Conservation Commission

Forest Management Plan Performance Assessment

Wungong Catchment Environment and Water Management Project (Wungong catchment trial/Wungong catchment thinning trial) – Performance Assessment PART B

Performance Assessment Number FMPPA 01/2010

Conservation Commission performance assessments are undertaken primarily to fulfil the functions described in S 19(g) of the Conservation and Land Management Act 1984. That is to "assess and audit the performance of the Department and the Forest Products Commission in carrying out and complying with the management plans". They will also help inform its policy development function and its responsibility to advise the Minister on conservation and management of biodiversity components throughout the State.

This performance assessment was undertaken in accord with the *"Conservation Commission policy and guidelines for the performance assessment of conservation reserve and forest management plans and biodiversity management in WA".* Further details are available at www.conservation.wa.gov.au. The use of Department of Environment and Conservation (DEC) data for the production of maps in this report is acknowledged.

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Table of Contents

Executive Summary 4
Introduction 5
Background 5
Roles and responsibilities 5
Treemarking 6
Key Finding 1 6
Monitoring 7
Key Finding 2 7
Key Finding 3 7
Key Finding 4 8
Key Finding 5 9
Key Finding 6 9
Burning 10
Key Finding 7 10
Dieback 10
Informal reserves 11
Protection of jarrah forest understorey elements 11
Key Finding 8 12
Conclusion 12
Appendix 1 13
Appendix 2 14
Attachments (3)

Executive Summary

This Forest Management Plan Performance Assessment (FMPPA) reviewed the implementation of the Water Corporation's 'Wungong Catchment Environment and Water Management Project'. The main emphasis of the assessment is upon the native forest areas subject to commercial logging and non-commercial thinning. Part A of this assessment was published in 2010 which reported on the context and planning of the project.

This analysis of the operational activities undertaken as part of the Wungong Project has confirmed the findings from Part A of the performance assessment. The interim silviculture guideline has been implemented essentially as stipulated, however, as pointed out in Part A, some of the variations to normal silvicultural practice which are outlined in the silvicultural guideline are inconsistent with the documentation provided at the proposal stage of the project.

Operational treemarking issues have been identified by DEC in its regulatory role in the course of the trial and some of the identified issues remain unresolved. Clearer operational guidance in relation to the defining and protecting the understorey is required.

Eight key findings are outlined in the document and these are listed below:-

Key Finding 1
There is no evidence available to demonstrate that the treemarking for the Wungong Project has been undertaken by trained foresters, as was indicated at the proposal stage of the Wungong Trial.

Key Finding 2
Results from treemarking surveys undertaken by DEC indicate that there are unresolved operational issues with the treemarking undertaken in Treatment Area 4.

Key Finding 3
Treemarking for the treatment areas has been below the retention level indicated at the proposal stage of the trial.

Key Finding 4
There is a lack of consistency between DEC and the Water Corporation in the way in which basal area information is collected.

Key Finding 5
There was no evidence available to demonstrate that monitoring of the impacts of increased herbicide use on non-target understorey vegetation was routinely being undertaken.

Key Finding 6
The final basal area figure derived by the Water Corporation includes a component of notched trees that were dying at the time of the measurement.

Key Finding 7
It is unclear what fuel-reduction burning strategy (e.g. pre- or post-treatment and schedule of integration with other activities) has been implemented in relation to the thinned native forest areas.

Key Finding 8
The available operational documentation does not provide clearly defined guidance in relation to the protection of understorey in the jarrah forest.

Introduction

This Forest Management Plan Performance Assessment (FMPPA) reviewed the implementation of the *Wungong Catchment Environment and Water Management Project* (Wungong Project). The project is an experimental trial designed to both enhance water production and to be consistent with the objectives and intent of the Forest Management Plan 2004-2013 (FMP). The primary objective of this assessment was to audit Wungong Project activities against the objectives and actions of the FMP. The audit process forms part of the basis for the decision by the Environmental Protection Authority (EPA) to forgo the setting of binding conditions on the Water Corporation through Part IV of the *Environmental Protection Act 1986.*

The main emphasis of this assessment is upon the native forest areas subject to commercial logging and non-commercial thinning. An assessment was published in 2010 (Part A) which reported on the context and planning of the project. This report, Part B, focuses upon the operational activities associated with implementation of the project in native forest areas. This report (Part B) is best read in the context of the findings and recommendations from Part A. Evidence was obtained from records, documents, interviews and observations. Part of the assessment process for this report incorporated field inspection of informal reserve boundaries, and field verification of basal area sampling plots which were established by both the Water Corporation and the Department of Environment and Conservation (DEC).

There is provision for the *Wungong Catchment Environment and Water Management Project* to be audited annually by the Conservation Commission and this assessment can be used to establish priorities for further assessments by the Commission. Other areas of activity such as silvicultural[1] treatment of exotic mine rehabilitation areas may be assessed in the future.

Background

The Wungong Catchment is a gazetted drinking water catchment located one hour's drive south-east of Perth in Western Australia (WA) which covers an area of 12,845 ha. The aim of the Wungong Project as outlined in the planning documentation is to increase stream flow through silvicultural treatments (thinning and burning regimes) in selected areas of the catchment. Silvicultural work began in the last quarter of 2006.

The catchment has been heavily impacted by a combination of mining, disease, timber production and uncontrolled access by the public.

Roles and responsibilities

- The proponent for the Wungong Project is the Water Corporation;
- The Department of Environment and Conservation (DEC) has regulatory responsibilities for the Wungong Project;
- There is provision for the project to be audited annually by the Conservation Commission;
- The Forest Products Commission (FPC) undertake the tree-marking and logging on the parts of the project area which they deem to be commercial.

