ha of virgin Jarrah and Wandoo forest; habitat for declared threatened mammal species; rare flora; adjoins Perup and Lake Muir Nature Reserves.	State Forest	Nature Reserve
		Dingup	210	Blackbutt open forest (intermediate rainfall zone)	Virgin Yarri and Jarrah forest	State Forest	Nature Reserve
		Chitelup		*See Mt Roe			
	Pemberton	Charley	2 445	Karri tall open forest; Jarrah open forest; Pultenaea closed shrubland (high rainfall zone)	Virgin forest; dunal landform; lakes and wetlands; adjoins Warren and D'Entrecasteaux National Parks	State Forest	National Park
	Walpole	Mt Roe	78 820	Karri tall open forest; Tingle tall open forest; Jarrah open forest; Jarrah/Marri open forest; Swamp and heath communities; Jarrah/Banksia/ Paperbark low open; woodland;Wandoo woodland (intermediate rainfall zone)	32 000 ha of virgin forest and woodland; high wilderness values; Monadnocks; river valleys; lakes and wetlands; numerous rare flora species; habitat for declared threatened species; adjoins Mt Frankland Mt Lindesay National Parks and Lake Muir Nature Reserve	State Forest/VCL	National Park
		Mattaband	250	Karri tall open forest; Jarrah/Marri open forest	Virgin Karri and Jarrah forest; benchmark catchment; adjoins Mt Frankland National Park	State Forest	National Park

5.3 Changes to Existing Tenure

In addition to the nature conservation reserve system outlined in Table 9, the process of implementation of the 1987 Regional Plans has highlighted a number of inconsistencies requiring minor changes to land tenure and classification.

These mainly relate to the appropriateness of the 1987 proposed classification in relation to the designated area's size or condition, or boundary changes requiring amendment to the plan.

Table 11 summarises all proposed changes to tenure and vesting the location and extent of which are shown on maps 3, 4 and 5 of the Draft Forest Management Strategy Review.

Table 11 Proposed changes in tenure, vesting and purpose for the Swan, Central Forest and Southern Forest Regions

ID No.	ID No. 1987 Plan	Area Name	Area (ha)	Current or Proposed(P) (1987) Classification	Proposed Classification (1992)
SWAN REGION					
Perth District					
1	-	Yanchep	45	VCL	national park
Mundaring District					
2	-	John Forrest	1 130	freehold	national park
3	46	Burkinshaw Road	10	conservation park(P)	delete from plan
Jarrahdale District					
4	34	Araluen-Canning	35	conservation park(P)	delete from plan
5	39	Monadnocks	15 370	conservation park(P)	national park
6	**-**	**Gibbs**	**5 850**	**State forest**	**conservation park**
7	**-**	**Gibbs**	**10**	**timber reserve**	**conservation park**
Dwellingup District					
8	7	Meelon	5	nature reserve(P)	delete from plan
9	**-**	**George**	**3 140**	**State forest**	**conservation park**
10	-	Lane Poole Reserve (Icy Creek)	180	conservation park(P)	5g reserve
CENTRAL FOREST REGION					
Harvey District					
11	57,63	Lane Poole Reserve	*26 420	Conservation park(P)	national park
12	-	Lane Poole Reserve (Stene)	1 465	State forest	national park
13	**-**	**Clarke (Falls Brook)**	**1 165**	**State forest**	**nature reserve**
14	54	Kemerton	1 405	5g reserve(P)	delete from plan
15	55	Kemerton	265	5g reserve(P)	conservation park
16	64	Wagerup	10	conservation park(P)	delete from plan

ID No.	ID No. 1987 Plan	Area Name	Area (ha)	Current or Proposed(P) (1987) Classification	Proposed Classification (1992)
Collie District					
17	36-40	Lane Poole Reserve	*9 845	conservation park(P)	national park
18		**Lennard**	**645**	**State forest**	**conservation park**
19	**-**	**Gervasse**	**2 015**	**State forest**	**conservation park**
20	**-**	**Roseneath**	**1 360**	**State forest**	**national park**
21	32-35	Goonac	5 140	conservation park(P)	national park
Kirup District					
22	**80**	**Goonac**	**30**	**conservation park(P)**	**national park**
23		**Preston**	**305**	**State forest**	**national park**
24	**-**	**Hovea**	**1 055**	**State forest**	**national park**
25	**-**	**Noggerup**	**1 690**	**State forest**	**national park**
26	84	Gwindinup	10	conservation park(P)	delete from plan
27	**-**	**Hester**	**780**	**State forest**	**conservation park**
28	**-**	**Ryall**	**260**	**State forest**	**conservation park**
29	**-**	**Camballan**	**7 155**	**vacant Crown land**	**conservation park**
30	**-**	**Camballan**	**1 430**	**State forest**	**conservation park**
31	**-**	**Camballan**	**110**	**other reserve**	**conservation park**
Busselton District					
32	-	Leeuwin-Naturaliste	325	other reserve	national park
Nannup District					
33	**-**	**Beaton**	**415**	**State forest**	**conservation park**
SOUTHERN FOREST REGION					
Manjimup District					
34	6	Jardee	10	conservation park(P)	State forest
35	14	Jervik Park	10	conservation park(P)	delete from plan
36	**-**	**Dingup**	**210**	**State forest**	**nature reserve**
37	**-**	**Keninup**	**6 740**	**State forest**	**nature reserve**
38	**-**	**Talling**	**6 410**	**State forest**	**nature reserve**
39	**-**	**Talling**	**5**	**other reserve**	**nature reserve**
40	**-**	**Chitelup (Mt Roe)**	**2 890**	**State forest**	**national park**
Pemberton District					
41	62,64	D'Entrecasteaux	90	national park	State forest
42	**-**	**Charley**	**2 385**	**State forest**	**national park**
43	**-**	**Hawke**	**60**	**State forest**	**national park**
Walpole District					
44	**-**	**Mattaband**	**250**	**State forest**	**national park**
45	223	Pardalup Road	30	nature reserve	delete from plan
46	129,130	Gum Link Road	575	nature reserve	national park
47	152,154	Thames	880	nature reserve	national park
48	153	Thames	500	nature reserve(P)	national park
49	**-**	**Mt Roe**	**11 715**	**vacant Crown land**	**national park**
50	**-**	**Mt Roe**	**37 050**	**State forest**	**national park**
51	**-**	**Mt Roe**	**26 770**	**other reserve**	**national park**

Note: ID numbers 40, 46-51 represent the proposed Mt Roe National Park (80 380 hectares).

* In the Draft Forest Strategy Review these figures (Table 16) were lower as parts of the identified areas were not included in the area statement. The supporting map (Map 4) showed the boundaries correctly.

5.4 Diverse Ecotype Conservation

A mosaic of heathlands, sedge and herb vegetation, rock outcrops, swamps, lakes, wetlands and low shrubby woodlands occurs throughout State forest, particularly in southern forests.

These are very important areas for wildlife conservation and in some cases passive recreation. They are also a distinctive and integral facet of the forest landscape, and they frequently provide linkage between conservation reserves and other undisturbed forests.

An area of 115,000 hectares of these diverse ecotypes occurs within the southern State forests and a further 88,000 hectares occurs within central and northern State forests.

No timber harvesting occurs in these areas and it is proposed that they be accorded special protection from roadmaking and other physical disturbance.

Effectively this will add a further 203,000 hectares to the area primarily managed for nature conservation within south west forests.

6. PROPOSED AMENDMENTS TO THE TIMBER STRATEGY

As well as proposing changes to the Forest Region Management plans, it is proposed that changes are made to the State's Timber Strategy (which was produced in association with the regional plans in 1987).

Changes to the Timber Strategy are required in the light of:

- changes to forest management strategies proposed in the Review of Forest Management;
- new information about timber resources obtained from the forest inventory;
- proposed changes to the forest reserve system and therefore to the area of forest available for timber production.

If approved, both the amended Regional Management Plans and the amended timber strategy will be current for the period 1992-2002.

Two amendments to the Timber Strategy are proposed.

The first is a restatement of standing volumes of timber in State forests, shown in Table 8 (page 17) of the 1987 Timber Strategy. The updated estimates of timber volumes are shown below in Table 12.

Table 12 **Inventory of timber resource on native forests designated for multiple use in regional management plans**

Forest Type	Area (ha)	STANDING TIMBER VOLUME				Stand Increments
		Gross Bole Volume (1)	Sawlogs	Other Logs	Forest Residue	
		(10^6m^3)	(10^6m^3)	(10^6m^3)	(10^6m^3) (7)	m^3/ha/an
karri and karri/marri	121 700	25.4	10.2	15.2 (2)	4.0	1.5 (3) to 10.0 (4)
Jarrah/marri	1 239 000	144.0	57.2 (5)	86.8 (6)	78.7	1.65

(1) GBV of all major species

(2) Includes 6 400 000m^3 of marri logs

(3) The increment of the selection cut component of old growth forest

(4) The increment of high productivity regrowth (average regrowth increment = 7.3m^3/ha/an)

(5) Includes 4 400 000m^3 of marri sawlogs

(6) Includes 34 800 000m^3 of marri logs

(7) Wood additional to gross bole volume (branchwood and wood derived from dead trees)

The second amendment concerns recommended sustainable yields for the jarrah, marri and karri forests. Tables 13 and 14 below are proposed to replace Tables 14-17 of the 1987 Timber Strategy.

