Interim Guideline for the First Thinning of Bauxite Rehabilitation Areas Established Before 1988 with Exotic Species in the Wungong Catchment

Sustainable Forest Management Series

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1 Introduction

1.1 Background

Bauxite mines in the high rainfall northern jarrah forest have been rehabilitated principally with exotic species before 1988. The dense regrowth stands that have resulted are now suitable for thinning to reduce the high water usage of these stands and to provide a commercial product.

This Interim Guideline is specifically directed at areas of bauxite rehabilitation that have been established before 1988 within the Wungong catchment. The Wungong catchment is the subject of an adaptive management trial of silvicultural practices aimed at increasing water yield along with the other objectives common to State forest. Small catchment studies conducted during the 1980s and 1990s have shown that thinning of native forest results in a substantial increase in water yield but the effect decays after about 5 years and returns to pre-thinning levels after about 12 years as the retained trees, regrowth and coppice, which develops in response to thinning, increase their water use (Bari & Ruprecht 2003). Control of regrowth and coppice development has been shown to prolong the increase in water yield (Stoneman 1993). While no specific data exists for bauxite pits rehabilitated with exotic species, a similar response can be anticipated.

The Wungong project aims to extend this work to the larger catchment scale and to areas of bauxite rehabilitation to better understand operational factors and the impacts on other forest values (Water Corporation 2005a, b). The principal strategy is that stands suitable for thinning will be thinned, commercially and/or non-commercially, favouring the retention of native species where possible. Following thinning, regrowth and coppice will be controlled or regulated until the stand is dense enough to repeat the thinning process or until regeneration is required.

Progressive thinning of these stands (with associated control of regrowth) to increase water production offers the opportunity to gradually reduce the number of exotic trees on these sites, facilitating the gradual conversion to native species. Where stands of mixed native and exotic species occur, the preferential removal and regrowth control of exotics will gradually increase the proportion of native species. In association with the thinning, the Water Corporation has also undertaken to conduct trials of the regeneration of native species to further facilitate the eventual conversion to native overstorey species.

Areas of native forest, and areas that have been mined and rehabilitated to native species and rehabilitated 'dieback' sites are the subject of separate guidelines.

The project and the Interim Guideline will be implemented with the co-operation of several agencies. The Water Corporation is the proponent of the project and is responsible for the funding of operational and research activities that are additional to those normally applied to operations in State forest. The Department of Environment and Conservation (DEC) is the land manager and contractor to the Water Corporation for some aspects of implementation of the project. The Forest Products Commission (FPC) is responsible for the application of this Interim Guideline where commercial harvesting activities occurs, through the normal DEC approval processes. The working arrangements between the Water Corporation and DEC are contained in a Memorandum of Understanding.

1.2 Scope

This document applies to areas of bauxite rehabilitation that have been established before 1988 with exotic species, are within the Wungong catchment and occur on State forest, timber reserves managed by DEC and freehold land held in the name of the CALM Act Executive Body.

1.3 Custodianship and management of this document

This Interim Guideline has been prepared by the Water Corporation in consultation with DEC. The custodian of this document is the Manager of the Forest Policy and Practices Branch of the Sustainable Forest Management Division in DEC. The document has been issued as an Interim Guideline based on the consultation that the Water Corporation has undertaken on the Wungong proposal. In this form the Interim Guideline is publicly available and will used to guide operational practice on an initial trial basis. It is intended that the initial trial will be during 2007 and 2008 and that the review of the Interim Guidelines will form part of the Water Corporation's first stakeholder project review for the overall Wungong project, which is planned to be by the end of 2008. On completion of the trial the Interim Guideline will be prepared as an SFM Guideline using the results of the initial trial and public feedback, submitted to the Conservation Commission for advice and approved by the Minister for the Environment. This process meets the requirements of the *Forest Management Plan 2004-2013* for guidelines.

2 Planning

2.1 Stand conditions.

The following is a summary of the statistics relating to pre 88 rehabilitation areas within the Wungong catchment:

- 1640 ha has been rehabilitated between 1969 and 1987;
- 1500 ha has been planted, the remainder seeded;
- 511 separate patches of rehabilitation ranging in size from 0.1 to 46 ha, with 39 patches >10 ha. Median size is 1.2 ha;
- 21 'dominant' species have been used in the rehabilitation (Table 1). Three of these (*E. resinifera, E. muellerana and C. maculata*) represent 60% of the area;
- 605 ha were planted with 'local' native species (*E. marginata, C. calophylla, E. patens, E. megacarpa*) in the species mixture;
- 84 ha are planted with exclusively 'local' native species; and
- The current species dominance and representation may vary significantly from that which was established.

Site conditions range from cleared but un-mined areas, to pit walls and bottoms. There is therefore considerable variation in growth rate, survival and vigour. Stand density varies from 8 to >30 m^2/ha and co-dominant height from 14m to 35m.