[1] Silviculture is the theory and practice of managing forest establishment, composition and growth to achieve specified management objectives. Also see glossary of terminology in Appendix 3.

Treemarking

As indicated above, the FPC undertake the tree-marking and logging on the parts of the project area which they deem to be commercial. An area within the Wungong Trial (Cobiac forest block) which was deemed to be of commercial value was managed by FPC accordingly. Under FPC established procedures the removal of forest produce is managed and regulated by license. Treemarking is undertaken by Forest Officers and the standards are supported by a system of approvals and guidelines which underpin an Environmental Management System (EMS).

It is effectively up to the judgement of the treemarker to determine the appropriate silvicultural technique and then mark the stand accordingly. It could be considered an 'expert system' where training and experience are critical for decisions which will shape forest structure in the future. In the response to public submissions on this issue the Water Corporation indicated that treemarking would be undertaken by 'trained foresters' (see Attachment 1). In the interviews and responses received for this assessment it could not be demonstrated that all treemarking was being undertaken by trained foresters.

Key Finding 1

There is no evidence available to demonstrate that the treemarking for the Wungong Project has been undertaken by trained foresters, as was indicated at the proposal stage of the Wungong Trial.

Water Corporation response – The Water Corporation has indicated in its response to this finding that it's preference is that treemarking for the trial is carried out by trained foresters (see full Water Corporation response in Appendix 2).

Conservation Commission response – The Conservation Commission notes the response from the Water Corporation. The treemarking for the trial is not being carried out by trained foresters and issues in relation to treemarking standards have been identified (see Key Finding 2). The Conservation Commission recommends that the Water Corporation engage formally certified treemarkers or alternatively seek and obtain formal certification for its treemarkers.

There has been little other commercial interest from FPC in the native forest areas of the thinning trial and therefore the established procedures do not underpin operations for the majority of the areas treated to date. At the proposal stage of the trial the Conservation Commission was given to understand that FPC (and it's underlying management systems) would have a more prominent role in the Wungong Trial area but this has not been borne out over the passage of time. In practice it is DEC staff undertaking the majority of the treemarking under contract to the Water Corporation and the notching is being undertaken through private contract. This places DEC in a role of both regulating the activities of the trial area and also performing some of the operational activities under contract to the Water Corporation. While this operational arrangement outwardly appears to place DEC in an awkward position there are examples of the systematic identification of issues (and reported resolution) as detailed below.

An example of the functioning of this regulatory arrangement is in treatment area 2 (Cobiac forest block). In this block the Water Corporation sought and received from DEC approval to undertake follow-up tree-marking of the commercially logged areas (applying the different parameters of the *Interim Guideline for Silvicultural Practice in the Jarrah Forest of the Wungong Catchment).* This process (follow-up treemarking of commercial areas) was not foreshadowed in the proposal documentation and advice from DEC indicates that follow-up

tree-marking by the Water Corporation of commercial areas under the operational control of FPC is no longer an approved process.

Monitoring

Part of the assessment process for this section of the report incorporated field inspection of the basal area sampling plots which were established by both the Water Corporation and DEC.

DEC issued work improvement notice

The result of the native forest treemarking check undertaken by DEC in its regulatory capacity resulted in a Work Improvement Notice being issued in 2009 by DEC because only 40% of the sample plots measured were treemarked to acceptable standards. No advice of any remedial actions undertaken to address the identified issues was available at the time of drafting this report, with the reason cited as being a shift in focus by the Water Corporation from native forest areas to the ex-mining, exotic rehabilitation areas within the trial area.

Key Finding 2

Results from treemarking surveys undertaken by DEC indicate that there are unresolved operational issues with the treemarking undertaken in Treatment Area 4.

Water Corporation response – The Water Corporation has indicated in its response to this finding that no thinning operations were carried out in Treatment Area 4 due to a proposed modification of the trial (see full Water Corporation response in Appendix 2).

Conservation Commission response – The Conservation Commission notes that the response to this finding does not refer to any remedial action for the identified shortfall in treemarking standards. The Conservation Commission recommends that actions to resolve the treemarking issues identified through the work improvement notice should be enacted.

Key Finding 3

Treemarking for the treatment areas has been below the retention level indicated at the proposal stage of the trial.

Water Corporation response – The Water Corporation has indicated in its response to this finding that some plots were marked below the retention levels and others were marked above this level, due to the uneven nature of the forest (see full Water Corporation response in Appendix 2).

Conservation Commission response – As stated in Part A of this performance assessment, it was not specified in the proposal (or planning) documentation that the tree marking parameters of the trial would be below the level specified at the proposal stage to allow for inefficiencies in thinning operations (and this is considered by the Conservation Commission to be an unacceptable approach). The Conservation Commission's recommendation is that the total basal area to be marked in the field for retention should be consistent with the original project proposal documentation.

Internal assessments by the Water Corporation

The Water Corporation has undertaken operational monitoring activities in the native forest areas subject to thinning. The results of this information were supplied to the Conservation Commission for the purposes of undertaking this assessment.

From the information supplied for this assessment by the Water Corporation, it appears that the total basal area outcome figure from internal field checking includes some measurements of sheoak and banksias. Advice from DEC indicates that sheoak and banksias are not normally included in the basal area estimates of overstorey tree density which are routinely undertaken by DEC. Instead DEC allocates such stems to the understorey or regeneration pool which are not normally recorded for the purposes of basal area estimates. DEC also routinely measures the basal area from species within a sample area that are above 15cm DBHOB (diameter at Breast Height Over Bark). The Water Corporation sampling procedure includes stems in the sample area above 10cm DBHOB. Both these factors (differing minimum diameter and species included) indicate that the basal area figures from Water Corporation sampling and those from treemarking samples undertaken by DEC cannot be directly compared.