Table 13 **Calculated annual sustainable yield from jarrah forests available for timber harvesting**

JARRAH					MARRI			
Year	SUSTAINABLE YIELD Gross Bole Volume m^3/an	LOG PRODUCT YIELDS (current specifications) First Grade Sawlogs m^3/an	Other Sawlogs m^3/an (1)	Other Logs m^3/an (2)	SUSTAINABLE YIELD Gross Bole Volume m^3/an	LOG PRODUCT YIELDS (current specifications) Sawlogs m^3/an	Other Logs m^3/an (2)	Forest Residue m^3/an (3)
1992-2001	1 360 000	459 000	216 000	685 000	469 000	57 000	412 000	300 000
2002-2036	1 360 000	To be allocated in future strategies			469 000	To be allocated in future strategies		

(1) Includes 2nd grade sawlogs, short sawlogs and small diameter sawlogs

(2) Includes inferior log grades which are available but not all of which are marketed currently

(3) Wood additional to gross bole volume yield (branchwood and wood derived from dead trees)

Table 14 Calculated annual sustainable yield from karri forests available for timber harvesting

Year	KARRI				MARRI			
	SUSTAINABLE YIELD Gross Bole Volume m^3/an	LOG PRODUCT YIELDS (current specifications) First Grade Sawlogs m^3/an	Other Sawlogs m^3/an	Thinning Residue m^3/an (1)	SUSTAINABLE YIELD Gross Bole Volume m^3/an	LOG PRODUCT YIELDS (current specifications) Sawlogs m^3/an	Other Logs m^3/an	Forest Residue m^3/an (2)
1992-2001	417 000	214 000	103 000	100 000	90 000	13 000	77 000	75 000
2002-2036	417 000	To be allocated in future strategies			90 000	To be allocated in future strategies		75 000

(1) Logs below sawlog specifications, derived from thinnings in regrowth forest.

(2) Wood additional to gross bole volume (branchwood)

7. CONCLUSIONS

The Ministerial conditions imposed following the EPA's review of the Regional Forest Management Plans and the WACAP ERMP have been addressed as follows:

- A new system of road, river and stream zones for all forest areas in the south west has been developed in consultation with the public. It is proposed that no logging of mature forests will occur in areas designated as road, river or stream zone, and that the new system be extended beyond the Southern Forest Region to encompass all south west forests. The area of the river, stream and road reserve system (including the additional area reserved on major roads) has been increased, as has the area of mature karri forest within the system.

- Visual resource management principles will be applied to all forest operations so as to minimise or prevent impact on aesthetic values. Specifically, visual resource management principles will be applied to the areas adjacent to the Dalgarup, Lennard, Mullalyup, Preston, Noggerup, Mowen and Dardanup conservation reserves.

- A system of identifying and managing high value old growth forest has been developed for southern forests and provision has been made to exclude timber harvesting from special areas. The system employed has been developed in conjunction with the Australian Heritage Commission and will be extended to central and northern forests during 1992.

- The jarrah silvicultural specification has been revised. In the new system mature trees will be retained on every hectare cutover irrespective of where cutting occurs.

- A review of the impact of harvesting operations has shown that they pose no significant threat to regional water resources. Stream and buffer zones of undisturbed vegetation and phased logging will be introduced throughout the intermediate and low rainfall zones to eliminate the occurrence of small, local and transient increases in stream salinity or sedimentation. Thinning intensity will be reduced to 15 metres basal area per hectare in the intermediate rainfall zone and the low rainfall zone. A comprehensive stream monitoring program will be introduced.

A number of other important changes to forest management in Western Australia are proposed. These include changes to karri silviculture, and an expansion of the conservation reserve system in south west forests.

In the light of the new forest inventory and proposals for changes to the areas of State forest and conservation reserve, revised volumes of timber and recommended sustained yields are presented.

The background and scientific basis for all changes are provided in the Nature Conservation and Forest Management Strategies which have been prepared and are issued in conjunction with this document.

8. REFERENCES

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DEPARTMENT OF CONSERVATION
AND LAND MANAGEMENT

SILVICULTURE SPECIFICATION 2/91

TREEMARKING AND SILVICULTURAL TREATMENT IN THE JARRAH FOREST

This Specification supersedes Silviculture Specifications 5/89 and 7/89.

CONTENTS

1. INTRODUCTION

The aim of silvicultural practice in the jarrah forest managed for multiple use purposes is to develop or maintain a forest structure that will achieve objectives for nature conservation, timber production, water quality and water production, heritage and aesthetics.

This specification details :

the broad goals for each value,
requirements for integrated planning,
the standards to be achieved for all values, and
guidelines for field application.

and outlines the variation to silvicultural practice that will be made to cater for various forest values, recognising their relative importance in different areas. It deals with the application of these strategies at the coupe level in areas from which timber is harvested.

The broader strategy that deals with zoning of the forest and the location, arrangement and harvesting is established at the regional planning level. This includes determining where harvesting can best located to achieve the strategic goals, the allocation of zones (e.g. water, wildlife) from which harvesting is to be excluded and the establishment of relative priorities between values.

This specificaton relates only to dieback-free jarrah forest designated as multiple use in the 1987 Regional Management Plans. Dieback infected forest is to be managed in accordance with Specifications 3 and 4/89.

The treemarking and silvicultural treatments outlined in Sections 4 - 7 of this specification do not apply to extensively managed areas of eastern and Sunklands jarrah forest (Sect. 3.2.3). A new specification is being prepared to cover these areas.

2. MANAGEMENT OBJECTIVES AND SILVICULTURAL STRATEGIES

2.1 WATER

Management Objectives

- To maintain the quality of water in all forested catchments.
- To enhance the quantity of water yielded from the forest within harnessed catchments.

Silvicultural Strategies

- Maintain an undisturbed stream zone in all forest areas. (dimensions and protective measures are specified in The Manual of Hardwood Logging Specifications).

- Ensure that harvesting in the salt sensitive areas of the intermediate and low rainfall zones does not lead to the excessive reduction of forest cover which may then result in a reduction in water quality.

This will be achieved through:

maintaining a stand basal area of at least 15m²/ha in the salt sensitive areas of the intermediate rainfall zone (900-1100mm) at the time of thinning.

regenerating no more than 70 per cent of a second order catchment in one felling cycle.

regenerating all gaps

separating felling cycles by at least 10 years.

Maintain regrowth stands in the high rainfall zones of harnessed catchments at a density which will enhance water yields by thinning to a density between 10m²/ha and 20m²/ha.

2.2 WILDLIFE

Management Objectives

- To maintain biodiversity at the genetic, species and ecosystem level in the forest throughout Western Australia.

- To maintain or replace populations of all taxa so that management activities do not lead to the loss of biodiversity at the local level.

- To protect and conserve threatened, rare and uncommon taxa and communities.

Silvicultural Strategies

- Maintain or enhance structural diversity of the forest.

- Retain those elements of habitat which could be lost through harvesting and tending and which take many years to replace.

This will be achieved by:

Maintaining, or developing several age classes within each coupe* After logging and regeneration treatment each coupe should contain a minimum of 3 age classes. Adjacent areas (e.g. riparian zones) within the same subcatchment should be considered as part of the coupe for this purpose.

By retaining mature trees at the rate of 3 per hectare and logs suitable for nesting and refuge throughout every harvested area.

By orienting temporarily retained strips of forest to link zones containing mature forest. These may act as wildlife corridors and allow greater use of regrowth areas.

Silvicultural Strategies

- The visual resources of each area will be inventoried and assessed to delineate and map Visual Resource Management Zones with the following Visual Quality Objectives:

  Visual Resource Management Zone A

  VRM Priority - High
  VRM Objective - Maximum Retention

  Avoid landscape alterations which would lead to a discernible deterioration in scenic quality in the short term. Focus on the maximum protection and retention of all existing visual attributes of the characteristic landscape.
  The recommended alteration is low, least accommodating to visual change.

  Visual Resource Management Zone B

  VRM Priority - Moderate
  VRM Objective - Retention

  Landscape alterations may range from visually apparent to visually dominant. Focus on the protection and retention of the dominant existing visualattributes of the characteristic landscape.
  The recommended alteration level would be moderately accommodating to visual change.

  Visual Resource management Zone C

  VRM Priority - Moderate
  VRM Objective - Partial Retention/Enhancement

  Landscape alterations may be visually dominant but should reflect the existing lines, forms, colours and textures of the characteristic landscape. Where possible, seek to optimise and enhance visual quality over the medium to longer term.
  The recommended alteration level would be highly accommodating to visual change.

  Special Visual Resource Management Area - Preservation

  VRM Priority - High
  VRM Objective - Preservation

  These preservation areas include those landscapes where visual resource values are of very high aesthetic importance and have priority over other natural resource values.

  The recommended alteration level for these areas allows for little more than natural change or very low impact changes which are carefully planned to accommodate and/or enhance the special visual qualities of the Preservation Area.

  Special Visual Resource Management Area-Rehabilitation

  VRM Priority - High/Moderate
  VRM Objective - Rehabilitation

Visual resource alterations which have resulted from past management practices or natural events and do not satisfy the Visual quality objective will require rehabilitation. This priority should be retained until the desired standard of visual quality is attained.

- Harvesting and treatment practices are to be varied in accordance with the site's visual resource management objectives. Gap size, thinning intensity, felling cycle, rotation length, treatment method and uncut strip width may all be adjusted. Coupes will be designed to attain the VRM objective with minimum impact on other values.

Leaving distinctive, rare and uncommon plant species and groups undisturbed by harvest. This should include patches of secondary storey which will take many years to regrow.

Excising rock outcrops, distinctive floral assemblages or fauna habitat from harvested areas.