Understorey condition is variable, mostly dominated by exotic species.

Table 1. Area by dominant planted species – 21 species

Species	Area (ha)	Species	Area (ha)	Species	Area (ha)
E. accedens	14	E. marginata	27	E. saligna	87
E. aggregata	6	E. megacarpa	5	E. wandoo	140
E. camuldulensis	11	E. microcorys	84	C. calophylla	117
E. cypellocarpa	2	E. muellerana	*274	C. citriodora	6
E. diversicolor	20	E. patens	33	C. maculata	*347
E. globulus	55	E. pilularis	5	P. pinaster	26
E. laeliae	19	E. resinifera	*359	P. taeda	3

2.2 Operational plans

An annual operational plan will be prepared by the Water Corporation (in consultation with DEC and the FPC) that outlines:

- Areas proposed for thinning (identified by Alcoa Planting number);
- Qualifiers to the generic prescription (including target density, species preference etc);
- Access routes for commercial harvesting;
- Additional roading required;
- Pre and post thinning burning proposals;
- Pre or post thinning regeneration proposals; and
- Post thinning coppice and regrowth control.

The normal protocols for commercial harvesting on State forest will be followed with the same responsibilities and authority normally exercised by the FPC and DEC.

3 Thinning objectives and strategies

3.1 Objectives

- provide for significant levels of water production by maintaining appropriate stand density;
- provide for the gradual increase in the proportion of native species by selective thinning of exotics, and by regenerating with native species where appropriate and feasible; and
- provide for wood production from exotic species in the short and medium term.

3.2 Strategy

- Thin to 8 or 12 m^2/ha depending on original density;
- Wherever possible achieve the thinning by commercial operations (from below or above);
- Preferentially remove exotic species from native/exotic mixtures;
- Control exotic coppice following the thinning operation;
- Regular control of exotic regrowth thereafter prior to the next thinning operation;
- Monitor and report on post thinning condition;

- Undertake trials to determine economically feasible methods of increasing the proportion of native overstorey by under planting, or by clearfelling and planting or sowing; and
- Extend the trial outcomes to a larger area of the pre 88 rehabilitation according to the results obtained.

The first six of these strategies are covered in this guideline. The details of the trials and their future extension will be the subject of specific proposals.

The large number of small patches, the variation in species, and variation in height and density within the same species preclude the use a separate detailed prescription for each patch. The following generic prescription will therefore be applied throughout, with specific qualifications relating to target density and preferred species being provided for each patch as part of the "Operations Plan" following field inspection at the beginning of each year.

In order to achieve a successful thinning of these sites it is desirable to ensure that as many as possible can be carried out as a viable commercial operation. The FPC considers that the current and future market of most of the exotic eucalypts is likely to be for pulpwood. There is therefore less emphasis on maximizing the growth of sawlog-sized trees. This provides greater flexibility in the style of thinning and greater opportunity to conduct commercial thinning operations. Nevertheless in stands that contain *E. saligna* or *E. maculata*, the opportunity will be taken to promote the growth of trees with sawlog potential where it does not conflict with the preference for retaining native species.

Non-commercial thinning will be undertaken in stands that are not commercially viable but which are standing at >15 m^2 /ha. Non-commercial follow-up of commercial operations will also occur where it is necessary to reduce total density to the acceptable post thinning level (see Section 6.1.1)
It is possible that some small areas where the rehabilitation has been unsuccessful will be clear-felled. Other areas will be clear-felled as a trial to re-establish a jarrah forest. Areas proposed for clearfelling will be specifically referred to DEC for approval when they have been identified.

4 Thinning operations

4.1 Pre thinning advance burn

The aim is that all areas proposed for thinning should be advance burnt to facilitate access for treemarking. Where burnt or unburnt understorey still inhibits access for treemarking, understorey may need to be scrub-rolled sufficient to achieve satisfactory access. Machine access in rehabilitated bauxite mines is difficult due to the presence of the contour mounds resulting from deep ripping. The most suitable machines and technique for scrub-rolling will need to be evaluated in trials and will be heavily influenced by considerations of operator safety.

The thinning program and its associated advance burning will be integrated as far as is possible with the fuel reduction burning program of the surrounding area.