Key Finding 4

There is a lack of consistency between DEC and the Water Corporation in the way in which basal area information is collected.

Water Corporation response – The Water Corporation has indicated in its response to this finding that although it is not standard practice for DEC to include species ratios in basal area measurements, there were exceptions made for the trial (see full Water Corporation response in Appendix 2).

Conservation Commission response – It is important that the trial monitoring and results are represented in a way that can be directly compared with monitoring results from standard silviculture. This is because of the way the trial proposal documentation was presented which in turn influenced the original Conservation Commission advice on the thinning proposal to the Environmental Protection Authority. The basis of that advice was a comparison with standard thinning and the view that the intent was to implement (under the Wungong proposal) essentially what is the current practice but actually achieve the proposed target basal areas (albeit at slightly higher retained basal area (15-18 m^2/ha) than under normal jarrah silviculture. The Conservation Commission recommends changes to the recording system for basal area information to enable a direct comparison of the monitoring results with standard silviculture under the FMP.

A key difference in the field application of herbicide in the Wungong Trial is that all culls[2] in excess of the nominated crop tree density are treated, compared to only those within 4 m of a crop tree (in normal operations). As stated in the Interim Guideline page 16 (see Attachment 2) this 'poses a risk of herbicide impact on non-target species, particularly understorey vegetation'. The interim guideline goes on to state that 'All areas subject to regrowth control by herbicide application will be monitored for the effectiveness of the operation on target species and the impact on non-target species'. The routine monitoring results provided by the Water Corporation do not include a measure or observation of the impact of herbicide use on the understorey in the proximity of notched stems.

[2] Culling is the deliberate felling, poisoning or pushing down of unwanted overstorey or understorey species, usually to reduce competition to retained crop trees or for establishing regeneration.

Key Finding 5

There was no evidence available to demonstrate that monitoring of the impacts of increased herbicide use on non-target understorey vegetation was routinely being undertaken.

Water Corporation response - In its response to this finding, the Water Corporation have indicated that the Interim Guideline page 16 only applies to the use of foliar spraying and that no foliar sprays have been used except on minute parts of some demonstration plots (see full Water Corporation response in Appendix 2).

Conservation Commission response – The Interim Guideline is not clear on the specific requirements for monitoring in this instance. The Interim Guideline does indicate that foliar spraying will be used for follow-up treatment in the trial (see Attachment 3). The Conservation Commission recommends that the Water Corporation consult with DEC and amend the Interim Guideline where necessary to:-

- Clarify whether routine recording of the impact of herbicide application on the understorey vegetation was intended to be undertaken only when applying foliar sprays; and
- Ensure that there is adequate routine monitoring of the impact of herbicide application on non-target species, including the recording of instances where understorey species have been inappropriately notched.

As stated in Part A of this performance assessment, it was not specified in the proposal (or planning) documentation that the tree marking parameters of the trial would be below the level specified at the proposal stage to allow for 'missed trees and trees that were notched and did not die' as stated by the Water Corporation in their response (and this is considered by the Conservation Commission to be an unacceptable approach).

Field observations and the results from internal monitoring by the Water Corporation indicate that these notched trees which have been impacted to varying degrees by notching, but were persisting at the time of monitoring, are part of the final retained basal area measurement from plot sampling. The Conservation Commission's view is that the guideline should specify the total basal area and this measure should also be the basal area which is marked in the field for retention.

Key Finding 6

The final basal area figure derived by the Water Corporation includes a component of notched trees that were dying at the time of the measurement.

Water Corporation response – In its response to this finding the Water Corporation has indicated that the finding is in accordance with normal DEC processes (see full Water Corporation response in Appendix 2).

Conservation Commission response – The Conservation Commission acknowledges the advice which indicates that it is routine practice to record these sick or dying trees in the final live basal area count. The monitoring results suggest that the sick or dying component of the basal area measurements contributed (on average) around one metre squared. However, as outlined in Part A and reiterated here, the Conservation Commission recommendation is that the sick or dying component is not 'allowed for' by treemarking at a level lower than that indicated at the proposal stage of the trial.

Burning

Field observations and records indicate that there has been a variable strategy in place with regard to prescribed burning. Treatment area 1 was burnt prior to thinning and the proposed fuel-reduction burn at Cobiac forest block will be post-thinning. There are apparently divergent views in relation to the amount of forest fuel which could be expected after silvicultural treatment and how this might impact on fire behaviour. All people interviewed indicated that the post-thinning burn within the demonstration plot area was undertaken at an undesirable time of the year (December) when the conditions were unfavourable for prescribed burning.

Field observations during this assessment indicate that in areas which have been felled (such as areas along roadsides felled for visual amenity purposes) high amounts of forest residue on the ground could be expected to elevate fuel levels.

As outlined in Part A of this assessment, the Conservation Commission queries the inclusion of prescribed burning as a "Follow-up Treatment" as referenced on page 7 of the *Interim Guideline for Silvicultural Practice in the Jarrah Forest of the Wungong Catchment (2007).* This is a variation from the content of *Silviculture Guideline 1 (2004),* and the use of fire as a follow-up treatment is not indicated in the proposal documentation.

Key Finding 7

It is unclear what fuel-reduction burning strategy (e.g. pre- or post-treatment and schedule of integration with other activities) has been implemented in relation to the thinned native forest areas.