* In this specification "coupe" means a contiguous area of forest which is used to plan harvesting. A coupe will usually be harvested in 1 - 2 years, however not all the forest in the coupe will necessarily be harvested in one felling cycle.

2.3 TIMBER MANAGEMENT AND SUPPLY

Management Objectives

- To manage native forests so that an efficient timber industry is able to be sustained indefinitely, based on the following principles:

  all cutover areas will be regenerated to a full stocking and all previously regenerated forests will be managed to optimise the attainment of all forest values.

  harvesting will only occur where the potential productivity is sufficient to cover cost of regenerating, establishing and managing those forests.

  the harvest from the forest will be regulated to levels that can be sustained indefinitely.

  all forest management operations, including logging, will be controlled by the Department of CALM.

Silvicultural Strategies

- Current timber supply will be achieved from trees which are not required for other purposes, including those retained for sustaining long term growth.

- Timber sustainability will be achieved by developing a grouped forest structure where the areas of regeneration are of a minimum sustainable size (ideally 4 tree heights). One silvicultural objective will be determined for each group. These are in order of preference:

  Thinning - to promote growth on retained trees.

  Regeneration Release (Established regeneration released in patches):
  Jarrah regeneration will be encouraged to develop unimpeded into saplings, poles and mature trees by the removal of competing overstorey.

  Shelterwood (Establishment of regeneration).
  Seedlings will be encouraged to establish and develop into ground coppice by reducing the competition of the overstorey. A forest canopy is maintained to provide a continuity of forest values until the ground coppice is developed and capable of response to release.

- Wherever possible implement silvicultural objectives through commercial removal and sale. Only when this process has been completed will non-commercial removal of trees be undertaken, and only then if they inhibit the silvicultural objective.

2.4 VISUAL RESOURCE

Management Objective

- To implement harvesting in a manner compatible with the visual resource management (VRM) objectives specific to the site.

- To maintain , enhance and improve scenic quality.

3. PLANNING FOR HARVESTING

Coupes for logging are nominated within a strategic framework at the regional planning level. This section deals with the planning of silvicultural practices to be adopted within a coupe. Details of operational planning (e.g. roading, disease management) are contained within the Manual of Hardwood Logging Specifications.

The aims of coupe planning are to:

(1) Identify the values present in the proposed cutting coupe, and
(2) Determine how the appropriate silvicultural practices will be implemented to the benefit of all values within the coupe.

Coupe planning is refined in the field as more accurate and detailed information becomes available through site inspection.

3.1 INVENTORY

The following are essential planning tools,

(1) Contour Maps showing watercourses
(2) Visual Resource Management Zones
(3) Rainfall Zones
(4) API Type maps, and maps showing cutting histories and silvicultural treatments
(5) Streams and other permanent zones
(6) Wildlife Values

It is also valuable to have current 230mm aerial photography as this assists in the interpretation of forest structure. Site/vegetation type maps for the area are useful indices for several values.

A coupe plan is prepared showing:

WATER: Harnessed catchments
Rainfall Zones
Stream Zones=

VISUAL RESOURCE: VRM Zones (including seen area)
VRM Special Areas
Roadside Zones (Southern Forest Region)=

WILDLIFE: Significant values

TIMBER: Low Value/Non Productive Areas
Structural Types (where known)

= Note that these zones are currently subject to review

3.2 FIELD INSPECTION

A field inspection of each coupe must be made to verify the values that are present. Field examination should examine the following, although some may be not be finalised until the time of treemarking.

3.2.1 Permanent exclusion zones

Areas of very high value for visual resource, water or wildlife may be permanently excluded from harvesting. In most cases these areas will have been defined at the regional planning stage, others will be determined by appraisal on site. These include:

WATER
Stream and river zones
Steep slopes
(See Manual of Hardwood Logging Specifications)

WILDLIFE
Areas of high flora value (for example Declared Rare Flora) - including a buffer to ensure they remain undisturbed.
Areas of high sensitivity or fragility. These may include rock outcrops, areas of shallow soil, eagles' nests, caves and other fragile areas.

Areas of particular species richness, e.g. riparian zone, ecotones.

VISUAL RESOURCE
Roadside zones established by the Woodchipping E.I.S. (currently subject to review).

Areas visible from travel routes within VRM Zone A and B which, in consultation with Landscape Branch, are considered to be of significant scenic quality and sensitivity. These will usually be focal areas.

When VRM zones have been mapped, practices described for the zones in this specification will over ride existing practices for road zones outlined in the Manual of Hardwood Logging Specifications.

TIMBER
Areas of very low timber productivity when it will be expensive to attain adequate regeneration should not be harvested. Appendix 1 lists site types to which this constraint should apply.

Permanent exclusion zones, in addition to those shown on the logging plan, should be defined 2 years prior to harvesting to allow time for location of alternative timber resources.

3.2.2 Temporary Exclusion Areas (TEAS)

TEAS are buffers established to provide protection for a nominated value while the cutover area regenerates. Once a suitable time has elapsed and the TEAS is no longer required, then it also may be harvested. The appropriate interval varies and is listed under cutting cycle in Appendix 2.

Each TEAS should all be of a minimum dimension (see Appendix 2) to ensure that their subsequent felling will not damage regrowth and that they themselves can be adequately regenerated when cut.

TEAS are most commonly retained to protect wildlife, visual resource and water values. For the visual resource they are established to confine the area regenerated to a size which meets the VRM objectives relevant to that zone. Appendix 2 details how gap size should vary with VRM zones.

Water values are protected by ensuring that no more than 70 per cent of a second order catchment is regenerated at any one time. If necessary TEAS are maintained to achieve this goal.

For wildlife, TEAS act as corridors for movement and dispersal into adjacent regenerating forests and contain habitat elements absent from the regenerating area. They also allow for the development of patches of varying age within the coupe, through the staggering of regeneration over 10 to 20 years.

Design Considerations

Although the precise location of each TEAS will be finally determined in the coupe, they should be planned so that they protect the relevant values at the current and future harvests. Their design will therefore play a key role in achievement of all objectives. Important design considerations include:

VISUAL RESOURCE
Plan for each stage of cutting to ensure that visual resource values are adequately maintained or protected during both current and future operations.

Within sensitive viewsheds sequencing of harvesting should ensure that no more than 2 active coupes are evident at one time, and only one should be in the fore- or middleground.
Gap edges and boundaries should be free flowing to reflect the natural lines and forms of the surrounding forest visual resource. The location of TEAS between gaps should respect strategic focal points in the upper and lower reaches of the landform, skylines, ridges, valleys and watercourses.

Patches of uncut forest, thinnings or shelterwood constitute suitable buffers that may be required to limit gaps to a particular size.

Clusters or islands retained within a gap should be located in areas above and including other focal points such as rock outcroppings, corners, embankments, cuttings, etc.

Wherever possible gaps should be designed to be seen obliquely through their orientation and across rather than up and down slopes. A meandering boundary most assists screening.

DIEBACK HYGIENE
TEAS are to be accessible from current roading and whereever practicable remain within a single hygiene microcatchment.

TIMBER PRODUCTION
TEAS shall be accessible from current roading.

WILDLIFE
Permanent exlusion zones should be linked by TEAS allowing them to act as temporary wildlife corridors.

3.2.3 Areas to be Harvested

REGENERATION SURVEY
Detailed planning of the regeneration requirements will facilitate treemarking in areas of uncertain regeneration status.

Treemarking decisions will be significantly assisted by the early identification of shelterwood areas. Appendix 1 is a general guide to their locations, however, broadscale ground surveys are necessary in areas with a high proportion of "shelterwood site-types". Ground survey should be programmed following aerial burning or advance burning. Specification 3/90 details this procedure.

SEED FORECASTING
As assessment of seed availability is required to determine whether and when natural seedfall can be used to regenerate a shelterwood stand. This is ideally done prior to marking so that a decision on the timing of harvesting can be made. Advice on assessing seedcrops should be sought from Silviculture Branch and seed collected and forwarded to the Seed Store to assess viability.

EXTENSIVELY MANAGED AREAS
In some areas of mature eastern jarrah forest and the Donnybrook Sunklands the proportion of sawlogs is low. In these areas the opportunity to create regeneration gaps by timber removal is limited i.e.gaps of 4 tree heights with a cull density of less than $12m^2$/ha will rarely be created. The requirement for TEAS and intensive treemarking discussed in this Specification are not appropriate for these areas. A more detailed specification for these areas is being prepared. Until this is available single tree selection will be practised, and subsequent regeneration work is not necessary.

4. TREEMARKING

4.1 GENERAL

Treemarking is the means by which stand objectives are marked out in the forest so that harvesting and tending operations can proceed. By marking trees to be retained the forester provides a vision of the future development of the stand.

Before marking commences, the forester must know:

the water, visual resource and wildlife objectives within the coupe, and the type of trees likely to be removed commercially.

Marking specifications will vary in accordance with the above objectives. (See Appendix 2).

The first task in marking a patch of trees is to determine the silvicultural objective (thinning, regeneration release, or shelterwood) and whether its boundaries are apparent. The process for making these decisions is outlined in "Treemarking and Silviculture in the Jarrah Forest" (1987).

Only after the objective has been identified for each patch can individual trees be marked.
Marking habitat trees and logs for retention are the first priority.

4.2 MARKING TO PROMOTE GROWTH (THINNING)

Wherever possible stands should be thinned in preference to regeneration release or shelterwood. Thinning aims to increase the growth of selected crop trees. In the high rainfall zone it will also increase the yield of water.

Selection of 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 high quality product of minimum specification.

Appendix 3 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 relatively higher basal area is retained.