4.2 Thinning intensity

Thinning intensity is influenced by current stand condition

Existing density	Thin to
<30 m^2/ha	8 m^2/ha
>30 m^2/ha	12 m^2/ha

4.3 Treemarking

Stands will be tree-marked prior to thinning by or under the close supervision of a DEC officer using the following guidelines:

- Mark for retention;
- Preference for retention:
    1. local species (jarrah, marri)
    2. other WA species
    3. exotic species;
- Retain healthy trees, preferably co-dominant trees of good form;
- Remove "wolf" trees, suppressed trees or trees with poor (unhealthy) crowns;
- Give preference for retention to well-formed sub-dominants of native species over exotic species; however do not retain poorly developed stems and whips of native species;
- Remove other trees either 'from below' or 'from above' retaining the trees of best form, with consideration to spacing. In stands with more than 30 m^2/ha, the emphasis is to be on thinning from below;
- Minimum final basal area may be ignored if the removal of unthrifty trees with poor crowns alone reduces density to less than the nominated figure;
- In stands containing exotic species, give preference to removal to the species that appear to be less vigorous and those with high regenerative capacity (e.g. *E. resinifera, E. microcorys, E. muellerana*); and
- Felling without removal of the logs (for habitat) is will be carried out at the rate of 10 spha.

Tree selection by the harvester operator may be considered after an appropriate trial period.

4.4 Method of thinning

4.4.1 Commercial thinning

Felling, bunching and debarking is expected to be undertaken with a small, tracked harvester and extracted to roadside with a forwarder. A skidder may be used to replace the forwarder for safety reasons in some situations. Out-rows may be desirable in some situations and some track construction may be required to safely access the pits.

Debris >75mm diameter should be moved at least 1m from the base of retained trees at the time of harvesting. The objective is to ensure that >95% tops disposal has been achieved.

Harvesting operations will be monitored to ensure that there is minimum damage to crop trees. The objective is to maintain a damage level of < 5% of crop trees.

The use of heavy machinery on rehabilitated bauxite pits will be limited to the Low and Medium soil risk periods (DEC 2007) as it is noted that rehabilitated bauxite pits are highly disturbed and may be sensitive to further disturbance in terms of the site capacity to support ongoing ecological

processes. Trials will be conducted to determine whether operations can be conducted in the Medium soil risk period and remain within the limits of acceptable soil damage. Soil disturbance will also be monitored using the methods described in the *Interim Manual of Procedures for the Management of Soils Associated with Timber Harvesting in Native Forests* (DEC 2007).

4.4.2 Non-commercial thinning

Where non-commercial thinning is required to supplement or replace commercial operations, it will generally be done by notching with herbicide, consistent with label requirements and DEC prescriptions.

In areas that are important for aesthetic reasons, thinnings will be felled by hand with herbicide applied to the stumps.

This work will be carried out under a contract to the Water Corporation.

5 Follow-up operations

Follow-up operations will be required to control coppice and exotic regrowth. Initial operations will consist of:

- A 'cool' tops burn in the spring following thinning. This will remove 'flash' fuel and may prevent some stumps from coppicing. It may also however promote seedling regeneration;
- Foliar spray the coppice and exotic seedling regeneration when it reaches 0.5 to 1 m in height; and
- Regular post-burn exotic regrowth control thereafter until the next commercial thinning.

This may be modified in the light of experience and further trials.

6 Monitoring

Systematically located plots will be established before and after thinning to monitor treemarking and thinning intensity, to determine the need for non-commercial thinning and to provide information on the change in the proportion of 'local' native, other WA native and exotic species.

Further plots will be established following coppice treatment to determine the success of coppice and regrowth control.

Understorey condition will be monitored on selected areas following specific treatments (time of burning etc) but will not be conducted on a routine basis.

Information about the area thinned, location of thinning and achievement of success criteria will be provided annually to DEC.

6.1 Success criteria

6.1.1 Thinning operations

Aspect	Requirements	
Target density	8 m^2/ha	12 m^2/ha
Marking density	6-10 m^2 /ha	10-14 m^2 /ha
Post thinning density (trigger for follow-up non-commercial thinning)	<10 m^2 /ha	<14 m^2 /ha
Damaged crop trees	<5%	<5%
Crop trees requiring tops disposal	<5%	<5%
Species composition	Increase in proportion of native species	Increase in proportion of native species

6.1.2 Follow-up coppice and regrowth control

- > 90% of target individuals to be treated.
- Mortality of treated individuals to be > 80%

These criteria may be modified in the light of experience.

7 Adaptive management trials

Adaptive management trials and/or monitoring will be undertaken to determine:

- The desirability and timing of the tops burn with respect to regrowth and coppice control;
- Coppice development in relation to harvesting time;
- Alternatives for method and timing of coppice and regrowth control; and
- The most appropriate species, technique, density and timing of rehabilitation with native overstorey species. Small trials to test techniques for the establishment of native species will be initiated. This will include:
    - Planting or seeding of overstorey trees and seeding with selected understorey species in areas that have been clear-felled.
    - Planting of native species under a canopy of exotics for several years before thinning to allow lignotubers to develop with the expectation of improved form.
    - Planting of native species under a canopy of exotics after thinning.

Details of these trials will be developed progressively and DEC will be advised accordingly.

8 References

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