Water Corporation response – The response to this finding from the Water Corporation indicates that the trial is subject to a management plan developed and implemented by DEC (see full Water Corporation response in Appendix 2).

Conservation Commission response – It is not clear from the response whether the intention is to apply fire as a follow-up treatment to control the understorey. This appears to be the intent as outlined in the Interim Guideline (see Attachment 3 and reference as follows: - '*Understorey is expected to increase in density following thinning and this will have an adverse impact on water yield*'). The intent to use fire as a follow-up treatment to control the understorey was not indicated at the proposal stage of the trial. Further detail on this will be requested at the 12 month review of this performance assessment.

Dieback

High disease impacted sites are potentially very productive for water run-off because of the reduced vegetation cover, however an objective of the FMP is to '*minimise, as far as is reasonable and practicable, the impact on the health and vitality of forest ecosystems of pathogens and their associated diseases*'. Dieback interpretation records for the Wungong area were reviewed as part of this assessment. It was apparent that all areas thus far assessed by dieback interpreters have been designated as high impact to forest values from *Phytophthora cinnamomi*. However, during interviews it was apparent that the judgement of treemarkers has been used to determine whether certain areas were 'high', or 'low' impact sites. These activities may have led to treemarking on dieback affected areas utilising the incorrect prescription parameters as it is the consideration of the dieback interpretation reports that all areas are current or potentially high disease impact sites. This practice was reportedly identified by DEC in its regulatory capacity and discontinued.

Informal reserves

A key objective of the FMP is to conserve biodiversity outside of formal reserves and forest conservation areas. Action 3.1 relates to the conduct of operations within informal reserves. These state that operations will be conducted in accordance with the Guidelines for the Management of Informal Reserves and, where the operation occurs prior to the approval of the Guidelines, in a manner that has regard to the requirements set out in Appendix 3.

Requirements relate to planning, identification in the field, and disturbances in informal reserves. All informal reserves must be identified and demarcation completed prior to commencement of operations.

There are a number of categories of informal reserves which are detailed in Appendix 3 of the FMP.

Field verification of informal reserve boundaries

Landmonitor (satellite) imagery was used to give an overview of the disturbance relative to the informal reserves within the coupe area. Areas where the boundary of operations appears to enter the informal reserve were field checked as detailed on the map in Appendix 1. The inspected areas were found to be within the demarcation and overlaps were found to be inaccuracies in the mapping shapefile used to define the boundary of thinning operations which was provided to the Conservation Commission for the assessment. A breach was observed in a recently thinned area however and the Conservation Commission requested to be provided with the details of the incident reporting as part of this assessment. The Water Corporation provided an incident report in relation to this incident at a later date. No other environmental incidents were reported as being recorded under the Water Corporations Environmental Management System, and no other incidents were encountered in the field inspection.

Protection of jarrah forest understorey elements

The *Interim Guideline for Silvicultural Practice in the Jarrah Forest of the Wungong Catchment* refers to the Protection of Soil, Understorey and Mid-Storey Elements protection in section 6.4. Section 6.4.2 outlines the range of measures taken from the FMP and the Kingston study[3] area to reduce the impact of silvicultural operations on flora diversity and abundance. It is not clear whether these measures are to be applied only to shelterwood areas or to gap areas as Section 6.6 'Treatment of Gaps' infers; or just to operations that disturb the soil; or how the protection of understorey species will be undertaken in post-logging activities (such as thinning) over the same areas. Also unclear is how the understorey and other forest elements are to be defined.

This issue is discussed in the *Water Corporation response to submissions from 2005 public review* which states that *the focus is on thinning the overstorey species (jarrah and marri) and will keep key understorey species (with some treatment only if they regenerate out of natural balance* (section 2.19)). It is unclear whether midstorey and understorey elements are determined by species, by development stage or by height. It is also unclear whether the intention is to treat understorey species only if they regenerate out of natural balance, and how this is to be defined. The DEC internal Technical Instruction Sheet (Silvicultural Treatment – Notching (*Sheet No. B17A – 1995*) lists the target species for notching as eucalypt saplings and trees, banksias and sheoak. These details are not specified in the *Interim Guideline for Silvicultural Practice in the Jarrah Forest of the Wungong Catchment* or

[3] A major interdisciplinary research study by the Department located in jarrah forest in Kingston and surrounding forest blocks north-east of Manjimup, to examine the impact of native forest silvicultural practices on flora and fauna.

the work instructions issued to workers and, as outlined, it is not specified which elements of the forest structure are the targets for culling. There are numerous instances in the Wungong Trial area where small, scattered, individual plants (such as *Banksia grandis*) which do not appear to be impeding regeneration establishment have been notched.

Key Finding 8

The available operational documentation does not provide clearly defined guidance in relation to the protection of understorey in the jarrah forest.

Water Corporation response – The response to this finding from the Water Corporation indicates that the finding is acknowledged (see full Water Corporation response in Appendix 2).