Thinning regimes for different crop tree sizes are detailed in Appendix 4. In areas of high visual resource value and salt sensitivity additional trees may need to be retained. (Appendix 2).

Diversity

Up to 10% of the retained trees may be 'non crop tree' marri to maintain diversity. Mark to protect native pear, river banksia and examples of snottygobble, peppermint, large blackboys etc. Additional diversity of size and density of retained trees is required in the first 150 metres of VRM Zone A. (Appendix 2).

Technique

Mark to retain the desired density of crop trees (Appendix 4), fauna habitat trees and logs (Appendix 5) and elements for diversity. Where there is the number of acceptable crop trees exceeds the thinning density, those of high commercial value (e.g. SEC poles) 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 Appendix 4, but at least 50% of that density, all crop trees must be retained and sufficient non-crop trees to keep the stand at a minimum basal area of 10m²/ha (15m²/ha in the salt sensitive parts of the Intermediate Rainfall Zone).

4.3 MARKING TO RELEASE REGENERATION (GAP CREATION)

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

Technique

Where it is evident that insufficient crop trees exist to enable a thinning, the forester must check that the stocking of ground coppice/saplings is adequate, (Specification 3/90) then determine the boundaries of the gap. In general only mark fauna habitat trees in gaps over 1 hectare in size, however where good examples occur in small gaps they should be retained. Sub-merchantable crop trees with very good growth potential shall also be marked for retention if they can be fully protected during logging and burning operations.

Gap Size

Where the gap would exceed the maximum dimension (See Appendix 2) temporary exclusion areas of uncut forest are required to confine the gap to that maximum. These must be at least 50-100 metres across depending on VRM zone (Appendix 2) and will not be available for timber harvesting until the next cutting cycle.

Diversity

Mature secondary storey species (e.g. sheoak) shall also be marked and retained undisturbed, preferably in clumps, to enhance stand diversity.

4.4 MARKING TO ESTABLISH REGENERATION (SHELTERWOOD)

A shelterwood is created where there is inadequate stocking of crop trees for thinning and where there is insufficient ground coppice available for immediate release.

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.

Technique

Mark to retain 50% of overstorey (up to 15m¬/ha) including habitat trees at a relatively even spacing. Preference for retention are jarrah trees which will grow vigorously for at least the next 20 years. In addition some elements of stand diversity, as outlined for gap creation, shall also be retained. The forester must endeavour to retain a stand which will sustain a harvesting operation in the future. Where the existing stand is of low density and a harvesting operation cannot be sustained, regeneration must be established before harvesting.

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 the existing stand structure consists of small groups of mature/overmature trees among small patches of thinnable forest, each below the minimum desirable size (i.e. 100m diameter). In these stands the forester should attempt to push the group/gap towards the desirable size. 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 trees and avoid creating a gap. These large trees will frequently be required as habitat trees.

Gaps as small as 50 metres in diameter (2 times tree height) are acceptable.

5. CONTROL OF HARVESTING

This phase involves the removal of all unmarked merchantable trees. For restrictions on removal of products see Appendix 2. Details of harvesting control are contained in the Manual of Hardwood Logging Specifications.

Crop Tree Protection

Contractors are required to protect all marked trees during falling and skidding operations, and to 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.

A zone of 5 metres is to be retained undisturbed around all habitat trees and groups.

Visual Resource

Retained vegetation in the roadside zones (Appendix 2) is to be free from visible damage and scarring. Damaged trees should be felled.

Utilisation should be maximised near roadsides and other visible areas. Log grades with a limited market shall be removed from the roadside zones in preference to their removal from remote and unseen areas.

Silvicultural Treatment

Some silvicultural treatments (e.g. disturbance for shelterwood regeneration, banksia scrub rolling, Section 6) are better carried out during harvesting than as a separate operation. Some logging contracts make provision for this.

6. TREATMENT FOLLOWING HARVESTING

The aim of these operations is to develop the stand to meet the treemarking objectives. Unless a stand is fully marked to indicate the silvicultural objective, interpretation for follow-up treatment will be difficult.

6.1 TIMING

Manual silvicultural treatments required in regeneration patches and thinning groups should be carried out after burning (Section 7) to improve operator access and safety. Machine treatments must be done before post-harvest burning. All treatments should commence within 2 years of the completion of harvesting. Where significant quantities of merchantable produce remain, do not treat until harvesting is completed.

6.2 PRIORITIES FOR TREATMENT

The resources required for silvicultural treatment following harvesting will not always be sufficient to complete the available work. In allocating resources the following priorities will be adopted:

(1) Only treat those areas which are secure from disturbance, e.g. outside the 25 year bauxite mining envelope, and will remain available for timber production.

(2) Only treat those areas which are either secure dieback free or low potential risk or of low dieback hazard.

(3) Areas of high quality forest where the potential for growth is greatest.

(4) Areas of shelterwood have highest priority as regeneration must be established now so they will be ready for release in the next felling cycle. Areas of regeneration release have second priority. Areas of thinning have third priority.

(5) Locate treatment in areas of highest utilization where the management objective has not been fully achieved by harvesting. This will ensure minimal conflict by the culling of potentially valuable trees.

(6) Areas of high landscape sensitivity where treatment is essential to meet the management objective.

6.3 TREATMENT OF THINNING GROUPS

Individually release crop trees by removing competing trees for a distance of 4 metres by removing all vigorously growing culls over 50cm DBH not required for habitat, and all mature Banksia grandis by notching with an approved herbicide (See Herbicide Manual, Technical Instructions). Where trees which appear to share a common root system with adjacent retained trees, fell without poisoning the stumps. Culling by felling and treating stumps with herbicide may otherwise only be used where visual resource values are high (Appendix 2) and on burn boundaries.

Culls within 5 metres of fauna habitat trees should not be treated. Do not individually release around retained trees which are not of crop tree standard.

6.4 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 0.25-2ha

Remove any unmarked non-crop trees and mature *Banksia grandis* by felling, pushing down or notching. Do not treat within 5 metres of fauna habitat trees.

Where the density of culls is high (>12m²/ha) treatment should be deferred until more produce has been removed.

This prescription should also be applied to larger gaps of higher visual resource value (see appendix 2).

Gap Size > 2ha

As for the above, but only remove the following unmarked culls:
DBH >40 cm - all cull trees.
DBH 20-40 cm only if within 15 metres of other trees, including crop or habitat trees or other remaining culls.
DBH 10-20 cm if within 7 metres of other trees.

Consider trees less than 3 metres apart as one tree. See Appendix 6 for interpretation.

Technique

Where stump coppice is needed, fell saplings (DBH <15cm) close to ground level. Otherwise remove all unwanted stems by pushing over with a machine or by notching with an approved herbicide. (See Appendix 2 and Herbicide Manual, Technical Instructions).

6.5 TREATMENT OF SHELTERWOODS

Competition removal and soil disturbance where regeneration is absent.

Remove competing rootstock understorey in swathes at least 3 metres wide and not more than 10 metres apart. Preferably use a tracked machine with a rake blade. Also remove mature Banksia grandis and unmarked sheoak. Do not establish swathes within 3 metres of retained trees. This work must be done in dry soil conditions to ensure that a receptive seedbed results. Install erosion barriers at the appropriate

intervals (See Manual of Hardwood Logging Specifications).

Where regeneration is adequate in number but too small for immediate release, no additional treatment is required.
Culls should also be removed where total basal area of the shelterwood exceeds 18m²/ha.

Natural Seedfall

Examine the seed crop in late summer and where there is viable and plentiful crop, aim to burn in autumn (See Silviculture Specification 1/91).

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 a mixture of:
20,000 viable jarrah seed per ha, and
450kg/ha No. 1 superphosphate.

Apply seed and fertiliser to disturbed soil during autumn after burning.

Establishment Survey

For both natural seedfall and artificial seeding undertake regeneration survey in the following February see Specification 3/90.

7. BURNING AND PROTECTION

Burning and protection requirements vary according to silvicultural objectives. The detailed requirements are listed in Specification 1/91.

8. RECORDS

Good silvicultural records are essential for future managers to assess the condition and needs of the forest without having to undertake detailed assessment. The aim is to have an accurate description of 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 and complete CLM 160 including requirements for completion of follow-up treatment.
Areas to be protected from fire should be recorded on district master burning plans.