Conservation Commission response – The Conservation Commission recommends that the Water Corporation consult with DEC and amend the Interim Guideline to outline and define the protection measures to be applied for understorey species in the trial. This should include:-

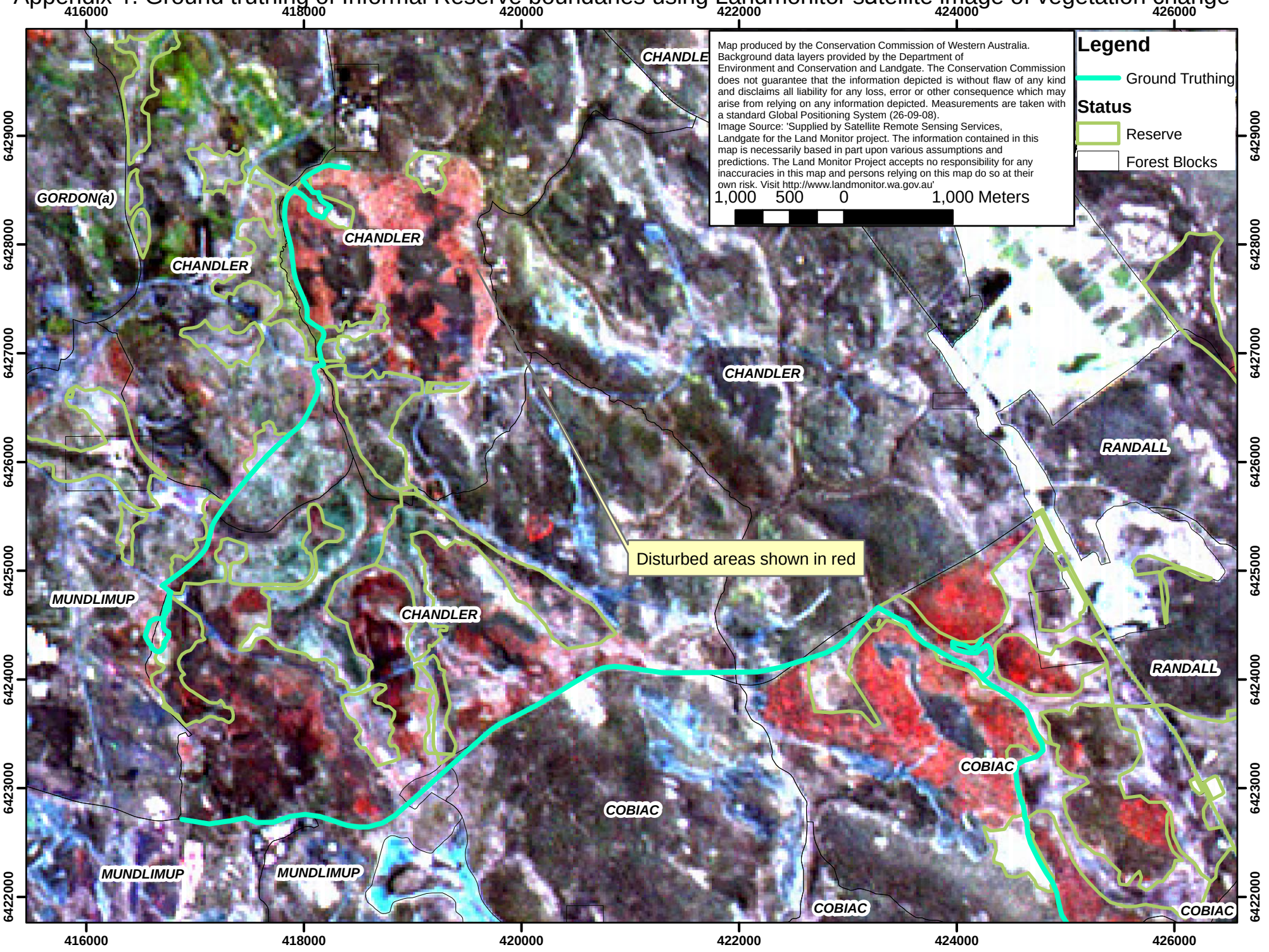
- how the understorey and other forest elements are to be defined;
- the operations to which the protection measures apply; and
- a clear outline of the range of measures to be undertaken to protect understorey species.

Conclusion

This analysis of the operational activities undertaken as part of the Wungong Project has confirmed the findings from Part A of the performance assessment. The interim silviculture guideline has been implemented essentially as stipulated, however, as pointed out in Part A some of the variations to normal silvicultural practice which are outlined in the silvicultural guideline are inconsistent with the documentation provided at the proposal stage of the project.

Operational treemarking issues have been identified by DEC in its regulatory role in the course of the trial and some of these issues remain unresolved. Clearer operational guidance in relation to the defining and protecting the understorey is required.

Appendix 1. Ground truthing of Informal Reserve boundaries using Landmonitor satellite image of vegetation change



Water Corporation Response to the Conservation Commission's Performance Assessment of the Wungong Catchment Trial PART B: Number FMPPA 01/2010

This document is presented in response to the above assessment which has identified eight Key Findings. As the proponent of the Wungong Catchment Trial (the Trial), the Water Corporation acknowledges the value of these assessments and will address and rectify findings to the best of its ability.

As a lead in to the responses the Water Corporation advises that:

1. most notching for the Trial has been carried out by trained Department of Environment and Conservation (DEC) staff rather than by contractors;
2. no follow up treemarking was carried out by the Water Corporation in commercially thinned areas of Cobiac;
3. all notched trees were un-utilisable cull trees, and were not retained as crop or habitat trees by Forrest Products Commission (FPC) or removed for commercial use; and
4. all basal area sampling plots were established by the DEC.

Key Finding 1

There is no evidence available to demonstrate that the treemarking for the Wungong Project has been undertaken by trained foresters, as was indicated at the proposal stage of the Wungong Trial.

Water Corporation response

The Water Corporation's preference is for the Trial's treemarking to be done by trained foresters. FPC undertakes commercial silviculture operations for the Trial with non-commercial silviculture operations and treemarking done by the DEC.

All DEC staff went through induction and on-ground training in treemarking standards and techniques based on Silvicultural Guidelines appendices under the Forest Management Plan. The training was conducted by certified hardwood treemarkers from the DEC.

Key Finding 2

Results from treemarking surveys undertaken by DEC indicate that there are unresolved operational issues with the treemarking undertaken in Treatment Area 4 (TA4).

Water Corporation response

Parts of TA4 were treemarked by the DEC based on the current interim silvicultural guidelines. However, no thinning operations were carried out in TA4 because the Water Corporation is awaiting a response from the Conservation Commission regarding its proposed thinning modification for the Trial. Treemarking in TA4 will be reviewed pending the Conservation Commission's approval of the proposed modification.

Key Finding 3

Treemarking for the treatment areas has been below the retention level indicated at the proposal stage of the trial.

Water Corporation response

While some plots have been marked below the retention levels of 15-18 m^2 Basal Area Over Bark (BAOB), other plots were marked above this level. This simply reflects the uneven nature of the forest. The means of BOAB for all plots have been within the predicted range.

Averages of the thinning areas assessed showed that four areas were actually marked slightly below target retention levels for basal areas (12.5, 12.5, 13.2, and 13.4 m^2). However, the live basal area remaining in all these areas was within the target range of 15-18 m^2 (respectively 15.3, 16.8, 15.2 and 17.6 m^2). This was made up of a combination of marked trees, missed culls, surviving notched trees and trees unavailable for treatment.

Averages also showed that three thinning areas were actually marked within the target range (15.4, 16.4 and 17.7 m^2) with the live basal area remaining within the target range 15-18 m^2 (respectively 15.5, 17.8 and 18.2 m^2).

Three sites in Cobiac were treemarked by FPC under commercial operations to a Shelterwood prescription. The live basal area was still within the Trial's retention levels. The overall average of all thinning sites assessed had an actual treemarked basal area of 14.4m^2 with the live basal area remaining at 16.6 m^2.

Key Finding 4

There is a lack of consistency between DEC and the Water Corporation in the way in which basal area information is collected.

Water Corporation response

Although it is not standard practice for DEC to include species ratios in basal area measurement, there were exceptions made for the Trial. The monitoring form was developed jointly by DEC and the Water Corporation and includes banksia and sheoak recorded separately from jarrah and marri. This is to monitor species diversity throughout the trial. Such standards for measuring basal area and minimum diameter are determined jointly according to the objectives of the Trial's monitoring plan.

It is helpful to note that the DEC undertakes the Trial's monitoring of native forest areas subjected to thinning. Therefore all basal area data obtained by the Water Corporation is, by default, in alignment with the DEC.

Key Finding 5

There was no evidence available to demonstrate that monitoring of the impacts of increased herbicide use on non-target understorey vegetation was routinely being undertaken.

Water Corporation response

Reference is made in point 3 of Section 6.4.1 of the Interim Silvicultural Guideline[1]. This states that understorey regrowth occuring as a response to thinning should be monitored when using foliar spraying. Please note that this would not apply to the Trial as no foliar sprays have been used except on minute parts of some demonstration plots.

Additional Information

The Water Corporation has implemented pre-thinning monitoring and post-thinning monitoring of vegetation at 18 months, with subsequent monitoring every 3 years.

The herbicide injected into notched trees rapidly decomposes in soil and thus makes post monitoring possible at limited times of the year.

Monitoring has occurred pre and post thinning on a number of different sites and the results on non-target species is assessed by Mattiske and Associates as a requirement of the Trial's research project.

[1] Department of Environment and Conservation (2001) 'Interim Guideline for Silvicultural Pratice in the Jarrah Forest of the Wungong Catchment' Sustainable Forest Management Series, DEC SFM Interim Guideline No. 1, 2001

These reports show improvement in understorey in areas thinned by notching. The reports by Mattiske have been made available to the Conservation Commission. Refer to Attachment 1 for further details.

Please note that the Water Corporation is currently undertaking pre-thinning vegetation monitoring of TA4 with a similar schedule, in preparation for the possible approval by the Conservation Commission of the Trial's proposed modification.

Key Finding 6

The final basal area figure derived by the Water Corporation includes a component of notched trees that were dying at the time of the measurement.

Water Corporation response

Water Corporation confirms this finding is in accordance with normal DEC processes.

The final live basal area of the seven thinning areas assessed did include a component of notched trees.

An assessment at the time of survey to determine whether these notched trees were dead, sick or healthy was undertaken and results recorded. The sick category was used for those trees that may swing (may be "dying", may be surviving) either way in the future but were showing signs of surviving the herbicide treatment.

The inclusion of these trees in the final live basal area is simply because the trees were not dead.

Removing these sick trees from the final live basal area category would change the results from: 16.8 to 14.4 m^2, 15.2 to 14.2 m^2, 17.6 to 15.5 m^2, 15.3 to 14.2 m^2, 18.2 to 18.1 m^2, 17.8 to 17.1 m^2 and 15.5 m^2 having no change. The average live basal area would decrease by one square meter given in key finding 3 (from 16.6 m^2 to 15.6 m^2) should the sick trees be removed from the live basal area category.

Key Finding 7

It is unclear what fuel-reduction burning strategy (e.g. pre or post-treatment and schedule of integration with other activities) has been implemented in relation to the thinned native forest areas.

Water Corporation response

The Trial is subject to the Western Australian forest fire management plan, developed and implemented by the DEC. It is a complex task requiring consideration of fuel loads, weather conditions, staff numbers, threats to life and property, dieback mapping and post-notching requirements.

There has been considerable planning for fuel reduction burning in the Wungong catchment area.