F.J. Bradshaw
Manager, Silviculture Branch

9. REFERENCES

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APPENDIX 1

A GUIDE TO SILVICULTURAL OBJECTIVES

ATTRIBUTE		PREDOMINANT OBJECTIVE
History and API Type Site Vegetation Types	More common in virgin forest of types below. Northern Jarrah (Havel 1975) Types: B, F, J. D, E, Z on sandy soils. H, P with dense sheoak. S occasionally with dense banksia. Southern Jarrah (Strelein 1988) Types: X, N, Y. K with Karri understorey. S, Q, I, P with dense understorey and sandy soils.	Shelterwood
History API Type Site Preparation	Most virgin or light selection cut - (1940+). Fire damaged stands. Massed stands. Pole - Stands with 30% crown density in upper strata. Not applicable	Regeneration release
History API Type	Heavily cutover and treated prior to 1940. Pole stands with 20% or less in upper strata (but will contain groups of varying size).	Thinning
API Type Site Type	Flats, rock outcrops, "C" class forest. S and P stands when upper and lower strata are the same. Northern Jarrah (Havel 1975) Types: A, G, J. B (without regeneration). Southern Jarrah (Strelein 1988) Types: R, B, F, A. Sunklands (McCutcheon) Type: 6.	Other than timber

APPEN X 2

JARRAH SILVICULTURE SPECTRU . (FROM SPECIFICATION 2/91)

MANAGEMENT ZONES

SILVICULTURE OBJECTIVE	VRM A			VRM B AND STRATEGIC LOG ROADS		VRM C		SALT SENSITIVE		EXCLUSION
REGENERATION	0 TO 150M OR VISIBLE SLOPE>20°*	VISIBLE >150M *	NOT VISIBLE *	VISIBLE *	NOT VISIBLE	VISIBLE #	NOT VISIBLE	900 1100MM	<900MM#	DEFINED IN SECTION 3.2.1.
GAP SIZE	0 25 - 0 5HA (2-3 TREE HTS)	< = 1HA (2-4 TREE HTS)	<= 10HA (<12 TREE HTS)	<= 1 HA (2-4 TREE HTS)	<= 10HA	<=10HA VARY GAP SIZE ALONG TRAVEL ROUTE INCLUDING LOG ROAD	<=10HA	NO MORE THAN70% OF 2ND ORDER CATCHMENT	NO MORE THAN 70% OF 2ND ORDER CATCHMENT	NO HARVESTING
MIN TEAS WIDTH BETWEEN GAPS	50 METRES	50 METRES	100 METRES	100 METRES	100 METRES	100 METRES	100 METRES	AS FOR VRM ZONE	AS FOR VRM ZONE	
MIN. CUTTING CYCLE	20 YEARS 3 STAGES	20 YEARS 3 STAGES	20 YEARS 2 STAGES	20 YEARS 2 STAGES	10 YEARS 2 STAGES	10 YEARS 2 STAGES	10 YEARS 2 STAGES	AS FOR VRM ZONE	AS FOR VRM ZONE	
JSI	FELL OR SCRUB ROLL	FELL OR SCRUB ROLL	NOTCH, FELL OR SCRUB ROLL	FELL OR SCRUB ROLL FELL ON FOCAL POINTS	NOTCH OR SCRUB ROLL	NOTCH OR SCRUB ROLL	NOTCH OR SCRUB ROLL	AS FOR VRM ZONE	AS FOR VRM ZONE	
HABITAT TREES	ONLY ON EDGE OF GAP LOCATE TO VISUAL ADVANTAGE	ONLY ON EDGE OF GAP	NORMAL	NORMAL-LOCATE TO VISUAL ADVANTAGE	NORMAL	NORMAL	NORMAL	AS FOR VRM ZONE	AS FOR VRM ZONE	
OTHER	ROADSIDE ZONE UPTO 20 METRES*	ROADSIDE ZONE UP TO 20 METRES*		ROADSIDE ZONE UP TO 20 METRES*						
THINNING										
- INTENSITY	RETAIN UP TO 5M²/HA EXTRA FOR DIVERSITY SIZE AND DENSITY	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	MIN OF 15M²/HA	NORMAL	NO HARVEST
- TREATMENT	FELL AND POISON STUMPS	FELL AND POISON STUMPS	NOTCH	FELL AND POISON STUMPS FIRST 50M	NOTCH	NOTCH	NOTCH	NOTCH	NOTCH	
- HABITAT	NORMAL, PREFER CLOSE TO ROAD	NORMAL	NORMAL	NORMAL, PREFER CLOSE TO ROAD	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	
SHELTERWOOD	ROADSIDE ZONE UP TO 20 METRES*	NORMAL	NORMAL	ROADSIDE ZONE UP TO 20 METRES*	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NO HARVEST
ACCESS	RATIONALISE ACCESS. CLOSE ROADS/TRACKS NOT REQUIRED. LIMIT ACCESS TO MANAGEMENT AREAS.									
ROTATION	>200 YEARS	>= 100 YEARS								
PRIORITY FOR COMPLETION	HIGH - AIM FOR LESS THAN 2 YEARS		MODERATE			LOW				
PRIORITY FOR RESIDUE REMOVAL	1	3	4	2	4	3	4			

NOTE: * LANDSCAPE PLANNER TO ASSIST IN DESIGN

MARRI FOR WOODCHIPS MAY NOT BE REMOVED FROM THIS ZONE IN THE SOUTHERN FOREST REGION (CURRENTLY SUBJECT TO REVIEW).

APPENDIX 3

CRITERIA FOR SELECTION OF CROP TREES

Select crop trees to retain using the following considerations:

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 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.

e.g.

Original diameter	30cm	30cm
Bole length	5m	10m
Crown condition	Deep, broad	Shallow, narrow
Diameter in 20 years	50cm	34cm
Volume on 20 years	.63cu.m	.5cu.m
Time taken to reach sawlog size (50cm)	20 yrs	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.

APPENDIX 4
JARRAH THINNING INTENSITY

Mean DBHOB of best150 stems/haat first thinning	Crop Tree Basal Area (m^2/ha)	Schedule
Less than 20cm	N/A	Release 200 jarrah stems/ha from overtopping and crown objective is to maintain healthy crown develop ment 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 over stocked (50 years). More conservative thinning in the future will maximise s volume/ha.
40cm	18m^2/ha	Thin again when crop trees reach 50cm dbhob. Above comments apply.
50cm	20m^2/ha	

x An additional 5m^2/ha of the following may be retained:

Trees within 5cm of becoming an SEC pole or sawlog.
Sheoak crop trees.
Second grade sawlogs in areas which will have follow-up non-commercial thinning.

A further 1 sq.m/ha of potential pit props may also be retained where appropriate.
15m^2/ha (including habitat trees) in the Intermediate Rainfall Zone.

APPENDIX 5

CRITERIA FOR SELECTION OF HABITAT TREES

1. OBJECTIVE

To retain for hole nesting fauna the essential components of habitat which cannot be readily replaced through post-harvest forest manipulation.

2. STANDING TREES AS HABITAT

2.1 Characteristics of Habitat Trees

Mature and likely to live for many years. It is essential that these trees have the capacity to provide fauna habitat until regrowth trees can place them in the future.

Contain holes, or broken branch stubs below the live crown with the potential to develop into holes.
Average sized crowns. Excessively vigorous trees will affect regrowth over a wide area.
Marri in preference to jarrah.
Where there is a surplus of suitable habitat trees retain those of lower commercial value.

2.2 Rate of Retention

Habitat trees must be deliberately marked for retention. Trees, as defined above, are to be retained for fauna habitat at a rate of 3 trees per hectare. Where suitable trees are not present a rate of 15 trees per 5 hectares must be achieved. A clump of 3-4 trees is preferred to an even distribution. If insufficient trees with these characteristics are available retain mature trees as potential habitat.

Wherever feasible locate clumps on the boundary between patches of forest which are or will be of different ages, e.g. on the boundary of a gap and thinning or uncut strip.

In general do not retain habitat trees in regeneration gaps of one hectare or less, as they will provide excessive competition for regrowth. They may only be retained where required to attain the appropriate rate of retention or where they are of exceptional value.

3. GROUND HABITAT

3.1 Characteristics

Logs:

Diameter 30-100cm
Pipe 6-15cm diameter extending into log
Length - pipe at one end - 1.5 metres minimum
- pipe at both ends - 3 metres minimum

Stumps and Leaning Trees:

Stumps which have been lifted creating a protection underground cavity due to a leaning tree or some other agency.

3.2 Rate of Retention

Operators should be trained to recognise and retain suitable logs and stumps. If necessary they should be marked by the treemarker. Where available retain at least one per hectare. All marked logs must be retained undisturbed.

4. FAUNA HABITAT PROTECTION

As for protection of crop trees, tops and other residues larger than 7.5cm diameter are to be removed at least 1 metre from the bole of habitat trees to ensure subsequent protection from fire.

In this specification "coupe" means a contiguous area of forest used for the planning of harvesting. A coupe will usually be harvested in 1 - 2 years. however not all the forest in a coupe will necessarily be harvested in one felling cycle.

APPENDIX 6

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

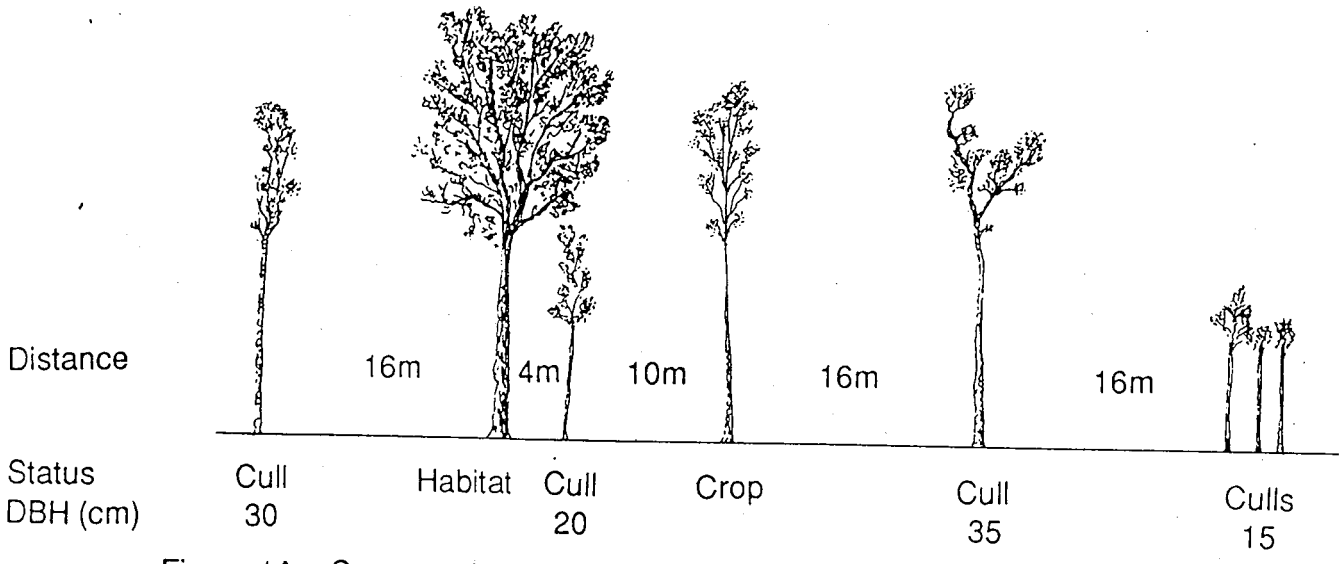


Figure 1A: Gap containing 2-3m²/ha culls which are widely spaced and do not require treatment.

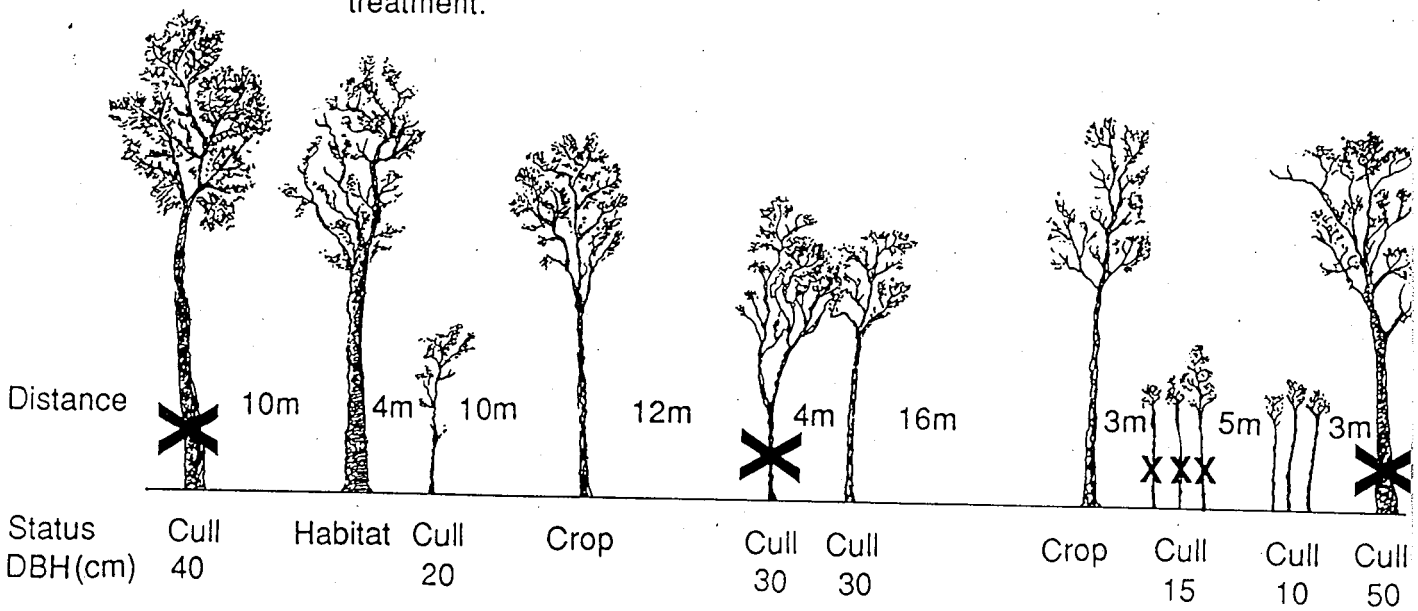


Figure 1B: Gap containing about 8m² /ha of culls, X indicating those to be removed.

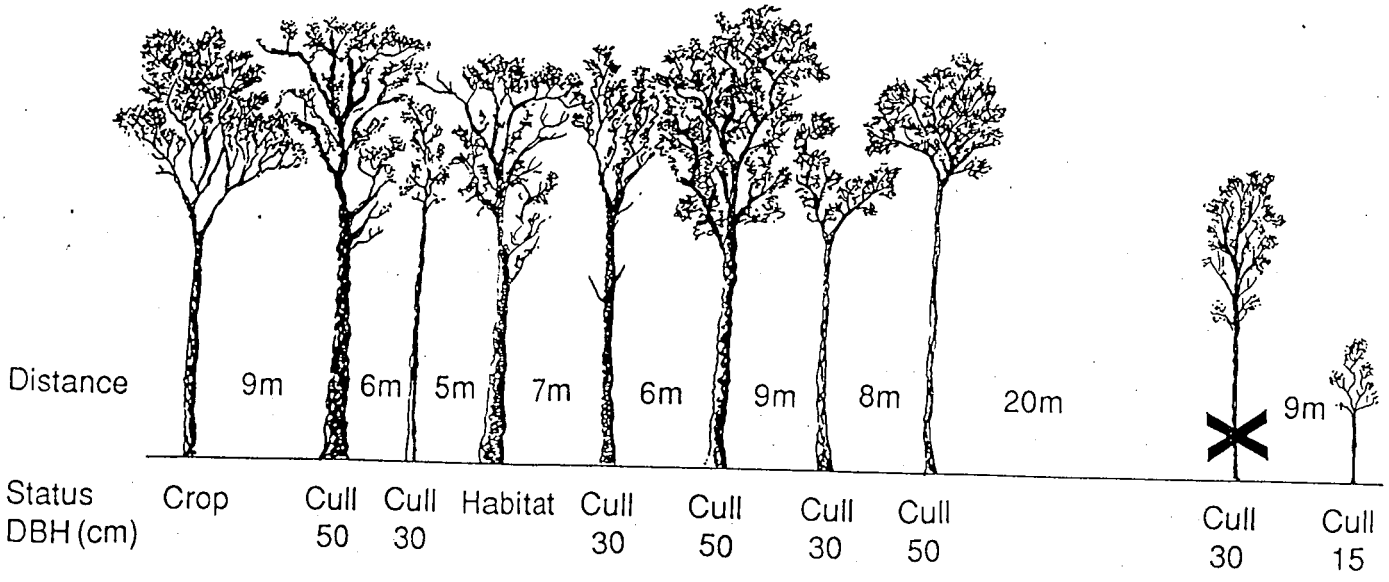


Figure 1C: Gap with a dense group of culls (> 12m²/ha) which should not be treated. Gap at right may be treated if 50 metres in diameter.

APPENDIX B

GLOSSARY OF TERMS

Anthropocentric: a human perspective which places human interests above those of other life forms.

Afforestation: the conversion of non-forested land to forest, by means of artificial sowing or planting with native or introduced species.

Biological diversity: the variety of organisms, including species themselves, their genetic diversity and the assemblages they form (communities and ecosystems). Sometimes includes the variety of ecological processes within those communities and ecosystems.

Biocentric: a human perspective which regards all life forms as having equal status.

Biogeography: the present and past patterns in geographic distribution of organisms over periods of time and areas at least as large as a natural district.

Code of forest practice: a document defining and prescribing forest practices aimed at protecting the forest environment, its assets, and its users (while allowing economically viable operations, good standards of work, and safe work).

Catchment: the surface area from which water runs off to a river or any other collecting reservoir, eg. swamps, groundwater.

Clearfelling: a silvicultural system in which the original crop is removed at one time over a relatively large area to allow regeneration to develop as an even-aged stand. Variations to facilitate regeneration establishment include strip clearfelling and clearfelling to seed trees.

Coupe: an area of forest that is subject to timber harvesting operations as a single unit.

Conservation park: similar to national park except that the condition, size or significance does not justify national significance.

Conservation: how people maintain the "natural capital" of physical and biological resources from which development can draw the income and benefits for human needs. Defined in the State Conservation Strategy as:- the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations, while maintaining its potential to meet the needs and aspirations of future generations. Thus conservation is positive, embracing preservation, maintenance, sustainable utilisation, restoration and enhancement of the natural environment.

Development: how people meet their needs and improve their lives, not necessarily in purely economic terms. Defined in the State Conservation strategy as:- the modification of the biosphere and the application of human, financial, living and non-living resources to satisfy human needs and improve the quality of human life. For development to be sustainable it must take account of social and environmental factors as well as economic ones; of the living and non-

living resource base; and of the long-term as well as the short-term advantages of alternate actions.

Dieback disease: in Western Australia the disease of plants caused by infection by soil-borne fungi of the genus *Phytophthora.*

Dieback disease risk area: an area of land declared by the Minister to be at risk from dieback disease. The area usually contains infected land, but is mainly uninfected land. Pedestrian access is permitted, but any other access requires a permit.

Disease: a disorder which results in a morbid (sickly) condition of a plant or animal.

Ecology: the study of plants and animals in relation to their environment.

Ecosystem: a community or an assemblage of communities of organisms, interacting with one another, plus the environment in which they live and with which they also interact.

Ecological processes: the complex of biological and physical processes such as growth, nutrient cycling, long term climate change, photosynthesis, predation competition, and reproduction which are interacting with environmental factors.

Ecological sustainability: the management of ecosystems so that the full suite of biological species, and ecological and evolutionary processes of each ecosystem, is retained in the long term, even though short term changes may occur.

Endangered: flora of fauna in danger of extinction and whose survival is unlikely if the causal factors continue operating.

Endemic: flora or fauna that is confined in its natural occurrence to a particular region.

Environment: defined in the State Conservation Strategy and Environmental Protection Act as:- "living things", their physical, biological and social surroundings, and interactions between all of these. The social surroundings of man are his aesthetic, cultural, economic and social surroundings to the extent that those surroundings directly affect or are affected by his physical surroundings.

Environmental ethic: moral principles related to the human use of the environment.

Entomology: the study of insects.

Equity between generations: provided by ensuring that future generations of Western Australians can choose an appropriate quality of life and have available a range of natural resources and opportunities which should be at least comparable to those of the present generation.

Equity among generations: attaining equity between sections of society with regard to the costs and benefits which accrue from forest use.

Exotic: a plant introduced from another locality. Not indigenous.

Fauna: animal life.

Feral: an introduced or domestic animal now living in the wild.

Fire protection: all activities concerned with protection of forest from fire, including prevention, detection, and suppression.

Flora: Plant life.

Forest: an ecosystem characterised by a more or less dense and extensive tree cover.

Forestry: the art and science of managing forest ecosystems to produce a sustainable flow of values whilst maintaining essential ecological processes.

Forest activities: activities involving people to fulfil functions of forest management and to which principles for forest practices apply.

Forest development stage: identifiable stages in forest development from seedling to death. For karri they are:

Establishment stage: in karri the period from decline (or removal) of the overstorey through regeneration and ending when the regenerating karri close canopy and dominate the understorey. Covers approximately the first 8 years.

Juvenile stage: in karri forest the period following establishment characterised by severe competition for dominance when stocking numbers may reduce from 5000 to 500 per ha. At its end (approximately 25 years old) crown shape changes character and understorey species have died off.

Immature stage: in karri forest following juvenile stage from about age 25 years to 120 years. Characterised by the formation of a semi-permanent crown and vigorous height growth.

Mature stage: in karri achieved at about 120 years and lasts to about 240 years. The rapid growth phase ends as the physical limitations of individuals is reached. Diameter continues to steadily increase but where there is a loss of a tree, remaining trees are unable to take up the available space and regeneration occurs.

Senescent stage: in karri forest from 240 years to 360 years and beyond. Few trees are known to live longer than 360 years. Is characterised by the individual tree's loss of control of the site as its crown breaks up, thus resulting in regeneration.

Forest operation: a forest activity deploying people and machinery to perform work.

Forest practices code: specifications or standards to be applied in the conduct of specific forest activities or operations.

Forest values: attributes of the forest and its environment, which are recognised and required to be managed for.

Gap: a discrete opening in the overstorey canopy created to reduce competition to allow seedlings to become established and or develop.

Group selection cutting: a silvicultural system in which the final crop trees are felled in small groups either to permit regeneration to develop or to release advance growth.

Habitat: a component of an ecosystem providing food and shelter to a particular organism.

Hardwood: the timber of broadleaved trees, and the trees themselves, belonging to the botanical group Angiosperms, eg. Eucalypts.

Hazard (in relation to dieback disease): the combination of environmental, climatic and management factors that influence the potential impact of dieback disease on a site.

Heritage: something which is to be passed on to future generations.

High rainfall zone (HRZ): the area of land on the 1100mm and above rainfall isohyet.

Host: the plant or animal that is invaded by a pathogen or parasite and from which the pathogen or parasite derives its energy.

Hygiene (in relation to dieback disease): actions that decrease the risk of the pathogen being introduced, spread, intensified or surviving.

Hygiene map (in relation to dieback disease): a map showing the location of infected and uninfected land and areas where dieback disease presence or absence can not be determined.

Inoculum: portions of any pathogen capable of being disseminated and of initiating disease.

Inter-generational equity: (see 'equity between generations')

Intra-generational equity: (see 'equity among generations')

Integrated resource management: the application of resources to a forest system for the simultaneous production of several socially desirable outputs. It is conditioned by an understanding of the consequences to the forest system of perturbations and constrained by the intention of maintaining the forest system as a forest system.

Intermediate rainfall zone (IRZ): the area of land falling between the 1100mm and 900mm rainfall ioshyet.

Interpretation: the process of communicating the significance (bringing out the meaning) of an area by describing and explaining its characteristics.

Landform: all the physical, recognizable, naturally formed features of land, having a characteristic shape; includes major forms such as a plain, mountain, or plateau, and minor forms such as a hill, valley or alluvial fan.

Landscape: the visual expression of the countryside, combining the visual elements of both the natural and built environment and including landforms, vegetation, waterform, land-use and architecture.

Low rainfall zone (LRZ): land occurring in the 900mm and below rainfall isohyet.

Management plan: a plan, revised periodically, defining forest policy governing management activities within the management plan area, typically includes forest geography and history, land uses allocation, objectives and prescriptions for management.

Mini catchments: an area within a larger catchment which is self contained in terms of surface water runoff.

Monadnock: an isolated hill or mass or rock which stands above the surrounding country because its rock has been more resistant to erosion than the rock of the area.

Multiple use: the use of land, especially forest land, for several different purposes concurrently or sequentially.

National Estate: those elements of the natural environment, the Aboriginal environment and the historic environment which are of special value to the Australian community, present and future.

Landscape chracter type: a broadscale area of land with common distinguishing visual characteristics based on an amalgamation of land form, climate, vegetation, water form and land use pattern.

Landscape management zone: a specific parcel of land within a defined landscape character type which has a common visual assessment classification.

National park: land which has national significance for scenic, biological or cultural values and which has been vested in the NPNCA to be managed for the protection of those values and the recreation requirements of the community.

Native forest: naturally occurring forest, whose current floristic and structural condition may or may not have been influenced by human activity.

Nature conservation: the protection of ecosystems and ecosystem processes to ensure the maintenance of biological diversity.

Nature reserve: land which has high value for wildlife and landscape conservation, scientific study and the preservation of features of archaeological, historic or scientific interest. It has been vested in the NPNCA to be managed for those purposes.

Normal forest: a forest structure which is designed to provide a sustained flow of the values the forest is being managed for.

Objective: a specific statement of measurable results to be achieved within a specific time period.

Old growth forest: a patch of forest in which the overstorey contains mature and over mature trees, the break up of whose crowns is resulting in seedling establishment and development.

Operations plan: a plan, revised annually, defining the timber harvesting schedule, wood production targets, roadworks, reforestation/afforestation and forest protection requirements.

Patch: a group of trees resulting from some past management activity such as gap creation and regeneration.

Pests: troublesome or destructive animals, including insects, either introduced or native.

Plantation: stands which have been planted, generally of one or few selected species, to fulfil a particular management objective. Plantations may be of indigenous or exotic tree species but do not usually contain a representative suite of species that occur in a native forest on the same sites.

Policy: the courses of action to be followed to achieve an organisation's objectives.

Prescription: a detailed specification of the objectives, area, procedures and standards a job is to be undertaken.

Prescribed burning: the application of fire to fuels under such conditions of weather, soil moisture, time of day and other factors that will result in the controlled spread and intensity of heat required to accomplish specific silvicultural, environmental or fire hazard reduction objectives.

Rare species: less than a few thousand reproductively mature specimens are known to exist in the wild.

Rehabilitation: process necessary to return disturbed land to a predetermined surface, land use or productivity.

Restricted: flora or fauna that occurs only in a confined area.

Reforestation: the re-establishment of forest on an existing forest site following tree removal. Reforestation can be achieved by the natural seeding, artificial sowing, or planting of native or introduced species.

Riparian: pertaining to the banks of streams, rivers or lakes.

Salinity: the measure of total soluble (dissolved) salt, ie. mineral constituents, in water. water containing more that 500 parts per million(mg/L) is not considered desirable for domestic use.

Scenic quality: the relative visual character of a landscape, expressed as an overall visual impression or value held by society after perceiving an area of land.

Seen area: the total area observed from one or more viewpoints. It is often measured in terms of distance zones viz,

foreground	0 - 0.5 km textual detail evident
middleground	0.5 - 6.5 km textual patterns evident
background	6.5 km + mainly mass colour patterns

Silviculture: the art and science of establishment and tending of forests to achieve specified management objectives.

Snigging: the pulling of logs, either wholly or partially in contact with the ground, from tree stump to log landing.

Softwood: the timber of trees, and the trees themselves, belonging to the botanical group Gymnosperms, eg. Pines.

Specially protected: under the Wildlife Conservation Act fauna which is designated as "otherwise in need of special protection".

Strategy: explains how policy is intended to be achieved.

State forest: public forest vested in the Lands and Forest Commission to be managed for a range of uses, including wood production, agreed by the community through Government.

Strategic planning: planning to determine and achieve management policy objectives for defined regional areas of forest lands.

Structure: when applied to forests is the vertical and spatial distribution of the vegetation.

Sustainability: when applied to forests the maintenance of ecological processes, soil, water etc. so that the forest ecosystem will continue.

Sustained yield: a plan of management which produces a more or less consistent , but not necessarily optimum, output of values being managed for which is within the long term capability of the ecosystem.

Thinning: a felling made in an immature stand for the purpose of improving the growth of trees that remain without permanently breaking the canopy and encouraging regeneration.

Timber harvesting: removal of timber produce from the forest for utilisation.

Timber salvage: timber harvesting of products which would otherwise be destroyed or wasted.

Topography: the delineation of the natural and artificial features of an area.

Turbidity: discolouration of water due to suspended silt or organic matter.

Underground water: water which occupies the pores and crevices of rock and soil.

Vegetation complex: a combination of distinct site vegetation types, usually associated with a particular geomorphological situation.

Virgin forest: forest which has not been cut over (logged).

Visual quality objective: a written guideline which provides a measurable standard for the acceptable protection of the characteristic landscape.

Visual resource: that portion of a landscape falling within a persons view.

Visual resource management (VRM): a system which provides a systematic and objective basis for the inventory, assessment, management and protection of visual resource.

Weeds: plants (often self-sown exotics) growing where they are not wanted.

Wetland: any lowland covered by shallow and sometimes temporary or intermittent waters, eg. swamps, creeks, rivers, lakes, estuaries.

Wood production: activities associated with the use of the forests for their wood values.

Woodland: a plant community in which trees form only an open canopy, the intervening area being occupied by lower vegetation, usually grass or scrub.

Yield: the amount of product(s) produced from the forest by a particular management strategy.

Yield regulation: the process by which the yield of any product(s) is(are) controlled to achieve the stipulated levels in the management plan.

APPENDIX C

Acting Executive Director
Department of Conservation and Land Management

Your ref:
Our ref:
Enquiries

Environmental Assessment of Proposals to Change Forest Management in the South West

Further to the briefing of the Environmental Protection Authority on the Department of Conservation and Land Management's preparation of documents resulting from reviews of nature conservation and forest strategies which will include proposals for change (including addressing environmental conditions set in 1987 by the Hon Minister for the Environment on the Forest Region Management Plans and Timber Strategy and W A Chip and Pulp Co Pty Ltd), I confirm that the following environmental issues should be included for the purposes of environmental assessment and also confirm agreement reached on the joint process (as attached) to satisfy statutory requirements under the Conservation and Land Management Act and the Environmental Protection Act.

Scope
The following issues have been derived principally from the Ministerial Conditions as already mentioned. Notwithstanding the specific issues, any proposal or issue with the potential to have a significant impact on the environment should be included within the Forest Management Plans Amendments ('Approvals Document') for environmental assessment.

These may emerge during the preparation of the documentation or arise during the assessment phase. The Department of Conservation and Land Management and Environmental Protection Authority should discuss these in the first instance.

Road, River and Stream Zones and High Value Forest Areas

- Objectives and description of existing Road, River and Stream Reserve system
- Discussion of the effectiveness of the existing Road, River and Stream Reserve system in meeting objectives
- Justification for change to existing Road, River and Stream Reserve system
- Objectives of proposed Road, River and Stream Zone system
- Criteria for identification of proposed Road, River and Stream Zone system
- Outline of the predicted effectiveness of the proposed Road, River and Stream Zone system
- Management prescriptions for proposed Road, River and Stream Zones system

- Objectives and criteria used for identification of exceptional scenic or conservation values or high value old growth forest areas
- Identification of areas of exceptional scenic or conservation values within multiple use forest which are proposed to be excluded from harvesting
- Identification of areas of high value old growth forest within multiple use forest which merit flexible harvesting management
- Management prescriptions for selected high value old growth areas and areas of exceptional scenic or conservation values within multiple use forest
- Future monitoring and reporting

Northern, Central and Southern Forest Regions - Jarrah Forest Types

- Objectives of management, and silvicultural procedures for Jarrah forests
- Proposed integrated logging/ silvicultural procedures and the basis of proposals
- Predicted impacts of integrated logging/ silvicultural procedures on Jarrah forest ecosystems, protection from fire and dieback disease, water resource values and the nature of the forest
- Conservation objectives (flora, fauna and landscape outside reserves) and their implementation through multiple use State Forest management, taking account of long term sustainability of ecosystems of Jarrah forest types
- Research directions

Southern Forest EMP

- The Marri resource in the "salt sensitive zone"
- Proposed integrated logging/ silvicultural procedures
- Predicted impacts on forest values
- Proposed monitoring and reporting

Conservation Reserve System

- Any significant alteration to the conservation reserve system as proposed in the Northern, Central and Southern Forest Region Management Plans or CTRC/ EPA Systems Recommendations
- Conservation protection management in multiple use forest adjacent to existing and proposed conservation reserves

Process

The attached chart outlines the joint process for preparation, public review, assessment and finalisation of the strategies and proposals documents.

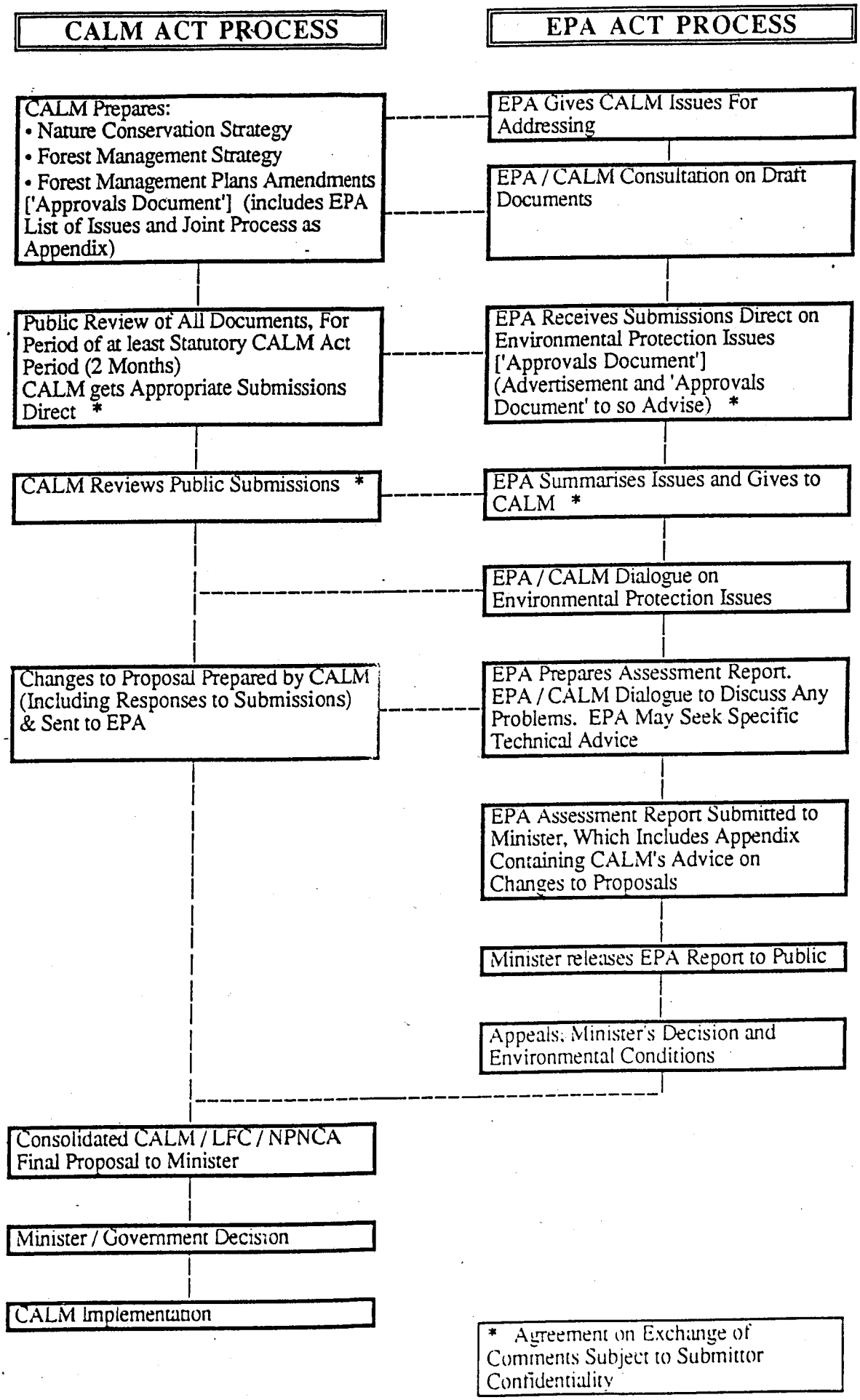
Terminology

One of the areas about which there has been considerable historical debate in the public discussion of forest issues has related to terminology. The Authority considers that these documents and this process provide the opportunity for the use of a commonly acceptable set of terms that can be applied to specific practices or processes. A set of terms and their clear definition incorporated in the documentation would assist understanding and review.

B A.Carbon
CHAIRMAN

19 September 1991

Process


CALM ACT PROCESS
EPA ACT PROCESS
CALM Prepares:
• Nature Conservation Strategy
• Forest Management Strategy
• Forest Management Plans Amendments ['Approvals Document'] (includes EPA List of Issues and Joint Process as Appendix)
EPA Gives CALM Issues For Addressing
EPA / CALM Consultation on Draft Documents
Public Review of All Documents, For Period of at least Statutory CALM Act Period (2 Months)
CALM gets Appropriate Submissions Direct *
EPA Receives Submissions Direct on Environmental Protection Issues ['Approvals Document'] (Advertisement and 'Approvals Document' to so Advise) *
CALM Reviews Public Submissions *
EPA Summarises Issues and Gives to CALM *
EPA / CALM Dialogue on Environmental Protection Issues
Changes to Proposal Prepared by CALM (Including Responses to Submissions) & Sent to EPA
EPA Prepares Assessment Report. EPA / CALM Dialogue to Discuss Any Problems. EPA May Seek Specific Technical Advice
EPA Assessment Report Submitted to Minister, Which Includes Appendix Containing CALM's Advice on Changes to Proposals
Minister releases EPA Report to Public
Appeals; Minister's Decision and Environmental Conditions
Consolidated CALM / LFC / NPNCA Final Proposal to Minister
Minister / Government Decision
CALM Implementation
* Agreement on Exchange of Comments Subject to Submittor Confidentiality