The Wungong catchment has been part of the Perth Hills District strategic burn program for the last 10+ years, in part making up Alcoa's commitment to integrate mining rehabilitation and surrounding State forest back into 'normal' forest management practices. Areas and years available to burn and season of burn have been indicated on long term fuel reduction maps and are held at DEC District and ALCOA.

The addition of the Trial has added other complexities to this District program, including the need to understand dieback infected areas, requiring areas remain unburned for three years allowing interpretation, and the requirement for areas that received herbicide treatment to remain unburned for nine months following treatment.

This has resulted in some areas burnt pre-treatment and some areas burnt post treatment.

All areas for fuel reduction burning however have been considered strategically and are constantly reviewed by ALCOA, DEC and the Water Corporation to ensure burning is carried out to meet the requirements of all parties.

Key Finding 8

The available operational documentation does not provide clearly defined guidance in relation to the protection of understorey in the jarrah forest.

Water Corporation response

It is affirmed that although retained trees and mid-storey elements are described in Section 5.2 and Appendix 3 in the interim silvicultural guidelines (SFM 1), understorey is not. The Water Corporation understands that understorey shrubs are protected and acknowledges this finding.

Attachment 1

This is extracted from the report submitted to the Conservation Commission in October 2010 regarding the modifications of the Wungong Catchment Trial.

FLORA

Plant biodiversity research has been allocated to Mattiske Consulting, a very experienced botanist, particularly in the jarrah forest. The work covers four aspects:

- Stream transect studies-Wungong
- Control and impacted upland sites-Wungong
- Demonstration plots- Wungong
- Inglehope thinning trial

Stream transects

Mattiske staff are monitoring four transects across stream zones, from below the Chandler gauging station to the upper reaches of Chandler creek. Data are collected on overstorey (species, diameter, height) as well as understorey (diversity, abundance and cover). A re-measurement some 24 months later showed no changes except below the gauging station (site SZ0), attributed to a DEC prescribed burn.

In 2006 a total of 227 taxa representing 108 genera and 45 families were recorded. The initial survey in 2006 was done in spring, whereas the 2008 survey took place in December. As a result, annual species and some weeds that were present in 2006 were not recorded in 2008 (D Angus, pers comm.). This may help explain why the untreated stream transects show a *decrease* of 15 Taxa and 8 Genera between 2006 and 2008.

Control and impacted upland sites-Wungong

In contrast to the stream transects, the (treated) upland transects show a *gain* of 11 Taxa and 7 Genera, despite the 2008 survey also being carried out later in the season. It is possible that the decreases in diversity noted in the stream transects may be associated more with falling water tables or burning rather than timing of survey. Future measurements may resolve this question.

There was also considerable variation between upland transects. For example

- In the two “notched” transects, the understorey component recorded increasing species richness in one, but a reduction in the other.

- In the two “logged” transects, there was an increase in understorey species richness in both.
- In the two “control” transects, there was an increase in species richness in one but no change in the other.

Species richness increased in three out of four treated transects, probably due to increased light, moisture and temperature, but only one out of two controls. In all treated areas the crowns of retained trees responded positively to increased water availability, with increased leaf production.

Demonstration plots Wungong

Demonstration sites thinned to various densities have been established in regrowth jarrah forest as well as a 14 years old bauxite pit rehabilitated by Alcoa. The sites were monitored in August 2009, some 24- 30 months after establishment. A total of 137 vascular plant taxa representing 71 genera and 36 families were recorded.

The regrowth forest showed a higher species richness and diversity than the rehabilitated area. This is likely due to a predominance of reseeder species as compared to resprouter species in the rehabilitation seed mix. Strangely, whereas the species richness in the native forest moderate treatments was similar to the controls (13.5), the light and heavy thinning treatments were slightly poorer (10).

	• Concern that old-growth forest will be logged.
Response	Non-commercial thinning of the native regrowth forest is the most important part of the Wungong project and it is also the part that has attracted the most criticism. There has been criticism through the submissions about the need for the thinning and the activity itself. Some of this criticism is from a misunderstanding that the project is about the permanent partial clearing of the catchments, which is not the case (Section 2.1). Other criticism is because the project will use a herbicide within a drinking water catchment as part of the thinning. The herbicide, which is Roundup®, is approved by the Department of Health for this use and is the safest solution to help the thinning succeed (Section 2.8). Finally, most criticism is because some people do not want any more disturbances in the native forest. While some submission raise concerns about tree marking, which will be done by trained foresters using guidelines under the Forest Management Plan (Section 2.15) and water quality (Sections 2.6 to 2.9), behind this is an emphasis of 'do not touch the native forest'. It may be that in some cases native forest should be left alone, but in the case of the Wungong project there is a need to test whether intervention can help. In the context of a catchment mainly containing a native regrowth forest that does not allow as much run-off as a mature forest and in a drying climate – the need for the project is to help restore streamflow for the benefit of the ecology and water resources, and help move the forest towards a mature structure. Given the importance of this thinning to the project, without it the Wungong project would not proceed. Jarrah is a long lived, tough tree, and nature will make changes to suit the conditions. Some individual jarrah trees may die young, but as a whole the jarrah regrowth forest tends to stagnate (or 'lock-up') and is expected to take centuries to self-thin. If it survived at all it would probably take 300 years to grow from 20 to 50 cm diameter (Stoneman, G.L., Bradshaw, F.J. and Christensen, P. (1989) "Silviculture". In B. Dell, J.J. Havel & N Malajczuk (eds.), *The Jarrah Forest - A complex mediterranean ecosystem*, pp. 335–355. Kluwer Academic Publishers, Dordrecht.). The regrowth forest in the Wungong Catchment is for the most part overcrowded, in that there are too many trees per hectare, which compete for resources such as light and water. In a drying climate, thinning is expected to help reduce water stress on the forest and prompt growth of individual retained trees to help move the forest to a more mature structure (Section 2.22). There are differences between mining areas rehabilitated to native species and a native regrowth forest. In particular the planted stocking rates of the mining rehabilitation are on average higher than the regeneration in the regrowth forest. In general this means drought deaths are more likely than in a regrowth forest when rainfall is significantly reduced. Drought deaths may be part of self-thinning, but this process will take a long time to move the forest towards a mature structure. With a climate that is drying quickly compared to the life expectancy of a jarrah tree, it may be better to proactively move the forest to a structure that allows it to cope better with less rainfall – rather than let it

Where a significant number of culls exist >30cm in diameter, it may be necessary to follow up the machine pushing with a notching operation to remove sufficient culls to release regeneration.

The technique for establishing regeneration will depend on the availability of seed.

6.4 Protection of Soil, Understorey and Mid-Storey Elements

6.4.1 Thinning areas

The silvicultural treatment of thinning areas in the Wungong catchment involves greater use of herbicides for control of regrowth than is standard practice elsewhere in the jarrah forest. This poses a risk of herbicide impact on non-target species, particularly understorey vegetation. To reduce the risk to non-target species the following practices will be employed:

- Those undertaking herbicide application will receive adequate training so that they can reliably identify target and non-target species and so they use the correct methods of application which minimise the effect of herbicide on non-target species;
- The herbicide application operation will be closely supervised to ensure that practices are being implemented appropriately; and
- All areas subject to regrowth control by herbicide application will be monitored for the effectiveness of the operation on target species and the impact on non-target species.

6.4.2 Shelterwood cut areas

Mechanical disturbance of the vegetation and soil occurs incidentally during commercial timber harvesting but may also be undertaken after commercial timber harvesting to reduce competition to jarrah advance growth and to enable jarrah seedlings to establish following germination. The shelterwood silvicultural treatment is often accompanied by such disturbance to ensure jarrah seedlings are able to establish and develop a lignotuber.

While it is the intention of the silvicultural treatment to disturb the ground and reduce the competition from understorey species, the impact on flora diversity and abundance can be contained to acceptable levels by implementing the following guidelines:

- Pushing of understorey species to promote regeneration of jarrah will only be undertaken in areas where there is clear evidence of the past presence of jarrah, such as old stumps;
- Balga (*Xanthorrhoea preissii*) thickets should generally be preserved;
- Push down treatments of the understorey will focus on groups or clumps of species such as bull banksia (*Banksia grandis*) and sheoak (*Allocasuarina fraiseriana*) that are impeding regeneration establishment. Approximately 20 per cent of these groups or clumps of species should be retained as small clumps (0.02 hectare) or as scattered individuals. Avoid push down where these species occur as scattered (greater than 10 metres apart) individuals rather than clumps;
- Retain scattered mature individuals of species such as balga, woody pear *(Xylomelum occidentale)*, river banksia *(Banksia verticillata)*, snottygobble *(Persoonia longifolia)*,

6.10.2 Control of stump coppice and regrowth in thinned stands

Coppice and regrowth developing in thinned stands will negate the positive impact of thinning on water yield within about 10 years. To maintain the value of thinning for water production thinned stands will require follow-up to control stump coppice and regrowth either by the use of herbicides or by mechanical means. It will enhance timber production as well as water production.

Initial practice will involve a tops disposal burn in the first or second summer after treatment, followed by foliar spray of stump coppice before it reach 0.5 - 1m in height. This would be followed by notching of sapling regrowth and any surviving stump coppice within 5-10 years of the thinning. Control of regrowth at the sapling stage ensures that a lignotuber pool can continue to develop and be available for regeneration release when required. Field trials of alternative methods will be developed as the need becomes apparent.

Understorey is expected to increase in density following thinning and this will also have an adverse impact on water yield. Secondary tree species (*Banksia* and *Allocasuarina*) will require herbicide application to control regrowth and coppice. This can be controlled at the same time and by the same technique as eucalypt regrowth control. The requirements of Section 5.4, aimed at ensuring continued representation of second storey species will apply.

It is not possible to predict at this time how often regrowth control will be necessary but it may be in the order of once a decade. The ecological impact of these practices will be monitored.

A second thinning of crop trees will be required in about 20 years time.

Regrowth control cannot be continued indefinitely without compromising the long term capacity for renewing the forest. This is safeguarded by the provisions of the current guidelines i.e. when stands are considered unsuited to thinning and require regeneration, they cannot be cut to a gap until there is adequate ground coppice available to regenerate it. The process described above should ensure that there is an adequate lignotuber pool available when required. Long term thinning to the proposed densities also serves a similar role to shelterwood by providing a seed source and level of competition from the overstorey that should allow seedlings to establish.

The requirements of Section 6.4, aimed at managing the risks to understorey vegetation from regrowth control operations will apply.

6.10.3 Routine prescribed burning

Understorey is expected to increase in density following thinning and this will have an adverse impact on water yield. In order to reduce the average period over which understorey transpires strongly and to reduce rainfall interception by heavy litter, a burning frequency aimed at maintaining fuel loads of <8 tonnes/ha is the objective. The exception to this is where a longer period is required to protect regeneration that has been released.

6.10.4 Monitoring of forest density

Areas thinned for water and timber production will be monitored using variable radius plots on a coupe basis. Success criteria will be as follows: