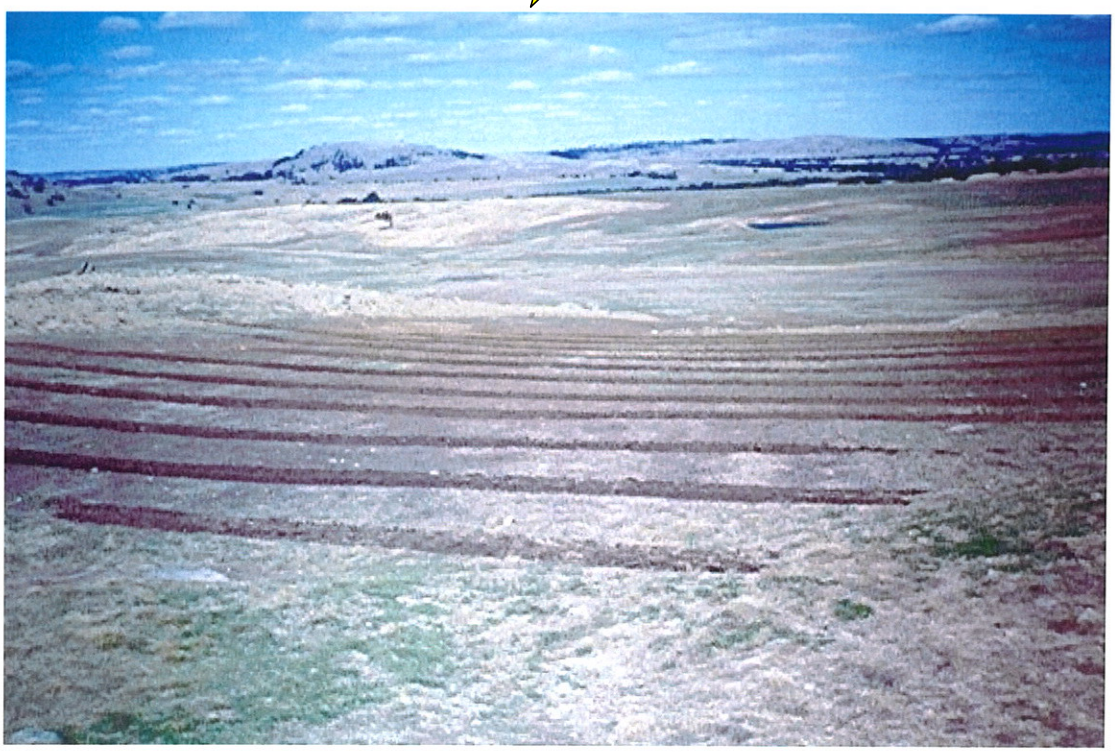
Dan Huxtable

State Agency Contributions to Land Conservation/Biodiversity Revegetation

Natural Heritage Trust (Project Ref. Number 973355)

PROJECT REPORT

Component 1: Capacity Building
CALM 2 – Revegetation Development Officer
Report By: Dan Huxtable
January 24, 2001



CONTENTS

Revegetation Development Officer – Meta Project #2.

Project Review - January 2001.

REPORT BY: **Dan Huxtable**
DATE: **January 17, 2001**

Background

Dan Huxtable was offered and accepted the position of Revegetation Development Officer (CALM/AgWA Meta-Project) in July 1999. Due to other employment opportunities, Dan tendered his resignation from the position in January 2001.

The purpose of this report is to:
1. Summarise the major actions performed by Dan since his appointment.
2. Document issues which have affected the success or otherwise of the project so far.

Key Objectives of Position

1. Developing planning and design approaches for revegetation of medium rainfall areas. Key design principles will include biodiversity, aesthetics and fire management.
2. Developing and implementing several demonstration sites which, where possible, integrate with the Maritime Pine Project.
3. Delivering extension and training services to front line revegetation advisors such as Bushcare Support Workers, Community Landcare Co-ordinators and Land For Wildlife workers.

Progress Towards Key Objectives

- Demonstration plantings, using regionally occurring native species, were established on 6 Maritime Pine Project properties, as follows:

Location	Landowner	Number of Sites	Total Area (approx)
Beverley	Mr L.Shaw	5	12 ha
Beverley	Mr D.Adams	2	10 ha
Wagin	Mr V.Spooner	2	2 ha
Wagin	Mr T.Manglavite	3	2 ha
Woodanilling	Mr F.Carter	2	3 ha
Jingalup	Mr W.Owens	3	5 ha

Summary reports, which could form the basis of extension tools/materials, have been prepared for each of these locations. However, due to a number of factors, these revegetation sites were only partially successful in meeting project objectives (see **Issues Affecting the Project Outcomes** section).

- A 2.5 hectare arboretum was jointly established with MPP staff at Moora, to demonstrate a range of species which have potential for producing timber products. The arboretum includes the following species native to south west WA: *Eucalptus accedens, E.longicornis, E.loxophleba, E.occidentalis, E.salmonophloia, Acacia acuminata* and *Acacia microbotrya*. In time, the arboretum will be a useful demonstration site in the Midlands region.

- A summary report on commercial possibilities for native species was prepared, and presented to, the Gillingarra Landcare Group.

- A summary report explaining land capability assessment techniques for perennial revegetation options was prepared for the Agaton Catchment Group.

- Farm forestry sections were jointly prepared with CALM FFU staff for two AgWest focus catchments in the Katanning District. These were the Middle Balgarup Catchment and the Queerfellows Creek Catchment.

- Techniques for revegetation design and implementation on farms were researched. This included the preparation of a review of revegetation methodology in the medium rainfall zone of WA.

- An economic analysis of commercial revegetation options was initiated using a discounted cash flow model. Products investigated included fuelwood, sawlogs and sandalwood. This analysis has been documented, however the work was ceased due its low priority (in terms of project objectives) before a final report was prepared.

Issues Affecting the Project Outcomes

In attempting to realise the key objectives of the CALM #2 Meta-project position, a number of difficulties were experienced which warrant documentation.

Firstly, one of the fundamental tasks of the position was to plan and implement revegetation demonstration sites which integrated nature conservation values into farming enterprises. The intention was that these sites could be used as case studies for extension purposes. The mode of delivery for this task was through the Maritime Pine Project (MPP).

During the initial consultations with farmers eligible for MPP supplementary species plantings, it became apparent that none of them were interested in pursuing nature conservation objectives on their farms. In short, the implementation of plantings with a nature conservation objective did not meet their goals or aspirations. As a consequence, the ability to create meaningful demonstration sites was seriously undermined.

A number of other farmers not connected with the MPP were also approached in the process of searching for suitable demonstration farms. In every case, the farmers were not interested in incorporating nature conservation values into their revegetation. One example is the Agaton Catchment group. This group of farmers had been through an extensive farm planning process in conjunction with agency personnel, culminating in a successful NHT funding application for $286,900. The major component of the funding was for nature conservation oriented revegetation with local native species. However, when this group was approached in 2000 and offered assistance to implement the project, the group members claimed that the project did not meet their planning goals and aspirations. The group has since taken steps to reject the NHT funding.

The second major difficulty faced by the position was the lack of genuine support in the Maritime Pine Project for supplementary species plantings. Dan Huxtable provided an explanation of the status of the supplementary species component in a report to management in August 2000. A copy of this report is attached.

The nature of these issues and their importance was communicated to management on several occasions. This included the preparation of two written reports to management, one in March 2000 and the other in August 2000 (attached, as above).

Notwithstanding the above issues, the project was able to deliver a range of useful outcomes as previously detailed in this report. However, a clear message has been received about attitudes toward nature conservation in the WA farming community. The documentation provided here is intended to:

1. Help maximise the ability of the project to meet its objectives in the next 18 months.
2. Provide relevant information to future projects with similar objectives.

ATTACHMENT

Report for management prepared by Dan Huxtable in August 2000.

Since commencing my position, the Maritime Pine Project has undergone significant changes. Firstly, the biodiversity incentive was changed from the 10% native species offer to an up front cash offer in 1999. Secondly, it is now likely that the biodiversity component will be axed due to funding constraints and a lack of landowner interest.

These changes highlight a **fundamental conflict between the objectives of my project and the Maritime Pine Project**, outlined as follows:

One of the most difficult tasks faced by the Maritime Pine Project has been land acquisition – farmers on the whole do not want to plant trees (any type of tree!) on any significant scale (unless the trees can compete economically with conventional agriculture, without a significant compromise in cash flow).

The MPP Biodiversity component was created as an incentive for farmers to take up the overall MPP package. However the attraction for biodiversity plantings has always been very low, such that there has been pressure to offer species with a (potential) commercial value. Species in this category include eastern states eucalypts and other exotics. In some instances, farmers have not taken the free trees at all or have planted an extra 10% of pines.

As an example, since it commenced in 1995 the Maritime Pine Project Midwest office has established in the order of 6000ha of Pinus pinaster. During this time, some 200ha or so of "biodiversity" plantings have been established. Of these, at least 50% have consisted of pines or non local species such as Spotted Gum, River Red Gum and Sugar Gum. A similar scenario has occurred in the Lower West and South Coast Maritime Pine Cells. This outcome has been driven by the aspirations of farmers who are seeking commercial revegetation options, and have little or no interest in biodiversity outcomes.

It is an unfortunate aside that the biodiversity component was not formulated to address these farmer aspirations for commercial species. As a result, where "psuedo-commercial" species have been provided there has been little guidance in establishment and management methods that will enable a useful product to be realised (eg Eucalypt sawlogs).

My project is seeking to integrate native species (preferably locally occurring) into farming systems, in a way that improves the nature conservation/biodiversity values of farmland. Farmers are sometimes interested in the landcare benefits of revegetation, such as erosion control and water use. However, the vast majority are not interested in nature conservation values. Virtually all of the landcare benefits farmers are interested in can be achieved with "potentially" commercial species (ie water use, erosion control).

Biodiversity oriented plantings which do not have a commercial value are not attractive to farmers. As a result, they have failed to provide an incentive for the uptake of the Maritime Pine Project. The implication is that my project has little to offer the Maritime Pine project now or in the foreseeable future. Equally, there is little reason for the Maritime Pine project to provide me with additional resources.

I have been fortunate thus far that there were a handful of farmers who were owed biodiversity trees from 1998 (and therefore did not have the up front cash option), allowing me to plant sites in 2001 with purely local native species. In all cases they were interested in planting to alleviate excess water in the landscape and had virtually no interest in what species I planted. I doubt that any of them would have planted these sites without the significant government assistance they received (ie fully paid for by CALM).

LAND CAPABILITY ASSESSMENT

FOR

DEEP ROOTED PERENIAL VEGETATION LAND USE OPTIONS

Report to Agaton Catchment Group
Prepared by Dan Huxtable (CALM Farm Forestry)
December 18, 2000

BACKGROUND TO LAND CAPABILITY ASSESSMENT:

In order to help control rising watertables and associated salinity problems, it is widely recognised that there is a need to incorporate deep rooted perennial vegetation into WA farming systems.

To be able to determine the suitability of a site for a perennial vegetation land use option, information is required on the **soil profile to 3 meters** (*eg* soil texture and structure, acidity/alkilinity, nutrient status) and **hydrological characteristics** (*eg* depth to watertable, surface and sub-surface salinity, whether the watertable is expected to change over time). **Climatic information** such as annual rainfall and its distribution throughout the year is also important.

Unlike an annual crop such as wheat, **perennial crops** need to be able to grow and produce over several or many years. In general, the critical factor affecting the survival and productivity of these crops is water availability during the year and between years. **Soil profile depth is a very important site characteristic which impacts on whether a particular species will have enough water to 1) survive and 2) be productive.**

A land capability assessment should not be thought of as a single, fixed procedure. Rather, each individual study will be tailored to meet the objectives and aspirations of the instigating landowner or group. The methods used and overall costs will vary accordingly.

POSSIBLE COMPONENTS OF LAND CAPABILITY ASSESSMENT:

- **Aerial Photograph interpretation**
- **Geophysical survey**
- **Soil Ground Survey**
- **Hydrological Assessment**

1) Aerial Photograph interpretation

What It Can Provide:

- An indication of landforms, soil types and boundaries across a farm/catchment.
- This will be indicative only, and require ground truthing with an on ground soil survey.
- However, it can greatly improve the efficiency of later ground surveys and therefore reduce overall costs.

Equipment/Expertise Required:

- An experienced air photograph interpreter.
- 1:25,000 standard colour aerial photographs, in stereo pairs, for the target area(s).

Approximate Cost:

- Expert assistance = $40-80 per hour.
- Aerial Photographs = $53 per stereo pair (Available from DOLA, ph 9273 7373)

NOTE: The information provided by aerial photograph interpretation has probably already been collected through the farm planning process done by the Agaton Catchment Group.

2) Geophysical survey

Geophysical surveys involve using specialised equipment to examine particular physical features of the land surface and sub-surface.

What It Can Provide:

- Magnetic survey – a map of underlying magnetic influence which can indicate the structure of underlying basement rock. This can provide an insight into subsurface water movement and salinity risk. ***Probably not useful on sedimentary soils in Agaton catchment.***
- Electro-magnetic survey – maps of soil conductivity for the surface 1m (EM38) and in the top 6m (EM31). These can provide an indication of salt distribution across the farm/catchment and the risk of the salinity spreading. This information can also be useful for designing a bore network.
- Radiometric Survey – a map of the distribution of radioactive elements in the top 30cm of the soil. This provides information about the composition of soils and the distribution of soil types across the farm/catchment.

Equipment/Expertise Required:

- TESLA 10 is a Perth based company which can undertake a one pass survey for all or desired components of the above information. The service includes preparation of customised maps. Contact: Mr Andrew White (08) 9364 8444.

Approximate Cost:

- Catchment Scale (line spacing 200-400m) - $3-6 per hectare.
- Farm Scale (line spacing 50-100m) - $8-16 per hectare.
- Paddock Scale (line spacing 25-50m) - $16-28 per hectare.

NOTES:
Through prior farm planning, it may be possible to focus a geophysical survey onto specific, target areas of the farm/catchment where particular information is required. This can greatly reduce costs.

3) Soil Ground Survey

Soil ground surveying is the probably the most important component of a land capability assessment. It involves either using hand augers, drill rigs or backhoe pits to assess characteristics of the soil profile to 3 meters.

What It Can Provide:

- Detailed information on the distribution of soil types across the landscape. This can be used to produce **farm or landscape scale maps of land suitability for different species**.
- Information on soil properties (such as texture, structure, pH, presence of root impenetrable layers) in the top 3m of the soil profile for different parts of the landscape.
- Information on soil water characteristics including soil water salinity and watertable movement for different parts of the landscape.

Equipment/Expertise Required:

- A qualified/experienced soil scientist.
- A hand auger, drill rig or backhoe.

Approximate Cost:

- Soil scientists - $40+ per hour
- Hand Auger (with extensions) - $450-600
- Drill Rig with operator - $20-25/3m hole, approx 30 holes per day.
- Backhoe with operator - $65-90/hour, approx 2-3 described pits per hour.

4) Hydrological Assessment

The purpose of hydrological interpretation is to develop a conceptual model of the hydrology beneath the farm/catchment. This assessment is done through a combination of aerial photograph interpretation, geophysical survey interpretation, topographic interpretation and analysis of bore/piezometer data where available.

What It Can Provide:

- An indication of present and future waterlogging and/or salinity risks at the target site(s).
- An indication of how perennial vegetation may influence water movement and groundwater levels on other parts of the farm/catchment.

Equipment/Expertise Required:

- Qualified/experienced hydrologist.
- Any map, bore and survey data available (as per previous sections).

Approximate Cost:

- Hydrologist - $40+ per hour.
- Maps and other survey information – as per previous sections.

NOTES: Hydrological interpretation is a difficult task which involves significant assumptions and uncertainty, depending on the quality of information available to the interpreter. Often the final assessment will be indicative only.

Total Cost Estimate for Land Capability Assessment.

The following "ballpark" costs for land capability assessment are provided for a farm scale project. Note that the actual cost can vary significantly based on a wide range of factors such as:

- The size of the farm and nature of the landscape in which it is situated.
- The major soil types and their variation across the farm.
- The nature of the current farming operation.
- The amount of time and money able to be allocated to the study.
- **The questions posed, and answers sought, by the landowner when implementing a land capability study. The design of the study will vary greatly depending on its overall objectives.**

Cost Component:	**Approx Cost Range (Farm Scale)**
Aerial Photograph interpretation	**= $ 300-500**
Geophysical survey	**= $2000-5000**
Soil Ground Survey	**= $1800-3000**
Hydrological Assessment	**= $400-$1200**
TOTAL	**= $4500-9700**

REVEGETATION OPTIONS FOR GILLINGARRA

(Supplementary Species component of the Maritime Pine Project)

Report to: Gillingarra Landcare Group
Report by: Dan Huxtable, CALM Farm Forestry Unit
Date: July 4, 2000

Background:
In 2000/2001, the Gillingarra Landcare group is planting a combined total of some 1500ha of Maritime Pine under share-farming agreement with CALM.

As a component of the scheme, pine growers are also receiving funding assistance of $70/ha (of pines planted) to be used for supplementary species plantings and biodiversity protection.

At the group meeting on March 21, 2000 a number of farmers expressed interest in using this funding to plant **native species that have a commercial value**. The group members were keen to coordinate their revegetation efforts, in order to develop a combined resource of commercial, native species. This would greatly improve the marketing prospects for any future products.

The purpose of this report is to outline a number of options for integrating native species with commercial potential into farming systems in Gillingarra. This will help the Gillingarra Landcare Group to develop implementation plans for supplementary species plantings in the area.

The Commercial Prospects for Native Species
There are a variety of ways in which revegetation can benefit farming systems and the wider landscape. These include:

- Excess water utilisation
- Erosion control (wind or gully erosion)
- Improved farm aesthetics
- Use of unproductive land (*eg* deep sands or saline land)
- Enhanced nature conservation values.
- Commercial products

At the present time, very few native species are grown exclusively to produce commercial products for the simple reasons that it is not economically viable or markets do not exist. The main exception to this is the purpose-grown wildflower industry. A significant research and development effort has been put into oil mallee's over the past 8-10 years, such that this industry is nearing becoming a viable commercial prospect.

As a result, it is recommended that revegetation using native species should not target commercial products alone, but seek to incorporate other benefits such as: water use, erosion control and nature conservation (*see attachment at end of report*). The potential commercial value of native species is best viewed as a bonus on top of these other benefits.

Despite this, it is important that the commercial potential of native species is enhanced through appropriate planting configurations and ongoing management.

Five species options are discussed in the next section. These are:

- Brown mallet for sawlogs
- Spotted gum for sawlogs
- Sandalwood
- Wattles for edible seed
- Oil mallee's

It is important to note that there is significant uncertainty about how to optimally grow and manage these species for commercial products, or to predict what they will be worth in the future. The five options are seen as "best bets" and are intended to serve as an initial guide to help farmers make decisions rather than as strict prescriptions. Sources of extra information have been provided for each option.

Option 1: Brown Mallet (Eucalyptus astringens)

Description of plant (adapted from REX 96):
Medium sized tree, occurs on gravel hills and breakaways in the southern wheatbelt and southern coastal areas from Moora - Narrogin - Mt. Barker and eastwards to Corrigin and Ravensthorpe.

Adaptable to most well-drained soils in full or filtered sun.

Moderately lime tolerant . Waterlogging sensitive.

Very fire-sensitive. Life span > 75 years.

Light red-brown to dark grey-brown heartwood, with reddish streaks has a fine texture, straight or interlocked grain and is very hard, strong, tough and moderately durable. It has low shrinkage and is easily dried. It machines well and has a beautiful sheen when polished.

When in contact with the ground, timber must be treated to prevent termite attack.

There is anecdotal evidence from farmers in the Narrogin district that brown mallet is unpalatable to sheep.

Possible products:
- Sawn Timber
- Posts (also good for electric fence droppers)
- Firewood

Suggested Site Type At Gillingarra:
Gravels and shallow sands over gravel, on hilltops and upper slopes. Gravels must be penetrable by roots.

Suggested Planting Configuration:
To achieve the straightest tree form, mallets should be planted at high density (3m between rows and 2-3m along rows – this will give a density of 1100 to 1650 stems per hectare). Block plantings, or wide belts (10 rows) are the recommended configurations.

The sites should be deep ripped in April/May and weeds controlled prior to planting after the break of season. Mounding is probably unnecessary on most sites. Scalping may be an option on sandier sites.

It may be possible to direct seed this species.

Seed provenance is likely to have a strong influence on growth rates and tree form, which may warrant trials of several "best bet" varieties being established.

Management inputs required:
Establishment: Ripping, weed and pest control, planting, fencing (may not be required – damage by stock needs to be assessed).

Silviculture:
It is difficult to predict the silvicultural requirements for brown mallet at Gillingarra with much precision. Individual site factors, such as soil type and water availability, will influence these requirements. As with growing crops, it is essential that sufficient time is allocated to tree management and that required works are done on time.

The following table shows a potential management regime which is believed to be suitable for growing sawlogs in the <600mm rainfall zone. This has been included to give an indication of inputs required by the farmer.

Potential Sawlog regime.

Year After Planting (depending on growth rates)	Task	Description	Time of year
4-6	Form Prune	Correct double forks, cull poorest trees.	June-Sept
6-10	Prune and Thin	Thin to 150 SPH (approx), prune crop trees to half tree height.	June-Sept
8-11	2nd Prune	Prune to half tree height.	June-Sept
30+	Harvest	Clear fell stand	

The cost effectiveness of fertilising is unknown but is worth investigating.

"Ballpark" Returns (todays dollars):
Sawlogs:
Estimated number of crop trees = 150/ha
Estimated stumpage (value of standing tree) = $20-50/tree
Estimated Gross Return per hectare = $3000-7500/ha

Brown mallet is a good firewood. There is scope to sell it in bags as kindling for the Perth market.

It may be possible to utilise the thinnings for firewood or fence posts at year 5-8. The crown wood generated at the final harvest could also be used for firewood.

Other species options:
Silver Mallet (*Eucalyptus argyphea*) is a similar species to brown mallet but tends to have faster growth rates. The timber qualities are believed to be similar for posts and sawn timber, but not for tool handles.

Powderbark wandoo (*Eucalyptus accedens*) may also be worth trying on similar sites. It produces a hard, good quality timber.

Key Issues to Consider:
- Growing trees for timber is a long term objective. To attain trees of sawlog size is likely to take in excess of 30 years. **The main advantage of brown mallet is that it is suited to gravelly hills that are unsuitable for most other tree species.**
- Marketing – possibly the best way to market brown mallet timber would be as a "specialty" product for niche businesses (tool handles, paneling, floorboards, furniture). Considerable effort would be required to source/develop such markets. Being able to guarantee a continuity of supply is a critical factor to consider. A co-operative approach by farmers would help to achieve this.
- Value adding (*eg* through on farm milling) – depending on markets and time available, may be cost effective for farmers.

Extra Information:
Tree Notes series
"*On site processing for farm forestry*", RIRDC publication #98/79 – contact 02 6272 4539 to purchase a copy, or visit the RIRDC website at **http://www.rirdc.gov.au/**

Option 2: Spotted Gum (Corymbia maculata)

Description of plant (adapted from REX 96):
Occurs on coastal plains and hills from Bundaberg in Qld, south along NSW coast, with disjunct occurrence in the Mottle Range north-west of Orbost in eastern Victoria. Altitude ranges from near sea level to 950 m.

Hardy. May be frost tender when young. Adaptable to most well-drained soils in full or filtered sun. Moderately drought tolerant. Moderately lime tolerant .

Hard, strong, moderately durable, light to dark brown heartwood, often with an interlocked grain and gum veins, and occasionally having an attractive "fiddleback" figure. Wide band of sapwood (up to 8 cm) is very susceptible to Lyctus borer attack, particularly if trees are stressed.

Possible products:
- Sawn Timber
- Posts
- Firewood

Suggested Site Type:
Well drained sands/sandy loams where soil profile depth >3m, on mid-lower slopes. It is preferable to have clay at depth.

Suggested Planting Configuration:
For block planting, spotted gum should be planted at a density of about 1250 stems per hectare (4x2m spacing).

Planting in belts is also considered to be feasible. Belts widths could range from 2-10 rows, although >5 rows is recommended to improve crop tree selection.

The sites should be rip/mounded in April/May and weeds controlled prior to planting after the break of season.

Seed provenance is likely to have a strong influence on growth rates and tree form, which may warrant trials of several "best bet" varieties being established.

Management inputs required:
Establishment: Ripping, weed and pest control, planting, fencing

Parrot Control: Likely to be an ongoing requirement until sufficient tree height is obtained. The target bole length (pruned trunk of tree) would be 5+ meters for this species.

Silviculture: The silvicultural requirements for spotted gum at Gillingarra will be influenced by individual site factors, such as soil type and water availability. As with growing crops, it is essential that sufficient time is allocated to tree management and that required works are done on time.

The following table shows a potential management regime which is believed to be suitable for growing sawlogs in the <600mm rainfall zone. This has been included to give an indication of inputs required by the farmer.

Potential Sawlog regime.

Year After Planting	Task	Description	Time of year
3-4	**Form Prune**	**Correct double forks, cull poorest trees.**	**June-Sept**
5-8	**Prune and Thin**	**Thin to 150 SPH (approx), prune crop trees to half tree height.**	**June-Sept**
8-10	**2nd Prune**	**Prune to half tree height.**	**June-Sept**
20-30	**Harvest**		

The cost effectiveness of fertilising is unknown but is worth investigating.

"Ballpark" Returns (todays dollars):
Sawlogs:
Estimated number of crop trees = 150/ha
Estimated stumpage (value of standing tree) = $40-60/tree
Estimated Gross Return per hectare = $6000-9000/ha

It may be possible to utilise the thinnings for firewood or fence posts at year 5-8. The crown wood generated at the final harvest could also be used for firewood.

Key Issues to Consider:

- Marketing – possibly the best way to market spotted gum timber would be as a "specialty" product for niche businesses (panelling, floorboards, furniture). Considerable effort would be required to source/develop such markets. Being able to guarantee a continuity of supply is a critical factor to consider. A co-operative approach by farmers would help to achieve this.
- Value adding (*eg* through on farm milling) – depending on markets and time available, may be cost effective.
- Parrot damage – parrots have the potential to ruin the value of a spotted gum plantation. The risk at Gillingarra needs to be further assessed.
- Drought stress – Spotted gum naturally occurs in higher rainfall areas. Good site selection and sufficient thinning is required to ensure that the water available at the site is sufficient to sustain a 20+ year rotation.

Other species options:

A range of other trees species have potential to be grown for sawlogs, as per the above recommendations for spotted gum. These include Sugar Gum *(Eucalyptus cladocalyx),* Red Ironbark *(Eucalyptus sideroxylon)* and for wetter sites Southern Mahogany *(Eucaluptus botryoides).*

However, in order to maximise the potential resource, it is recommended that the group selects one preferred species.

Extra Information:

Tree Notes series

"*On site processing for farm forestry*", RIRDC publication #98/79 – contact 02 6272 4539 to purchase a copy.

Option 3: Sandalwood (*Santalum spicatum*)

Description of plant:
Sandalwood is a parasitic tree that occurs naturally in the southern half of WA and western SA. It has a fragrant timber, which is used predominantly in South East Asia for incense sticks.

Possible products:
- Specialty timber
- Nuts (for seed or bush tucker).

Suggested Site Type:
Gravels and shallow sands over gravel or clay, on hilltops and upper-lower slopes. Gravels must be penetrable by roots.

Suggested Planting Configuration:
Host plants needed to be established 1-2 years prior to (Jam *Acacia acuminata* is the preferred host species, rock she-oak and *Acacia saligna* could also be used in combination with jam).

The sandalwood is planted as seed in the following Autumn.

2-4 hosts are required for each sandalwood, to ensure good growth and survival of the sandalwood over an 18-25 year rotation.

Site preparation required includes deep ripping, weed/pest control and host establishment at 500-825 stems per hectare. Further knock down weed control is needed prior to sandalwood seed planting.

Sandalwood plots could be established as blocks or belts (2+ rows).

Management inputs required:
Establishment: Ripping, weed and pest control, planting, fencing.

Seed harvesting: August to November, after about year 5.

Final harvest (whole tree removal) at year 18+.

"Ballpark" Returns (todays dollars):
A stocking rate of 200-300 sandalwood trees per hectare could be expected to yield about 2-3 tonnes of commercial timber at harvest.

Approximate value of timber = $6,000/tonne.

Estimated gross return = $12,000-18,000/ha

The seeds have potential to provide a source of income during the rotation. Possible markets for the seed require further investigation.

Key issues to consider:
- A market for sandalwood already exists, based on wild stock harvested under license from the Goldfields.
- The timber is a high value product.
- Based on present day assumptions, this option offers the greatest potential return to the farmer.
- There is some scope for using a number of the edible wattle seed species (option 4) as hosts, although sandalwood parasitism would reduce their production potential.

Extra Information:
Sandalwood Information Sheet – Issue 1 (CALM, 1999).

Option 4: Wattles for bushtucker

Description of plant:
The wattles comprise a diverse group of species (the *Acacia's*), not all of which produce edible seed.

Species that may have potential for edible seed production in the Gillingarra area include:

- *Acacia murrayana*
- *Acacia victoriae*
- *Acacia scirpifolia*
- *Acacia blakelyi*
- *Acacia saligna*

Most of these species are fairly short lived (10-20 years).

Possible products:

- Edible seed
- Firewood

Suggested Site Type:
Sandy gravels and sands (upper to lower slopes), valleys which do not get waterlogged.

Suggested Planting Configuration:
The wattles should be spaced 3-4m apart to allow maximum growth and seed production. Either a block (4x4 spacing) or belt configuration (*eg* 2-4 row windbreak) would be suitable.

Direct seeding may be a cost effective option for wattle establishment.

Otherwise, seedlings can be planted into riplines or scalplines.

Management inputs required:
Establishment: Ripping/scalping, weed and pest control, planting, fencing.

Seed harvesting (December): Seed would be expected to be produced after about age 4-6 years. The seed currently is harvested by hand, a labour intensive task.

Wattle seed requires no treatment prior to storage, only needing to be cleaned of contaminants prior to wholesale. It is roasted and made into a flour during manufacturing.

"Ballpark" Returns (todays dollars):
Possible returns from edible wattle seed are difficult to even "guestimate"

As a rough guide, a study of the feasibility of growing bush food in western Queensland estimated the following returns for *Acacia victoriae* grown in that region (Source - *"The feasibility of a sustainable bushfood industry in Western Queensland", RIRDC Research paper #97/11):*

Time to maturity = 4 years
Yield = 1.5 kg/plant
Farm gate value = $5.00/kg
Return = $7.50 per plant per annum.

The estimated return (minus operating costs) for a stocking of 625 stems per hectare was about $1000/ha per annum. Harvesting costs were estimated to be $1200/ha.

Key issues to consider:
- The market is small and based solely on one species at present (*A.victoriae*). As such, the food value of the other species is untested.
- This is a higher risk option in that future returns are highly uncertain.
- The multiple benefits of wattles (windbreaks, sand stabilising, fodder value) should not be overlooked.
- To my knowledge, there are no producers of wattle seed in WA. This suggests that there is opportunity to create a local supply chain.
- Value adding opportunities, through on farm or local processing, are worth exploring.

Extra information:
"*Edible Wattle Seeds of Southern Australia*" B.R.Maslin et al 1998, CSIRO Publishing – available from CALM Como Office (Ph 9334 0333).

Option 5: Oil Mallees and *Melaleuca's*

Description of plant:
A range of mallee eucalypt and *Melaleuca* species are believed to have good commercial potential. These are being developed by the Oil Mallee Association (OMA), in conjunction with CALM.

Possible products:
- Cineole (Oil)
- Biomass for electricity generation
- Activated carbon
- Brush fencing material (*Melaleuca's* only)

The likely market for oil mallee's is as a feedstock for integrated processing facilities, which are able to produce multiple products thereby improving economic viability.

Suggested Site Type:
A range of species, suited to a range of sites, are potentially available.

Some *Melaleuca* species may be able to tolerate waterlogged sites lower in the landscape.

The hedgerow configuration is the design commonly advocated by the OMA (twin rows 2m apart with trees planted 1.5m along the rows). This allows integration of trees with cropping and pasture enterprises, in the form of belts. Block plantings are also possible.

The OMA can provide guidance with matching species to sites.

Suggested Planting Configuration:
As per Oil Mallee Association recommendations.

Management inputs required:
As per Oil Mallee Association recommendations.

"Ballpark" Returns (todays dollars):
A recent economic analysis by Alan Herbet from AgWA summarises the latest thinking on this subject ("*Economics of oil mallees*", Alan Herbet, April 2000 - Ph AgWA 9368 3333 on to obtain a copy).

The main findings of this study are:

- Assuming first harvest at age 4 years and then every second year thereafter, and a farm gate biomass value of $15/tonne, oil mallees are financially attractive for planting into paddocks which have a current agricultural production value of $79/ha or less.
- The profitability of oil mallees is significantly less on lower biomass yield sites, where mallees are initially harvested at age 5 years and then every third year thereafter.

Further information:
Contact Max and Angela Water's from the Oil Mallee Association – ph 9666 2131

ATTACHMENT

Revegetation designs which can enhance nature conservation values.

Without compromising other objectives, revegetation projects can make an important contribution to nature conservation values through one or a combination of the following:

- **Planting locally occurring species**, which add to existing populations of native species in the landscape.
- By using a **mixture of species**, to provide varied structure and habitat for wildlife.
- Increasing the **effective size** of areas of remnant vegetation
- Improving **linkages** between areas of remnant vegetation.
- Reducing **threats** to remnant vegetation (*eg* mitigation of rising watertables).

The main revegetation designs which can enhance nature conservation values are:

- **Expanded remnants**: Increase the "effective" size of remnants by minimising the perimeter /area ratio of the remnant (*ie* make irregular remnants as square or circular as possible).
- **Buffer zones around remnants (or pines):** Suggested minimum width of 20m.
- **Corridor Linkages:** To connect areas of remnant vegetation or revegetation (including pines). Could be planted along fence lines, drainage lines, drive ways, road reserves *etc*. Suggested minimum width of 40m, linking remnants >5ha and spanning a distance <1000m.
- **Riparian Zone Plantings:** suggested minimum width of 30m either side of creek/drainage line.

Other benefits of Revegetation

- Reduced wind erosion through strategically positioned windbreaks
- Reduced recharge to groundwater systems. This can potentially help to alleviate "localised" waterlogging and salinity problems on some sites.
- Improved aesthetic value of farm and the wider landscape.

P2000 Supplementary Species Project Documentation

Property Owner:	**David and Geena Adams**
Location:	**Beverley-Brookton Rd, approximately 5km south of the Beverley town-site.**
Number of sites:	**2**
Report By:	**Dan Huxtable (Bushcare Revegetation Development Officer)**

Background:

In 1998, the landowners entered into a share-farming agreement with CALM resulting in the planting of 282ha of *Pinus pinaster* on low productivity soils. As a part of the sharefarm agreement, up to 28 ha of supplementary species was available for the purposes of nature and land conservation.

In 1999, 10ha of the supplementary species allocation was planted on the property. In 2000, 10 more hectares was established. This report documents the year 2000 planting project.

All establishment works were funded by CALM, with the farmer required to provide fencing where necessary. Dan Huxtable (Bushcare Project Officer) coordinated project planning and implementation tasks.

Underlying Aims (Bushcare Project):

1) To develop revegetation designs that integrate nature and land conservation with profitable agriculture.
2) To implement designs that were compatible with the aspirations of the farmer and the existing farming enterprise.
3) To use a design methodology that could easily be adopted and replicated by large scale commercial revegetation projects, such as the CALM Maritime Pine Project[1].

Site Selection:

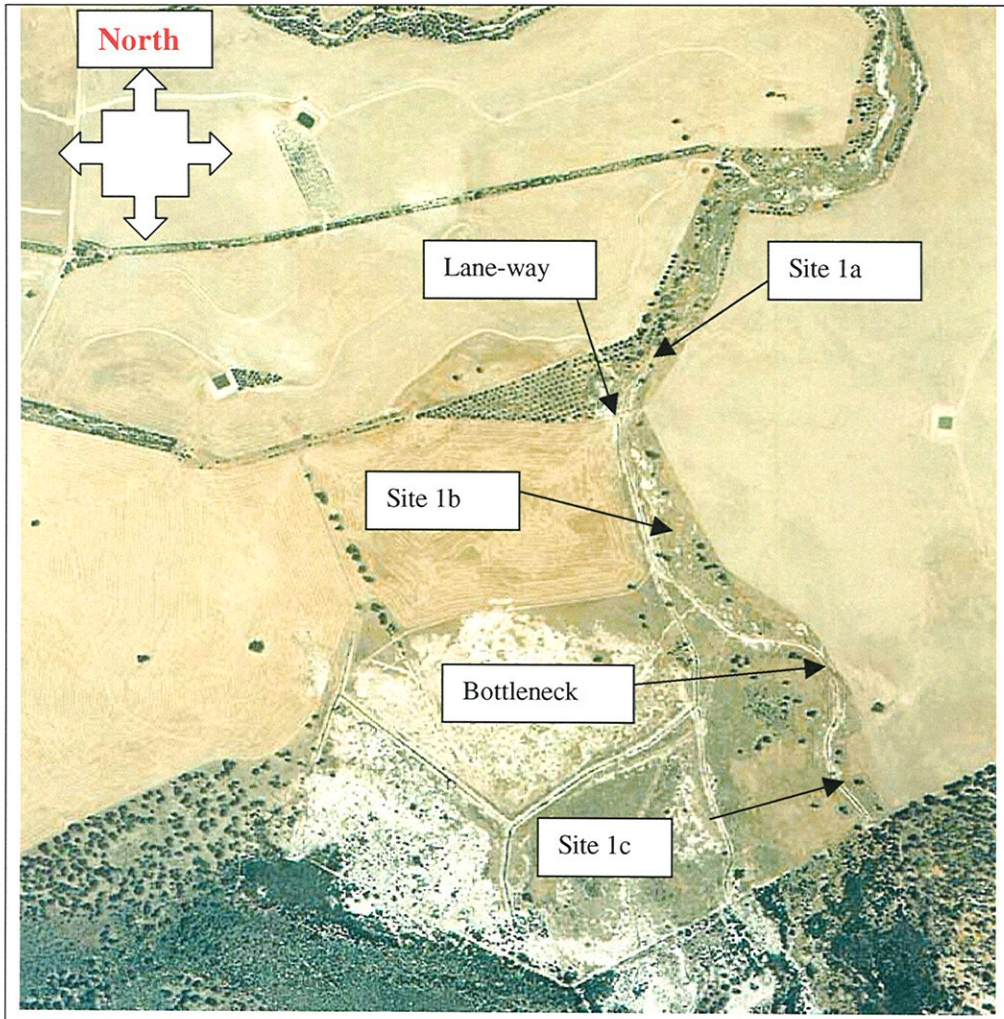
After a discussion of revegetation options, the landowner selected 2 sites. These complemented past revegetation works, mainly along drainage lines, spanning the previous 20 years. He did not feel that nature conservation objectives were a high priority for this revegetation work. His main aim was to address land degradation issues.

Site 1 was selected in order to help reduce the encroachment of waterlogging and salinity into the adjacent crop paddock, and to improve the aesthetic appeal of salt affected land. The nature of the wider catchment makes it unlikely that this action in itself will overcome the salinity problem at the site. However, it was considered feasible to establish vegetation that will persist at the site and offer some water use benefits.

Site 2 was selected to create a windbreak along part of the northern boundary of property, in order to protect the adjacent crop paddock.

[1] In November 2000, responsibility for the Maritime Pine Project was transferred from CALM to the newly created Forest Products Commission.

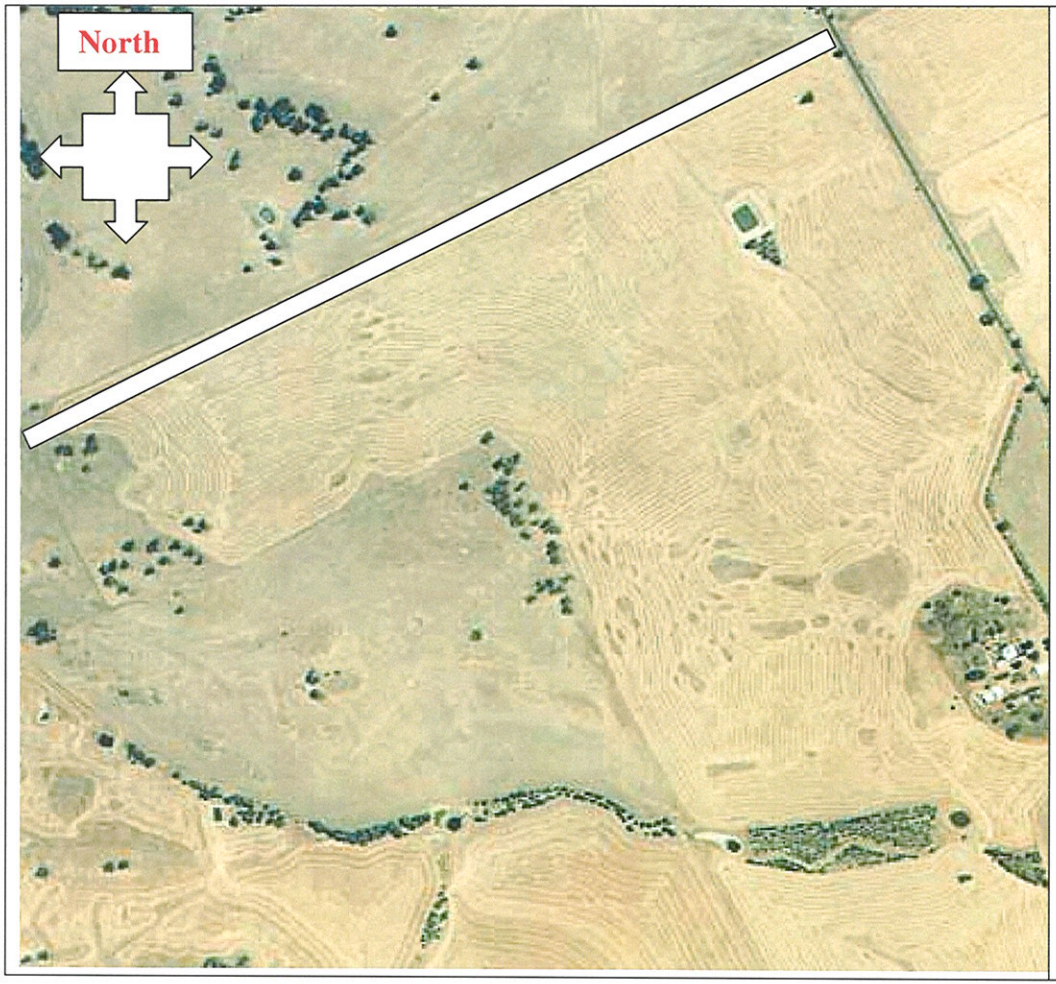
Site 1: Drainage line (from photo 5116, Run 39, 10/10/98)



Design Features

- 3 rows of trees species (*E. loxophleba, E. capillosa*) at 3m spacing along eastern fenceline.
- Blocks of *M. thyoides* and *C. obesa* planted at site 1a.
- 20m gap left at bottleneck (bare salt scald) to provide a barrier against fire spread.
- Clumps of *Callistemon phoeniceus* (60 seedlings/clump) planted at site 1b at 1m spacing. Other species planted in sections between clumps at 2-3m spacing.
- Blocks of *E. occidentalis* at 3m spacing planted on either side of bottleneck.
- Clump of *Hakea preissii* planted at site 1c (60 seedlings/clump). Other species planted in sections between clumps at 2-3m spacing.
- *Hakea preissii* planted as scattered individuals at site 1b.

Site 2: Windbreak (from photo 5117, Run 39, 10/10/98)



Design features.

- 5 row windbreak along fence.
- 3 rows nearest fence – predominantly *E. capillosa* in bottom 2/3 of site (eastern end) and *E. loxophleba* near hill crest (western end). This corresponds approximately with soil boundaries.
- Outer two rows – *Acacia acuminata* in bottom 2/3 of site (eastern end) and *Allocasuarina huegeliana* near hill crest (western end). Some *Melaleuca uncinata* in middle section. These species will provide a lower windbreak component whilst having less shading and root competition effects than trees.

Establishment Tasks Summary – Site 1:

Task	Date	Description
Site preparation	**May 19, 2000**	Prescribed burn by landowner to remove dead grass matter. Contractor (Anspach Agricultural Contracting) ripped and mounded on May 25, 2000, using a twin disc mounder with 500mm ripper and roller. **Cost = $120/ha + travel costs of $3.80/km**
Weed control	**June 28, 2000**	Sprayed by CALM staff using 100L tank and boom unit mounted on utility. **Rates:** Wipeout® 450 (Glyphosate) @ 1L/ha, Gesatop® (Simazine) @ 3L/ha, 50L/ha application of mixture.
Seedling storage and transport	**July 6, 2000** **July 11, 2000**	Seedlings transported from CALM Nurseries (Narrogin and Manjimup) to CALM Sharefarms office (Guildford). Seedlings watered daily. Seedlings transported to site on day of planting in covered trailer. Seedlings were moist and in good condition at time of planting. Bogginess of access meant vehicle movement for seedling transport was restricted.
Planting	**July 11, 2000**	Handplanted using Potti-putki's. **Rates:** 5 planters, 124 trays, 8 hrs **3.1 trays/person/hour (approx)** *NB Boggy areas slowed planting rate (difficult to move through).*

Establishment Tasks Summary – Site 2:

Task	Date	Description
Site preparation	**May 25, 2000**	Contractor (Anspach Agricultural Contracting) ripped only with 500mm ripper and constructed water-bars spaced at 100m (approx) with mounder. **Cost = $120/ha + travel costs of $3.80/km**
Weed control	**June 28, 2000**	Sprayed by CALM staff using 100L tank and boom unit mounted on utility. **Rates:** Wipeout® 450 (Glyphosate) @ 1L/ha, Gesatop® (Simazine) @ 3L/ha, 50L/ha application. Weed control only partially effective (**see Post Establishment/ Monitoring section**).
Seedling storage and transport	**July 6, 2000** **July 11, 2000**	Seedlings transported from CALM Nurseries (Narrogin and Manjimup) to CALM Sharefarms office (Guildford). Seedlings watered daily. Seedlings transported to site on day of planting in covered trailer. Most seedlings were moist and in good condition at time of planting. *M.thoides* and *M.uncinata* seedlings were small (<10cm high).
Planting	**July 11, 2000**	Handplanted using Potti-putki's. **Planting rates:** 3 planters, 39.5 trays, 3.5 hrs = **3.8 trays/person/hour (approx)**

Species List for Site 1:

Species	Common Name	Seedlot Number and Location	Planting design category	Site 1: Drainage Line (Trays)			Total Number of Trays
				Site 1a:	Site 1b:	Site 1c:	
Callistemon phoeniceus	Fiery bottlebrush	D236 (Darkin Swamp)	Clump	-	5	-	5
Casuarina obesa	Swamp sheoak	99104 (Esperance)	In-fill	6	12		18
Eucalyptus capillosa	Inland wandoo	98118 (Jaurdi Station)	Buffer	2	14		16
E. loxophleba	York gum	PW95 (?)	In-fill/buffer	6	26		32
E. occidentalis	Flat topped yate	98100 (Grass Patch)	Buffer	4	3	0	7
Hakea preissii	Needlebush	NS16515 (?)	Scattered	2	2	0	4
Melaleuca cuticularis		99121 (Esperance)	In-fill	2	13		15
M. hamulosa		99020 (Esperance)	In-fill	2	9		11
M. uncinata	Broombush	94103 (Kalannie)	In-fill	2	11		13
M. thyoides		98145 (Holt Rock)	Clump	-	0	3	3
TOTAL							134

Species List for Site 2:

Species	Common Name	Seedlot Number and Location	Total number of trays
Acacia acuminata	Jam	N98188 (Murchison river)	10
Allocasuarina huegeliana	Rock Sheoak	97040 (Victoria Rock)	2
E. accedens	Powder Bark Wandoo	D623 (Dryandra State Forest)	1
E. capillosa	Inland Wandoo	98118 (Jaurdi Station)	16
E. longicornis	Red Morrel	94255 (Harrismith)	1
E. loxophleba	York Gum	PW95 (?)	7.5
M.. uncinata	Broombush	94103 (Kalannie)	2
TOTAL			39.5

Post Establishment/ Monitoring – Site 1a

Task	Date	Qualitative Assessment
Monitoring	**Aug 10, 2000**	**Weeds:** minor Guildford Grass, otherwise not significant. **Survival:** *E. loxophleba* – dead in waterlogged/salty areas, 5% dead in other areas. *C. obesa* – Good survival, seedlings turned red in colour. *M.. cuticularis* – Good survival *M.. hamulosa* – Good survival *M. uncinata* – Most alive, but appear stressed. *M.. thyoides* – Many (70%) dead, very small seedlings
Monitoring	**Oct 12**	**Weeds:** minor Guildford Grass and other unidentified grassy weeds, otherwise not significant. **Survival:** *E. loxophleba* – 95% dead. *C. obesa* – survival not assessed. *M.. cuticularis* – Good survival *M.. hamulosa* – Good survival *M. uncinata* – Most dead. *M. thyoides* – 100% dead
Monitoring	**Nov 28**	**Weeds:** minor Guildford Grass and other unidentified grassy weeds, otherwise not significant. **Survival:** *E. loxophleba* – 98% dead. *C. obesa* – Some alive but not vigorous. *M. cuticularis* – Good survival *M. hamulosa* – Reasonable survival *M. uncinata* – Most dead. *M. thyoides* – 100% dead

Post Establishment/ Monitoring – Site 1b

Task	Date	Qualitative Assessment
Monitoring	**Aug 10, 2000**	**Weeds:** Patchy Guildford Grass, otherwise not significant. **Survival:** *E. loxophleba* – Most alive. *E. capillosa* – Most alive, purple colouration. *E. occidentalis* – Survival not assessed. *C. phoeniceus* – Most alive, purple colouration. *C. .obesa* – Most alive. *H. preissii* – All those sighted were alive. *M. cuticularis* – Most alive. *M. hamulosa* – Most alive. *M. uncinata* – Most alive, but appear stressed. **Pests:** Kangaroo prints sighted but no damage to seedlings observed.
Monitoring	**Oct 12**	**Weeds:** Patchy Guildford Grass, Annual Ryegrass, Wild Oats and Capeweed – mainly in zone near fence on east side. **Survival:** *E. loxophleba* – Some deaths, many appear to have symptoms of simazine toxicity. *E. capillosa* – Most alive, purple colouration. *E. occidentalis* – Some deaths. *C. phoeniceus* – Most alive. *C. obesa* – Most alive, except in a few very saline areas. *H. preissii* – Not observed. *M. cuticularis* – Most alive. *M. hamulosa* – Most alive. *M. uncinata* – Many dead.
Monitoring	**Nov 28**	**Weeds:** Browned off, minor emergent Wireweed and Afghan Melon. **Survival:** *E. loxophleba* –30% dead, better growth where less weed competition, a few with simazine toxicity symptoms. *E. capillosa* – 30%-40% dead, a few with simazine toxicity symptoms. *E. occidentalis* – 30% dead. *C. phoeniceus* – 30% dead, survivors in good health. *C. obesa* – 40%-60% dead, survivors not vigorous. *H. priessii* – Not observed. *M. cuticularis* – Most alive. *M. hamulosa* – Many alive *M. uncinata* – Many dead. **Pests:** Adult locusts present, some *C. obesa* and *M. hamulosa* damaged by locusts.

Post Establishment/ Monitoring – Site 1c

Task	Date	Qualitative Assessment
Monitoring	**Aug 10, 2000**	**Weeds:** Patchy Guildford grass, some Cape Tulip at south end. **Survival:** *E. loxophleba* – Most alive. *E. capillosa* – Most alive, some appear stressed. *E. occidentalis* – Most alive, some appear stressed. *C. phoeniceus* – Most alive, purple colouration. *C. obesa* – Most alive. *H. preissii* – Most alive. *M. cuticularis* – Most alive. *M. hamulosa* – Most alive. *M. uncinata* – Most alive, many appear stressed. **Pests:** Kangaroo prints and scats sighted, some damage to *C. obesa* seedlings observed.
Monitoring	**Oct 12**	**Weeds:** Patchy Guildford grass, Annual Ryegrass, Wild Oats and Capeweed – mainly in zone near fence on east side. **Survival:** *E. loxophleba* – Many alive. *E. capillosa* – Many alive, not vigorous. *E. occidentalis* – Most alive. *C. phoeniceus* – Most alive, purple colouration. *C. obesa* – Most alive. *H. preissii* – Most alive, not vigorous. *M. cuticularis* – Most alive. *M. hamulosa* – Most alive. *M. uncinata* – Many dead.
Monitoring	**Nov 28**	**Weeds:** Minor emergent Wireweed. **Survival:** *E. loxophleba* – 30% dead. *E. capillosa* – 40%-60% dead. *E. occidentalis* – Most alive. *C. phoeniceus* – Most alive, purple colouration. *C. obesa* – Most alive. *H. priessii* – Most alive, not vigorous. *M. cuticularis* – <30% dead. *M. hamulosa* – <30% dead. *M. uncinata* – Most dead. **Pests:** Adult locusts present, significant locust damage to *C. obesa* and *H. preissii*. Minor damage to *M. hamulosa*.

Post Establishment/ Monitoring – Site 2

Task	Date	Qualitative Assessment
Monitoring	**Aug 10, 2000**	**Weeds:** Minor young Radish and Doublegee in patches, Couch in patches. **Survival:** *A. acuminata* – Most alive *E. accedens* – Most alive *E. loxophleba* – Most alive. *E. capillosa* – Most alive. *E. longicornis* – Most alive. *A. huegeliana* – Most alive. *M. uncinata* – Most alive, many appear stressed.
Monitoring	**Sept 19**	**Weeds:** Quite thick in patches: mainly crop (Wheat), some Capeweed, Annual Ryegrass, Doublegee, Radish, Couch. **Survival:** *A. acuminata* – Under competition with weeds, many have yellow leaf tips, little new growth. *E. accedens* – Most alive. *E. loxophleba* – Many stressed, yellowing leaves. Some dead. *E. capillosa* – Most alive, new growth evident. *E. longicornis* – Most alive. *A. huegeliana* – Many appear stressed, yellow leaf tips. *M. uncinata* – Many (>70%) dead.
Spot spraying	**Sept 21**	• Approximately 50% of site spot sprayed using back pack sprayer. • Seedlings protected with funnel on broomstick. • Wipeout 450 (Glyphosate) @ 6ml/L, with Pulse penetrant. • Rate: 7 trees/minute approx
Monitoring	**Oct 12**	**Result of spot spray:** • Effective control of Capeweed/Annual Ryegrass and Wheat. • Poor kill on Radish, Doublegee and Couch. **Survival:** Overall, poor where weeds thick, better where weeds sparse or controlled. **Pests:** Small locusts (1st and 2nd instar) sighted, concentrated in couch patches.
Monitoring	**Nov 28**	**Weeds:** Most have browned off, some radish and couch alive. Some emerging Wireweed and Afghan melon. **Survival:** *A. acuminata* – >90% dead, locust and Rutherglen damage evident. All Eucalypts – patchy survival, 40%-50% dead, some Rutherglen damage on *E. capillosa*. *A. huegeliana* – >90% dead, locust damage evident. *M. uncinata* – Most (>95%) dead. **Pests**: Rabbit holes/diggings found in one area.

Project review and evaluation (as at Jan 2001):

SITE 1:

Planting Work:

- Planting a series of clumps and filling the gaps between clumps with lines of different species is relatively easy to implement, but is slower than simply planting all seedlings at a standard spacing. This slower planting rate could increase the cost of using contract labour for hand planting. Planting clumps and varying the spacing between seedlings along the rows is not amenable to machine planting.
- Compared with mixing seedlings of different species prior to planting, planting by the tray (ie each planter reloads using the entire contents of one tray) results in less fine scale species mixing but potentially can increase planting speed.
- The method described in points 1 and 2 above represents a compromise between no planting design and designs which seek to emulate the structural characteristics of remnant vegetation stands.
- The occurrence of saline patches, access lanes and bottlenecks in the planting area were exploited for use as firebreaks/fire retardant areas.
- The farmer indicated an aesthetic preference for trees along the fenceline between the revegetation site and the paddock to the east. This was incorporated into the design.

Species Selection:

- The main aim of the species selection was to achieve variety in **vegetation structure** and **species composition**. This aim was underpinned by the assumption that a mixture of species, planted in an appropriate design, will provide better habitat for fauna than single species or single structure plantings.
- This broad objective was then refined based on the availability of different species from nurseries and their ability to grow at the chosen sites. Ideally, a mixture of local provenance species would have been used.
- The aesthetic benefits of using a variety of species were also considered.

Site Preparation

- The prescribed burn was effective in removing dead grass matter, which improved the quality of mounds at the site. The burn may have affected subsequent weed establishment at the site, however this was not assessed.
- The mounding work produced mounds of suitable height, width and shape. However, in more clayey patches the mounds were quite cloddy. Mound cloddiness may have reduced the effectiveness of residual herbicide (see below) and can make planting more difficult.
- As an alternative method, mouldboard ploughing before rip/mounding may have reduced the cloddiness.
- The rows were spaced at 4m apart and approximately aligned with the longest dimension of the site (along fenceline).

Weed Control:

- The residual herbicide was only partially effective. A range of factors could have contributed to this, including: insufficient rainfall for simazine activation and the cloddiness of mounds preventing good dispersion.
- Some eucalypt seedlings displayed symptoms of simazine toxicity (see photograph library), suggesting that the lack of residual effect was more related to dispersal problems than application rates.
- In hindsight, an overspray with grass selective herbicides in August/Early September would have been warranted given that most emergent weeds were grasses.

Seedling Survival:

- Weed competition restricted seedling growth in patches where weeds were thick. In some cases seedlings were out competed and died.
- Poor seedling size and vigour was believed to be a contributing factor to mortality in *M. thyoides* and *M. uncinata* seedlings. Many of these seedlings died within 4 weeks after planting, before weed competition set in.
- Excessive soil salinity probably killed *E. loxophleba* seedlings at site 1a, given that *Melaleuca* species grew well on this site and *E. loxophleba* seedlings grew well on slightly less saline parts of sites 1b and 1c. The salt tolerance of the *E. loxophleba* provenance used was unknown.

SITE 2:

Planting Work:

- **Matching species to soil type:** The soil along the windbreak changes from the upper hill slope towards the valley floor. The major species were matched to different landscape positions, York gums and Rock Sheoak on the upper slope and Jam and Wandoo on the lower slope. Aesthetically, this matching blends with paddock trees and nearby remnant vegetation.
- **Interface with paddock:** Jams and Rock Sheoak were chosen for the two edge rows closest to the crop paddock in order to provide a lower windbreak component, plus reduced shading and crop competition effects. Trees species only were used on the remaining three rows for height and thickness of windbreak.
- **Timber product options:** Closely spaced trees (at 3m along rows) improve the option for selective extraction for strainer posts and or firewood. The cut stumps could be allowed to coppice, providing structural diversity and an extra low component. If the windbreak is fenced, the jams could potentially be used as sandalwood hosts.
- **Erosion control:** Constructing riplines down the slope can create an erosion risk while plants are still establishing. Several waterbars were constructed with a mounder to reduce this risk on the steeper slope at the western end of the windbreak.
- **Fire management:** Reduction of windspeed across paddock can help to slow the rate of fire spread in the event of a fire. Closely spaced trees should suppress weeds in the longer term.

Site Preparation

- Ripping effective, no erosion problems observed.

Weed Control:

- The residual herbicide had limited success in preventing weed germination. This could have been due to insufficient rainfall for simazine activation and/or concentration of simazine into the riplines.
- Weed competition restricted seedling growth in patches where weeds were thick. A significant number of seedlings were out competed and died.
- Where spot spraying was done, most seedlings survived although weed competition had reduced their vigour. The jam seedlings could not be distinguished from the grassy weeds and therefore were not sprayed. Ideally, post planting spraying should have occurred earlier (late August)
- Overspraying the seedlings with selective herbicides would probably have been a better option than spot spraying, given that the major competitive weeds were Annual Ryegrass and Wheat.

Seedling Survival:

- Weed competition was the main cause of seedling mortality at this site. Overall, the weed control was not adequate.
- Rutherglen and locusts further damaged some seedlings, particularly *A. acuminata* and *A. huegeliana*. Weed competition stress is likely to have increased seedling susceptibility to insect attack.
- Poor seedling size and vigour was believed to be a contributing factor to mortality in *M. uncinata* seedlings. Many of these seedlings died within 4 weeks after planting, before weed competition set in.

Photograph Library

Site 1c: Northern end, looking south from bottleneck.

June 1, 2000
Site burnt and mounds constructed.

October 12, 2000

June 28, 2000
Site being sprayed

November 28, 2000

September 9, 2000

November 28, 2000
Much better seedling growth where weed competition was less severe.

Site 1b: Northern end, looking south from near lane-way.

June 1, 2000

October 12, 2000

September 9, 2000

November 28, 2000

Stress exhibited by York Gum (*E.loxophleba*) seedlings.
(Note: each photograph is of a different seedling)

		
Site 2: September 19, 2000 **Base of leaves yellowing.**	**Site 1b: October 12, 2000** **Yellowing following leaf vein pattern**	**Site 1b: November 28, 2000** **Yellowing except on leaf vein pattern**

Site 2: Looking west (uphill) from approximately half way along windbreak.

July 12, 2000 – Site being planted

October 12, 2000

September 19, 2000

November 28, 2000

Site 2: Result of spot spraying grassy weeds in area infested with annual ryegrass and crop.

Oct 12, 2000 – 21 days after spraying with Glyphosate.

1m diameter circle sprayed around each seedling (in this case *E.capillosa*)

Oct 12, 2000 – 21 days after spraying with Glyphosate.

P2000 Supplementary Species Project Documentation

Property Owner:	**Don and Frank Carter**
Location:	**Woodanilling.**
Number of sites:	**2**
Report By:	**Dan Huxtable (Bushcare Revegetation Development Officer)**

Background:

In 1999, the landowner entered into a share-farming agreement with CALM resulting in the planting of approximately 32ha of *Pinus pinaster* on low productivity soils. As a part of the sharefarm agreement, up to 3.2 ha of supplementary species was available for the purposes of nature and land conservation.

In 2000, 3.3 hectares of revegetation was established. This report documents the year 2000 planting project. All establishment works were funded by CALM, with the farmer required to provide fencing where necessary. Dan Huxtable (Bushcare Project Officer) coordinated project planning and implementation tasks.

Underlying Aims (Bushcare Project):

1) To develop revegetation designs that integrate nature and land conservation with profitable agriculture.
2) To implement designs that were compatible with the aspirations of the farmer and the existing farming enterprise.
3) To use a design methodology that could easily be adopted and replicated by large scale commercial revegetation projects, such as the CALM Maritime Pine Project[1].

Site Selection:

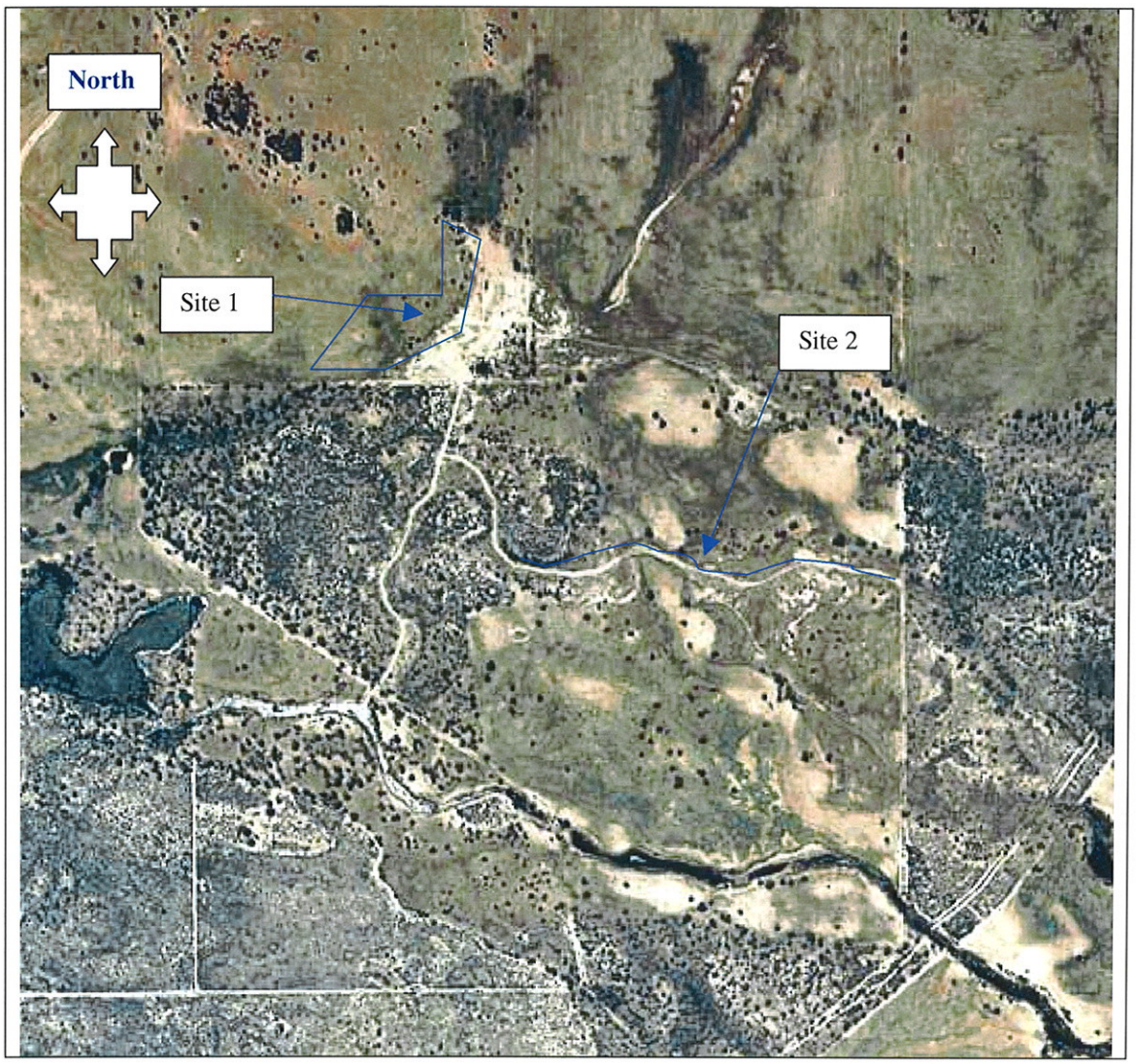
After a discussion of revegetation options, the landowner selected 2 sites. He did not feel that nature conservation objectives were a high priority for this revegetation work. His main aim was to address land degradation issues.

Site 1 was selected in order to help reduce the encroachment of waterlogging and salinity into the adjacent crop paddock, and to improve the aesthetic appeal of salt affected land. The nature of the wider catchment makes it unlikely that this action in itself will overcome the salinity problem at the site. However, it was considered feasible to establish vegetation which will persist at the site and offer some water use benefits.

Site 2 was a 3 row belt along a constructed drain in a salt affected paddock.

[1] In November 2000, responsibility for the Maritime Pine Project was transferred from CALM to the newly created Forest Products Commission.

Location of sites (from photograph 5251, Run 4, 18/11/96)



Establishment Tasks Summary – Sites 1and 2:

Task	Date	Description
Site preparation	**mid-late April 2000**	Ripped and mounded by landowner on May 25, 2000, using a twin disc mounder with 500mm ripper and roller.
Weed control	**June 27, 2000**	Sprayed by landowner using boom-sprayer. **Rates:** Round Up 800mL/ha, Atrazine 4L/ha.
Planting	**July 11, 2000**	Handplanted using Potti-putki's. **Rates:** 3 planters, 53 trays (site 1 =43 trays; site 2 = 10 trays), 5.5 hrs **3.2 trays/person/hour (approx).**

Species List for Site 1:

Species	Seedlot number and location		Number of Trays
Acacia microbotrya	D886	Narrogin	3
Acacia saligna	C99013	Manjimup	3
Callistemon phoeniceus	D236	Darkin Swamp	3
Casuarina obesa	99104	Esperance	9
E.occidentalis	N98100	Grass Patch	9
E.spathulata	N16797	?	4
E.wandoo	K77	Collie	3
Melaleuca cuticularis	99121	Esperance	3
Melaleuca hamulosa	99020	Esperance	4
Melaleuca viminea	9086	?	2
TOTAL			**43**

Species List for Site 2:

Species	Seedlot number and location		Number of Trays
Casuarina Obesa	99104	Esperance	4
E.occidentalis	N98100	Grass Patch	2
E.spathulata	N16797	?	4
TOTAL			**10**

Post Establishment/ Monitoring – Site 1

Task	Date	Qualitative Assessment
Monitoring	**Aug 15, 2000**	**Weeds:** Good overall weed control, very little weed germination evident except for damp area *where M. viminea* planted (see photograph library). **Survival:** *A. microbotrya* – Good survival. *A. saligna* – Extensive kangaroo damage. *C. obesa* – Some kangaroo damage. *C. phoeniceus* – Good survival. *E. occidentalis* – Good survival. *E. spathulata* – Good survival. *E. wandoo* – Look sickly, yellow blotches with red borders on leaves. *M. hamulosa* – Good survival *M. cuticularis* – Some kangaroo damage. *M. hamulosa* – Good survival *M. viminea* – Minor kangaroo damage. **Pests:** Kangaroo damage as above.
Monitoring	**Sept 15, 2000**	**Weeds:** Good overall weed control, some small patches of Capeweed evident. **Survival:** *A. microbotrya* –Some are stressed, minor kangaroo damage to a few. *A. saligna* – Little recovery from Kangaroo damage. *C. obesa* – Some kangaroo damage. *C. phoeniceus* – Good survival. *E. occidentalis* – A few deaths, some others appear stressed. *E. spathulata* – Many appear stressed. *E. wandoo* – Significant deaths (30%), many stressed. *M. hamulosa* – A few deaths, otherwise OK. *M. cuticularis* – Most are reshooting, following kangaroo damage. *M. viminea* – Good survival, reshooting where attacked by Kangaroos. **Pests:** Kangaroo damage as above.
Monitoring	**Oct 22, 2000**	**Weeds:** Good overall weed control, some small patches of Capeweed, Barley grass and Annual Ryegrass evident. **Survival:** *A. microbotrya* –70% dead or dying, leaves turning yellow/red. *A. saligna* – Little recovery from Kangaroo damage. *C.obesa* – Many (80%+) growing well after kangaroo damage. *C.phoeniceus* – 30% dead, many others appear stressed. *E.occidentalis* – 30% dead, but others growing quite well.. *E.spathulata* – 30% dead, but others growing quite well. *E.wandoo* – 30% dead, but others growing quite well. *M.hamulosa* – 70% dead, wilting and leaves browning off. *M.cuticularis* Many (80%+) growing well after kangaroo damage. *M.viminea* – 30% dead, many appear stressed (wilting and leaves browning off). **Pests:** No new kangaroo damage since September 15 observed.

Post Establishment/ Monitoring – Site 2

Task	Date	Qualitative Assessment
Monitoring	**Aug 15, 2000**	**Weeds:** No significant weed germination. **Survival:** *C. obesa* – Extensive kangaroo damage. *E. occidentalis* – Dead in highly salty/waterlogged areas. *E. spathulata* – Dead in highly salty/waterlogged areas. **Pests:** Kangaroo damage to as above.
Monitoring	**Sept 15, 2000**	**Not assessed**
Monitoring	**Oct 22, 2000**	**Weeds:** A few small patches of Annual Ryegrass and Capeweed, otherwise no weeds. **Survival:** *C. obesa* – 90% dead, a few have recovered from Kangaroo damage. *E. occidentalis* – 90% dead, survivors are in weed patches. *E. spathulata* – 90% dead, survivors are in weed patches.

Review and Evaluation (as at Jan 2001):

SITE 1:

Planting Work:

- Planting a series of clumps and filling the gaps between clumps with lines of different species is relatively easy to implement, but is slower than simply planting all seedlings at a standard spacing. This slower planting rate could increase the cost of using contract labour for hand planting. Planting clumps and varying the spacing between seedlings along the rows is not amenable to machine planting.
- Compared with mixing seedlings of different species prior to planting, planting by the tray (ie each planter reloads using the entire contents of one tray) results in less fine scale species mixing but increases planting speed.
- The method described in points 1 and 2 above represents a compromise between no planting design and designs which seek to emulate the structural characteristics of remnant vegetation stands.
- The narrow area between the pines and the main planting block was planted with close spaced *E. occidentalis* only to provide a buffer against fire spread. In addition to suppressing weed growth after canopy closure, these trees could be pruned to remove fuel loads near the ground.

Species Selection:

- The main aim of the species selection was to achieve variety in **vegetation structure** and **species composition**. This aim was underpinned by the assumption that a mixture of species, planted in an appropriate design, will provide better habitat for fauna than single species or single structure plantings.
- This broad objective was then refined based on the availability of different species from nurseries and their ability to grow at the chosen sites. Ideally, only locally occurring species would have been used.
- The aesthetic benefits of using a variety of species were also considered in terms of foliage colours, flower colour, time of year when in flower and structural variety.

Site Preparation

- The mounding work produced mounds of suitable height, width and shape.
- The rows were spaced at 4m apart and approximately aligned with the contour.

Weed Control:

- The residual herbicide (Atrazine) was highly effective in suppressing weed germination. A single row which was accidentally not sprayed provides a good indication of this (see photograph library).
- The Atrazine was less effective in very damp or waterlogged areas.

Seedling Survival:

- The overall survival was not high. Stress and death caused by Atrazine toxicity appears to be the likely cause.
- Certain species suffered kangaroo damage to varying extents. However, *C.obesa* and *Melaleuca* species recovered quite well from this damage.

SITE 2:

Planting Work:

- **3 row belt:** The outer row (relative to bank) was planted with *C.obesa*. The other two rows planted to *E.occidentalis* and *E.spathulata* in the saltier sections. The aim of this design was to help use excess water and provide wind protection.
- All species were selected based on their salt tolerance. *E.occidentalis* occurs naturally at the site.

Site Preparation

- The mounding work produced mounds of suitable height, width and shape. However excessive waterlogging still occurred in some sections due to the very wet nature of the site.

Weed Control:

- Few weeds germinated at this site. However, this was probably due to excessive waterlogging and salinity.

Seedling Survival:

- Excessive waterlogging, in combination with salinity, is the likely cause of high mortality in Eucalypts. This is supported by the observation that most surviving seedlings occur where weeds have also been able to grow.
- *C. obesa* suffered extensive kangaroo damage. Waterlogging and salinity is likely to have caused additional stress and adversely affected recovery from this damage.
- The degree of waterlogging that the site experienced was underestimated.

Photograph Library:

Site 1: Looking west, from centre.

August 15, 2000
Note weed control less effective in waterlogged area.

October 23, 2000

September 15, 2000

Site 1: Eastern Section

	**September 15, 2000**
	**October 23, 2000** *E.occidentalis* seedlings visible.

Site 1

October 23, 2000

A stressed *Acacia microbotrya* seedling, possibly suffering from atrazine toxicity.

October 23, 2000

Weed growth on unsprayed mound.

P2000 Supplementary Species Project Documentation

Property Owner:	**Tom Manglavite**
Location:	**Wagin.**
Number of sites:	**3**
Report By:	**Dan Huxtable (Bushcare Revegetation Development Officer)**

Background:

In 1999, the landowner entered into a share-farming agreement with CALM resulting in the planting of approximately 18ha of *Pinus pinaster* on low productivity soils. As a part of the sharefarm agreement, up to 1.8 ha of supplementary species was available for the purposes of nature and land conservation.

In 2000, 1.8 hectares of revegetation was established. This report documents the year 2000 planting project. All establishment works were funded by CALM, with the farmer required to provide fencing where necessary. Dan Huxtable (Bushcare Project Officer) coordinated project planning and implementation tasks.

Underlying Aims (Bushcare Project):

1) To develop revegetation designs that integrate nature and land conservation with profitable agriculture.
2) To implement designs that were compatible with the aspirations of the farmer and the existing farming enterprise.
3) To use a design methodology that could easily be adopted and replicated by large scale commercial revegetation projects, such as the CALM Maritime Pine Project[1].

Site Selection:

After a discussion of revegetation options, the landowner selected 3 sites. His main aim was to address land degradation issues.

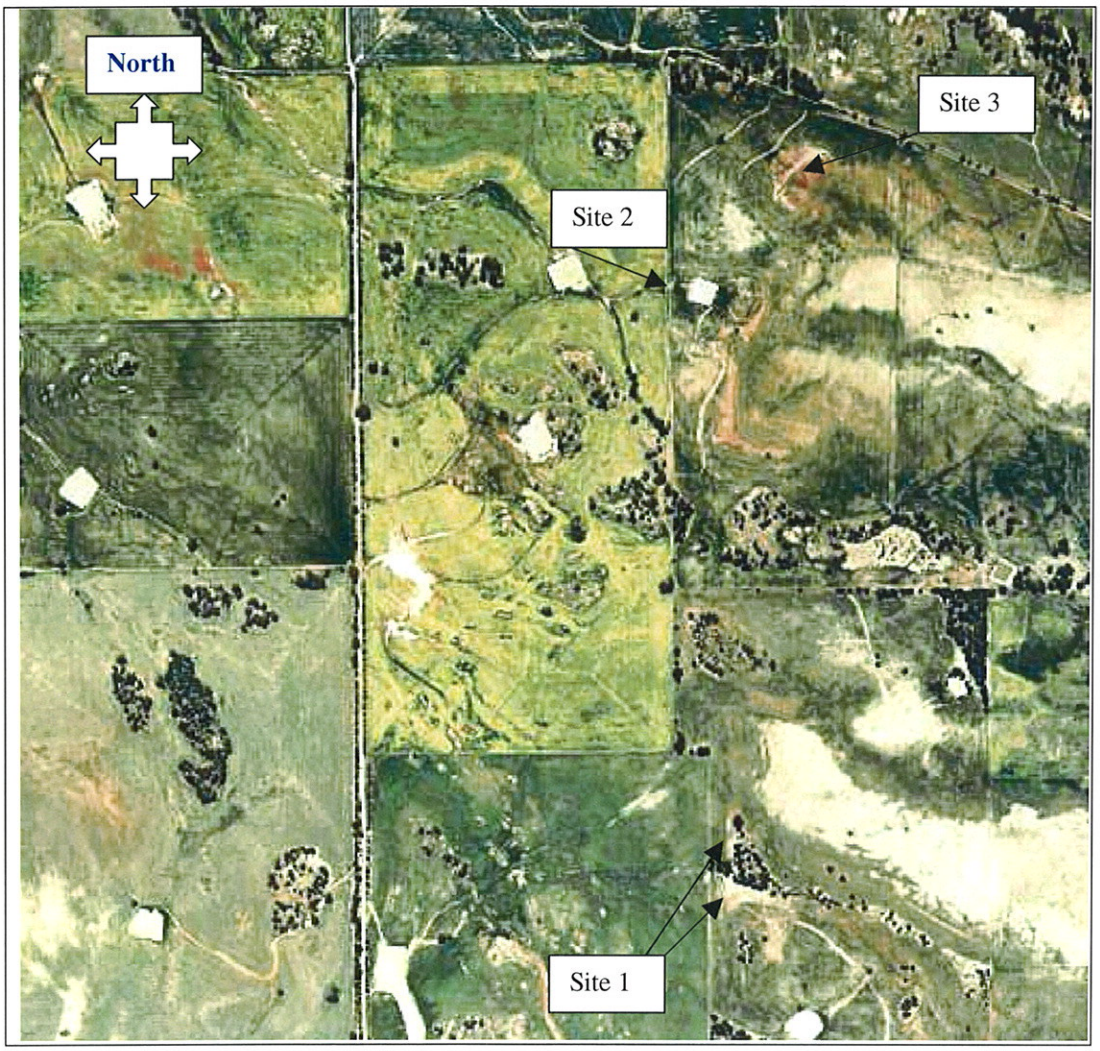
Site 1 was located on an eroding mallet hill. The aim of planting this site was to stabilise the erosion and reduce water run-off and recharge.

Site 2 was an area susceptible to seasonal dampness located below a dam. The aim of planting this site was to utilise excess water.

Site 3 was located on an eroding mallet hill. The aim of planting this site was to stabilise the erosion and reduce water run-off and recharge.

[1] In November 2000, responsibility for the Maritime Pine Project was transferred from CALM to the newly created Forest Products Commission.

Location of sites (from photo 5427, Run 3, 06/10/96)



Establishment Tasks Summary – Sites 1, 2 and 3

ask	Date	Description
ite preparation	**June 30, 2000**	Contractor (Bob Lilliman) ripped and mounded all 3 sites using a twin disc mounder with 500mm ripper and roller.
Veed control	**July 7, 2000**	Sprayed by Contractor (Tom Haddleton). **Rates:** Round Up 1L/ha, Simazine 2L/ha.
lanting	**July 25, 2000**	Handplanted using Potti-putki's. All 3 sites were planted by CALM staff and volunteers from BP Kwinana.

Species List (all sites):

Species	Seedlot number and location		Sites planted on	Number of Trays
Acacia acuminata	98188	Murchison River	3	1
Acacia celastrifolia	97023	Dwellingup	1	*** 40 Pots ***
Allocasuarina huegeliana	97040	Victoria Rock	1,3	2
Callistemon phoeniceus	D236	Darkin Swamp	2	1
Eucalyptus argyphea	?	?	1,3	2
E. astringens	D353	Dongolocking	1,3	18
E. drummondii	?	?	1,3	7
E. gardneri	?	?	1,3	2
E. longicornis	N98126	Tincurrin	2	3
TOTAL				**36 (not including Pots)**

Post Establishment/ Monitoring – Site 1

Task	Date	Qualitative Assessment
Monitoring	**Aug 10, 2000**	**Weeds:** minor Guildford grass, otherwise not significant. **Survival:** *Acacia celastrifolia* – Many appear stressed, yellowing leaves. *Allocasuarina huegeliana* – Good survival *E. argyphea* – Good survival *E. astringens* – Good survival *E. drummondii* – Good survival *E. gardneri* - Good survival
Monitoring	**Sept 15, 2000**	**Weeds:** minor Guildford grass, otherwise not significant. **Survival:** *Acacia celastrifolia* – some deaths, others appear stressed. *Allocasuarina huegeliana* - Good survival *E. argyphea* - Good survival *E. astringens* - Good survival *E. drummondii* - Good survival *E. gardneri* - Good survival
Monitoring	**Oct 22, 2000**	**Weeds:** minor Annual ryegrass germination, otherwise not significant. **Survival:** *Acacia celastrifolia* – Many dead *Allocasuarina huegeliana* – Many dead *E. argyphea* – Many dead. *E. astringens* – 30-40% dead. *E. drummondii* – >50% dead. *E. gardneri* – Many dead. **Pests:** Some sheep scats and minor grazing damage observed.
Monitoring	**Nov 29, 2000**	**Weeds:** Not significant. **Survival:** *Acacia celastrifolia* – All dead *Allocasuarina huegeliana* - All dead *E. argyphea* – All dead. *E. astringens* – 50% dead. *E. drummondii* – 90% dead. *E. gardneri* – 90% dead.

Post Establishment/ Monitoring – Site 2

Task	Date	Qualitative Assessment
Monitoring	**Aug 10, 2000**	**Weeds:** Some Guildford Grass. **Survival:** *C. phoeniceus* – Good survival. *E. longicornis* – Good survival overall. **Pests:** Evidence of rabbit damage (diggings) to a few *E.longicornis.*
Monitoring	**Sept 15, 2000**	**Weeds:** Some Guildford Grass. **Survival:** *C. phoeniceus* – A few deaths. *E. longicornis* – Good survival overall.
Monitoring	**Oct 22, 2000**	**Weeds:** Patchy Annual Ryegrass. **Survival:** *C. phoeniceus* 25% dead. *E. longicornis* – 25% dead.
Monitoring	**Nov 29, 2000**	**Weeds:** Some Guildford Grass. **Survival:** *C. phoeniceus* – 90% dead. *E. longicornis* – 30% dead, others seem OK. **Pests:** Some locusts sighted but no damage observed. Rutherglen attack observed on *C.phoeniceus.*

Post Establishment/ Monitoring – Site 3

Task	Date	Qualitative Assessment
Monitoring	**Aug 10, 2000**	**Weeds:** minor Guildford grass, otherwise not significant. **Survival:** *Acacia acuminata* – Some minor grazing damage, otherwise OK. *Allocasuarina huegeliana* – Many dead, grazing damage evident. *E. astringens-* – Good survival, except on patch of very rocky soil. *E. drummondii* – Good survival **Pests:** Grazing damage possibly from sheep.
Monitoring	**Sept 15, 2000**	**Weeds:** Some Guildford grass and Annual Ryegrass in patches. **Survival:** Bare area through middle of plot (rocky soil) has no weeds, all seedlings dead. Suspect unusual soil type. *Acacia acuminata* – Many dead.. *Allocasuarina huegeliana* – Many dead. *E. astringens-* – Good survival, except on patch of rocky soil. *E. drummondii* – Good survival, except on patch of rocky soil.
Monitoring	**Oct 22, 2000**	**Weeds:** One bad patch of Annual Ryegrass and Barley grass, otherwise OK. **Survival:** *Acacia acuminata* – All dead. *Allocasuarina huegeliana* – All dead. *E. astringens-* – 25% dead overall. *E. drummondii* – 25% dead overall. **Pests:** Small locusts sighted but no damage to seedlings observed.
Monitoring	**Nov 29, 2000**	**Weeds:** One bad patch of Annual Ryegrass and Barley grass, browned off. **Survival:** *Acacia acuminata* – All dead. *Allocasuarina huegeliana* – All dead. *E. astringens-* – 20% dead in eastern half, 70% in western half. *E. drummondii* – 70% dead. **Pests:** Rutherglen attacking seedlings where grassy weeds were thick.

Review and Evaluation (as at Jan 2001):

ALL SITES:

Planting Work:

- **Sites 1 & 3:** Species were selected based on their perceived ability to survive on the breakaway soils. *E. astringens* was the major species planted. The seedlings were generally mixed and planted at 1-2m spacing. The eastern half of site 3 was planted solely to *E. astringens*.
- Site 2: *E. longicornis* was planted as this was the species locally occurring on the soil type at site 2. *C. phoeniceus* was planted around the edge of the site for aesthetic purposes.
-

Site Preparation

- The mounding was effective in breaking up the hard breakaway soils.
- The rows were spaced at 4m apart and aligned approximately on the contour.

Weed Control:

- The weed control was reasonably effective overall, however there may not have been sufficient rainfall to fully activate the simazine. Drought stress is likely to have controlled weeds to some extent.

Seedling Survival:

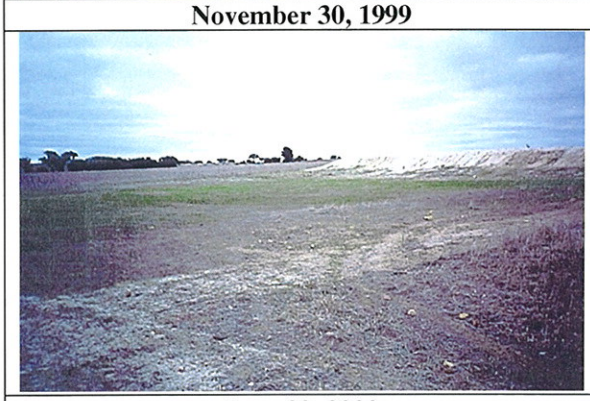
- Weed competition in patches stressed or killed seedlings through moisture competition. This is likely to have increased susceptibility of seedlings to insect attack.
- It is likely that many seedlings died from drought stress, due to below average rainfall at these sites.
- The bare patch of soil at **site 3** was inhospitable to plant growth. When queried, the landowner stated that this patch had never had vegetation growing on it possibly due to unusual mineral composition.

Photograph Library

Site 2: Area below dam

November 30, 1999

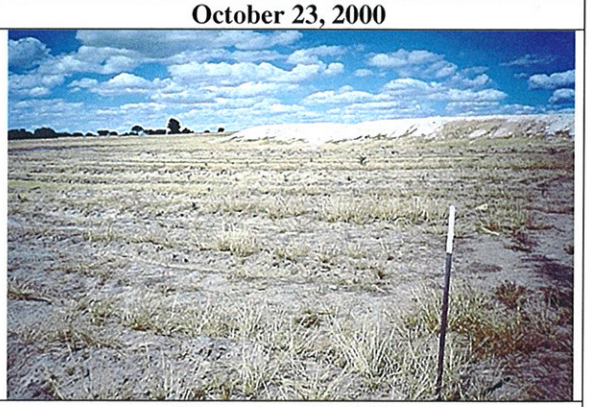
September 15, 2000



June 29, 2000

October 23, 2000

August 10, 2000



November 29, 2000

Site 1	Site 3
	
June 30, 2000	October 23, 2000
	
November 29, 2000	November 29, 2000

Mounding equipment used for site preparation

P2000 Supplementary Species Project Documentation

Property Owner: Will and Anette Owens
Location: Jingalup.
Number of sites: 3
Report By: Dan Huxtable (Bushcare Revegetation Development Officer)

Background:

In 1999, the landowners commenced a farm planning project with staff from CALM's Farm Forestry Unit. The project included the establishment in 2000 of several revegetation sites: including commercial eucalypts for sawlogs, sandalwood hosts and non-commercial native species.

This report documents the sandalwood host and native species components of the year 2000 planting project.

CALM contributed funding to the revegetation works. Dan Huxtable (Bushcare Project Officer) coordinated project planning and implementation tasks.

Underlying Aims (Bushcare Project):

1) To develop revegetation designs that integrate nature and land conservation with profitable agriculture.
2) To implement designs that were compatible with the aspirations of the farmer and the existing farming enterprise.
3) To use a design methodology that could easily be adopted and replicated by large scale commercial revegetation projects, such as the CALM Maritime Pine Project[1].

Site Selection:

Suitable revegetation sites were identified through the farm planning work carried out by CALM Farm Forestry Unit staff.

Site 1 was selected as being suitable for sandalwood establishment.
Site 2 was a natural drainage line in the upper landscape, which had been degraded through stock access, erosion and secondary salinity.
Site 3 was a natural drainage line in the lower landscape, which had been degraded through stock access and secondary salinity.

[1] In November 2000, responsibility for the Maritime Pine Project was transferred from CALM to the newly created Forest Products Commission.

Location of sites (from photo 5300, Run 2, 22/10/95)

Establishment Tasks Summary – Site 1:

Task	Date	Description
Weed control	**May 17, 2000**	Boom sprayed by landowner (as part of crop spraying). **Rates:** Round Up 800mL/ha.
Site preparation	**June 22, 2000**	Site cross ripped by contractor (3m between rows on approximate contour, 6m between rows perpendicular to contour).
Planting	**July 19, 2000**	Handplanted using Potti-putki's, at 6m spacing along rows. Each row 3m offset from adjacent rows. **Rates:** 2 planters, 25 trays, 8 hrs **2.5 trays/person/hour (approx)**
Weed Control	**Sept 25, 2000**	Strip sprayed by landowner using ATV, one pass for each herbicide. **Rates:** Lontrel 300mL/ha (without wetting agent), Fusilade 500ml/ha

Establishment Tasks Summary – Site 2:

Task	Date	Description
Weed control	**May 15, 2000**	Boom sprayed by landowner (as part of crop spraying). **Rates:** Round Up 800mL/ha.
	May 22, 2000	Boom sprayed by landowner (as part of crop spraying). **Rates:** Atrazine 2L/ha, 65t4
Site preparation	**June 2, 2000**	Mounded by Landowner using a single disc mound plough without roller (borrowed from Jingalup Landcare Group).
Planting	**July 20, 2000**	Handplanted using Potti-putki's. **Planting rates:** 2 planters, 11 trays, 2.5 hrs = **2.2 trays/person/hour (approx)**
Weed control	**Sept 25, 2000**	Strip sprayed by landowner using ATV. **Rates:** Lontrel 300mL/ha (without wetting agent).

Establishment Tasks Summary – Site 3:

Task	Date	Description
Weed control	**May 19, 2000**	Boom sprayed by landowner. **Rates:** Round Up 800mL/ha.
Site preparation	**June 2, 2000**	Mounded by Landowner using a single disc mound plough without roller (borrowed from Jingalup Landcare Group).
Weed control	**Late July, 2000**	Strip sprayed by landowner using ATV. **Rates:** Round Up 800mL/ha.
Planting	**Aug 4, 2000**	Handplanted using Potti-putki's. **Planting rates:** 3 planters, 24 trays, 3.5 hrs = **2.3 trays/person/hour (approx)**
Weed Control	**Sept 26, 2000**	Strip sprayed by landowner using ATV. **Rates:** Fusilade 500ml/ha

Species List for Site 1:

Species	Common Name	Seedlot Number and Location		Total Number of Trays
Acacia acuminata	Jam wattle	N98188	Murchison River	13
Acacia microbotrya	Manna wattle	D886	Narrogin	5
Allocasuarina huegeliana	Rock Sheoak	97040	Victoria Rock	7
TOTAL				**25**

Species List for Site 2:

Species	Common Name	Seedlot Number and Location		Total Number of Trays
E. occidentalis	Flat Topped Yate	N98100	Grass Patch	5
E. wandoo	Wandoo	K77	Collie	4
M. cuticularis	Salt Water Paperbark	99121	Esperance	1
M. viminea	Moohan	9086	?	1
TOTAL				**11**

Species List for Site 3:

Species	Common Name	Seedlot Number and Location		Total Number of Trays
E. occidentalis	Flat Topped Yate	N98100	Grass Patch	9
E. rudis	River Gum	98055	Narrogin	9
E. wandoo	Wandoo	K77	Collie	3
M. cuticularis	Salt Water Paperbark	99121	Esperance	1
M. viminea	Moohan	9086	?	2
TOTAL				**24**

Post Establishment/ Monitoring – Site 1

Task	Date	Qualitative Assessment
Monitoring	**Aug 28, 2000**	**Weeds:** Reasonable control overall, but some recent germination evident. **Survival:** *A. acuminata* – Good survival. *A. microbotrya* – Good survival. *A. huegeliana* - Good survival. **Pests:** A sheep sighted in paddock with seedlings, no damage to seedlings observed.
Monitoring	**Sept 30, 2000**	**Weeds:** Significant weed emergence – Capeweed, Annual Ryegrass and Clover. **Survival:** *A. acuminata* – Good survival, but weed competition a threat. *A. microbotrya* – Good survival, but weed competition a threat. *A. huegeliana* - Good survival, but weed competition a threat.
Monitoring	**Oct 24, 2000**	**Weeds:** Thick weed cover, persisting following spraying. Capeweed (wilting), Annual Ryegrass (dead), Barley Grass (dead). **Survival:** *A. acuminata* – Good survival, however some leaf curl and yellowing from herbicide. *A. microbotrya* – Good survival, however significant leaf curl and yellowing from herbicide (see photograph library). *A. huegeliana* - Good survival, no evidence of herbicide damage.
Monitoring	**Dec 20, 2000**	**Weeds:** Browned off. **Survival:** *A. acuminata* – 50-70% survival, weeds have suppressed growth. *A. microbotrya* – 50-70% survival, weeds have suppressed growth. *A. huegeliana* – 80%+ survival. **Pests:** Significant numbers of *A. acuminata* and *A. microbotrya* being attacked by Rutherglen.

Post Establishment/ Monitoring – Site 2

Task	Date	Qualitative Assessment
Monitoring	**Aug 28, 2000**	**Weeds:** Significant Capeweed and Annual Ryegrass on mounds. **Survival:** *E. occidentalis* – Significant grazing damage by Kangaroo's. *E. wandoo* - Significant grazing damage by Kangaroo's. *M. cuticularis* – Good survival *M. viminea* - Significant grazing damage by Kangaroo's. **Pests:** Kangaroo damage – Eucalypts eaten back to stem in many cases; only tops of *M.viminea* eaten.
Monitoring	**Sept 30, 2000**	**Weeds:** Significant Capeweed, with minor Annual Ryegrass, on mounds. **Survival:** Quite good survival for all species. Most have resprouted following kangaroo attack.
Monitoring	**Dec 20, 2000**	**Weeds:** Browned off. **Survival:** *E. occidentalis* – Reasonable survival (75%+). *E. wandoo* – Poor survival (30%) due to greater weed competition. *M. cuticularis* – Reasonable survival (75%+). *M. viminea* - Reasonable survival (75%+).

Post Establishment/ Monitoring – Site 3

Task	Date	Qualitative Assessment
Monitoring	**Aug 28, 2000**	**Weeds:** Weed control effective overall. **Survival:** Good survival for all species.
Monitoring	**Sept 30, 2000**	**Weeds:** Significant Annual Ryegrass germination. **Survival:** Good survival for all species. **Pests:** Sheep prints and wool sighted within planted area. Minor grazing damage to *Melaleuca* species.
Monitoring	**Oct 24, 2000**	**Weeds:** Significant Annual Ryegrass, stressed but not dead in spray strips. **Survival:** Good survival for all species.
Monitoring	**Dec 20, 2000**	**Weeds:** Browned off **Survival:** *E. occidentalis* – Reasonable survival (70%+). *E. rudis* – Reasonable survival (70%+), some minor insect damage to leaves. *E. wandoo* – Being attacked by Rutherglen, significant deaths. *M. cuticularis* – Reasonable survival (70%+). *M. viminea* - Reasonable survival (70%+). **Pests:** Rutherglen attacking wandoo as above.

Review and Evaluation (as at Jan 2001):

SITE 1:

Planting Work:

- Species were selected based on their suitability as sandalwood hosts. Studies by CALM have indicated that *A. acuminata* is the most suitable host species. *A. microbotrya*, which is also a suitable host, produces edible seed which may provide an additional product option. *Allocasuarina huegeliana*, which naturally occurs in the Jingalup locality, is believed to be a suitable host if used in conjunction with Acacias.
- Every second row planted with *Acacia acuminata* in between crosses. *A. microbotrya* planted on crosses in alternate rows on eastern side, *A. huegeliana* planted on crosses in alternate rows on western side.
- The cross ripped design has the following features:
  - Four hosts per sandalwood
  - provision of adequate growing space for hosts and sandalwood, to maximise growth.
  - Sandalwood to be planted every second cross of every second row (rows with *A. acuminata*), allowing root system to develop along lines of loosened ground.

Site Preparation

- The ripping was effective in breaking up the clay loam soil type.
- Rows were spaced at 3m apart and aligned approximately on the contour. Perpendicular rows were spaced at 6m. This equates to a host density of 560 stems per hectare and a sandalwood density of 140 stems per hectare.

Weed Control:

- The weed control undertaken at this site was not adequate to control weeds. The recommended prescription of Glyphosate and Simazine following ripping was not adhered to by the farmer.
- The post planting weed control was effective in killing grassy weeds, however the broadleaf herbicide (Lontrel) did not kill the Capeweed. Three factors may have contributed to this 1) the dry finish to the season had stressed the capeweed resulting in low herbicide uptake 2) the Capeweed was sufficiently mature at the time of spraying to withstand the herbicide 3) the rate used, without a wetting agent, was not sufficient to deliver a lethal dose.

Seedling Survival:

- Weed competition in patches stressed or killed seedlings through moisture competition. This is likely to have increased susceptibility of seedlings to subsequent attack by Rutherglen.
- The *Acacia* species were visibly effected by the Lontrel® overspray. This is may have contributed to the seedlings susceptibility to attack by Rutherglen.

SITE 2:

Planting Work:

- Species were selected based on their salt tolerance and whether they naturally occur in the Jingalup locality.
- The saltier sections were planted to *E. occidentalis* and *M. cuticularis*. Less saline wet areas were planted to *M. viminea*. *E. wandoo* was planted in those areas not affected by salinity or waterlogging.

Site Preparation

- The mound produced by the single disc mound plough was adequate but not ideal. A roller attachment would have improved mound structure by providing a better medium for planting into and improving the microhabitat for seedlings.

Weed Control:

- The weed control undertaken at this site was not adequate to control weeds. The recommended prescription of Glyphosate and Simazine following mounding was not adhered to by the farmer.
- The post planting weed control was only partially effective in killing capeweed which was the predominant weed at the site. Three factors may have contributed to this 1) the dry finish to the season had stressed the capeweed resulting in low herbicide uptake 2) the Capeweed was sufficiently mature at the time of spraying to withstand the herbicide 3) the rate used, without a wetting agent, was not sufficient to deliver a lethal dose.

Seedling Survival:

- Weed competition in patches stressed or killed seedlings through moisture competition.
- Kangaroo damage is likely to have increased seedling susceptibility to weed competition, particularly *E. wandoo* which suffered the most grazing damage.

SITE 3:

Planting Design and Species Selection:

- Species were selected based on their salt tolerance and whether they naturally occur in the Jingalup locality. The creek line was bordered by mature *M. cuticularis*, which is expected to regenerate now that the site has been fenced. The majority of seedlings used were tree species, in order to complement the Melaleuca's.
- The saltier sections were planted to *E. occidentalis* and *M. cuticularis*. Less saline wet areas were planted to *M. viminea* and *E. rudis*. *E. wandoo* was planted in those areas not affected by salinity or waterlogging.

Site Preparation

- The mound produced by the single disc mound plough was adequate but not ideal. A roller attachment would have improved mound structure by providing a better medium for planting into and improving the microhabitat for seedlings.
- In some areas, the mound were not large enough to adequately protect seedlings from waterlogged soil.

Weed Control:

- The weed control undertaken at this site was not adequate to control weeds. The recommended prescription of Glyphosate and Simazine following mounding was not adhered to by the farmer.
- The post planting weed control was only partially effective in killing the Annual Ryegrass which was the predominant weed at the site. Three factors may have contributed to this 1) the dry finish to the season had stressed the capeweed resulting in low herbicide uptake 2) the Annual Ryegrass was sufficiently mature at the time of spraying to withstand the herbicide 3) the rate used was not sufficient to deliver a lethal dose.

Seedling Survival:

- Weed competition in patches stressed or killed seedlings through moisture competition.
- Rutherglen damage killed some seedlings of *E. wandoo*. It is unknown why this species was targeted while adjacent seedlings of other species were not affected.

Photograph Library

Site 1

July 19, 2000: Cross ripping configuration for sandalwood hosts

October 24, 2000 –*Acacia microbotrya* displaying burnt and withered leaf tips 29 days after Lontrel® spray.

Weed growth at Site 1

September 29, 2000

December 20, 2000

October 24, 2000

Site 2: South west corner.

April 19, 2000
South end looking North

September29, 2000
Looking south from halfway along site. Capeweed growing thickly on mounds

June 11, 2000
South end looking North

December 20, 2000
South end looking north, *E.occidentalis* seedlings visible.

Site 3: South East arm of drainage line.

			
August 4, 2000	**September 29, 2000**	**October 24, 2000**	**December 12, 2000**

P2000 Supplementary Species Project Documentation

Property Owner: Lew and Sandy Shaw
Location: West Beverley
Number of sites: 5
Report By: Dan Huxtable

Background:

In 1998, the landowners entered into a share-farming agreement with CALM resulting in the planting of approximately 200ha of *Pinus pinaster* on low productivity soils. As a part of the sharefarm agreement, up to 20 ha of supplementary species was available for the purposes of nature and land conservation.

In 2000, approximately 10 hectares of revegetation was established. This report documents the year 2000 planting project.

All establishment works were funded by CALM, with the farmer required to provide fencing where necessary. Dan Huxtable (Bushcare Project Officer) coordinated project planning and implementation tasks.

Underlying Aims (Bushcare Project):

1) To develop revegetation designs that integrate nature and land conservation with profitable agriculture.
2) To implement designs that were compatible with the aspirations of the farmer and the existing farming enterprise.
3) To use a design methodology that could easily be adopted and replicated by large scale commercial revegetation projects, such as the CALM Maritime Pine Project[1].

[1] In November 2000, responsibility for the Maritime Pine Project was transferred from CALM to the newly created Forest Products Commission.

Site Selection:

After a discussion of revegetation options, the landowner selected 5 sites. The landowner did not feel that nature conservation objectives were a high priority for this revegetation work. His main aim was to address land degradation issues.

Site 1 was a rocky hill previously used for grazing sheep. The aim of planting this site was to reduce water recharge and hence excess water impacting on crop paddocks further down slope.

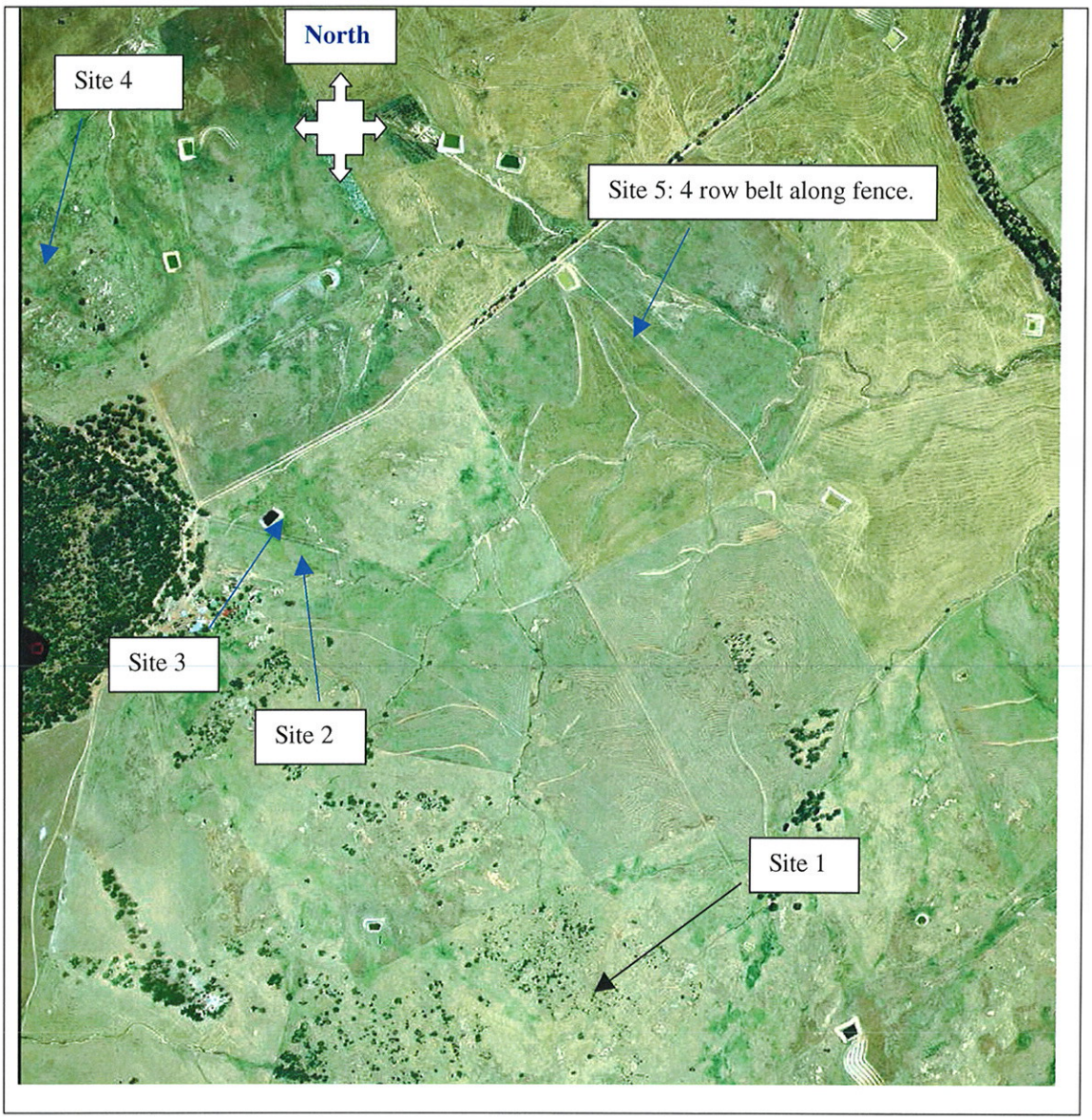
Site 2 was an area susceptible to seasonal waterlogging. The aim of planting this site was to utilise excess water.

Site 3 was an area susceptible to seasonal waterlogging located below a dam. The aim of planting this site was to utilise excess water.

Site 4 a rocky hill previously used for grazing sheep. The aim of planting this site was to reduce water recharge and hence excess water impacting on crop paddocks further down slope.

Site 5 was a 4 row belt approximately on the contour along a fenceline (midslope). The purpose of the belt was to intercept water moving down slope and to provide wind protection.

Location of planting sites (from photo 5144, Run 34, 15/02/00).



Establishment Tasks Summary – All sites:

Site preparation: All sites ripped using 500mm ripper and then mounded using a single disc mound-plough hired from the Brookton Landcare Group.

SITE	Preparation
1 - Rocky hill	Ripped then mounded in mid February 2000 (some areas ripped only).
2 - Adjacent to laneway	Ripped then mounded in mid February 2000.
3 - Below dam, adjacent to laneway	Ripped then mounded in mid February 2000.
4 - Rocky slope	Ripped then mounded in mid February 2000 (some areas ripped only).
5 - 4 row belt along fence	Ripped then mounded in mid February 2000.

Weed Control (done by farmer):

SITE	Control method
1 - Rocky hill	Round Up/Simazine (approx 1L/3L per ha respectively), applied by Quad bike in week of July 3-7.
2 - Adjacent to laneway	Round Up/Simazine (approx 1L/3L per ha respectively), applied by Quad bike in week of July 3-7.
3 - Below dam, adjacent to laneway	Round Up/Simazine (approx 1L/3L per ha respectively), applied by Quad bike in week of July 3-7.
4 - Rocky slope	Round Up/Simazine (approx 1L/3L per ha respectively), applied by Quad bike in week of July 3-7.
5 - 4 row belt along fence	Glean/Diuron (rates unknown), applied by Quad bike in week of July 3-7.

Planting (done by CALM staff):

SITE	Details
1 - Rocky hill	2 people, 9.25 hrs, 47.5 trays, **2.56 trays/person/hr**
2 - Adjacent to laneway	3 people for 45 mins + 2 people for 1hr, 17 trays, **4 trays/person/hr**
3 - Below dam, adjacent to laneway	3 people,1 hr, 8 trays, **2.66 trays/person/hr**
4 - Rocky slope	2 people, 3 hrs, 18 trays, **3 trays/person/hr**
5 - 4 row belt along fence	2 people, 2.25hrs, 16 trays, **3.55 trays/person/hr**

Species List:

Species	Seedlot Number And Location		Number of trays (64 Kwikpot)					
			Site 1:	Site 2:	Site 3:	Site 4	Site 5	Number of Trays (Total)
Acacia acuminata	N98188 (site 5 only) D471	Murchison River ?	12	2		2	4	**20**
Acacia lasiocalyx	D1018	?	4					**4**
Acacia microbotrya	D886A	Narrogin			2			**7**
Acacia saligna	99013A	Manjimup		2				**2**
Allocasuarina huegliana	97040A		11			3		**14**
Callistemon phoeniceus	D236	Darkin Swamp		4	1			**6**
Calothamnus quadrifidus	D30036	?				1	1	**2**
Calothamnus rupestris	D1206	Dwellingup	70 pots					**70 pots**
Casuarina obesa	99104 D27289	Esperance ?		3	2			**14**
E.accedens	D623	Dryandra State Forest				3	4.5	**7.5**
E.caesia	D1224	Narrogin	4.5					**4.5**
E.longicornis	94255	Harrismith					3	**3**
E.loxophleba	PW95 D11333	? ?	12	6		4	5	**27**
E.occidentalis	98100	Grass Patch			3			**3**
E.capillosa	98118	Jaurdi Station	2?					**10**
Heakea undulata	93051	?	17 pots	10 pots approx	10 pots	1		**40 pots**
Kunzea pulchella	D1348	?	1			2		**3**
Melaleuca fulgens	N12197	North West Esperance	1			2		**120 pots**
TOTAL			**47.5**	**17**	**8**	**18**	**16**	**104 (not inc. pots)**

Note: Most seedlings were obtained from CALM nurseries at Manjimup and Narrogin. Some *Acacia acuminata, E .loxophleba and C. obesa* were obtained from a local nursery. All of the *Calothamnus rupestris* and *Kunzea pulchella* were obtained from the local nursery.

Post Establishment/ Monitoring – Site 1

Task	Date	Description
Monitoring	**Aug 15, 2000**	**Weeds:** Effectively controlled. **Survival:** *A. acuminata* – Good survival, except where rabbits have attacked. *A. lasiocalyx* – Good survival. *A. huegeliana* - Good survival, except where rabbits have attacked. *C. rupestris* - Good survival. *E. caesia* - Good survival. *E. cappilosa* - Good survival. *E. loxophleba* – Good survival. *H. undulata* - Good survival. *K. pulchella* - Good survival. *M. fulgens* - Good survival. **Pests:** Major rabbit damage (90% of seedlings dead) in one patch of *A. acuminata* and *A. huegeliana*. Some minor scattered damage to other areas. No warrens located.
Monitoring	**Oct 12, 2000**	**Weeds:** Significant Barley Grass germination on rip lines (disturbed soil). Weeds in inter-rows browning off. **Survival:** Some seedlings (all species) appear stressed, presumably due to low rainfall and weed competition. Rabbits have killed patches of seedlings, mainly *A. acuminata, A. lasiocalyx* and *A. huegeliana*. **Pests:** Significant localised rabbit damage as above (diggings and scats evident). Locusts (1st and 2nd instar) present, >20/m^2 in patches. No damage to seedlings observed.
Monitoring	**Nov 28, 2000**	**Weeds:** Barley grass has browned off. **Survival:** *A. acuminata* – Most dead due to rabbit attack (prior to Oct 12), locust attack or weed competition. *A. lasiocalyx* – Most dead due to rabbit attack (prior to Oct 12), locust attack or weed competition. *A. huegliana* - Most dead due to rabbit attack (prior to Oct 12), locust attack or weed competition. *C. rupestris* - Good survival, however under attack from insects (see below). *E. caesia* - Reasonable survival. *E.cappilosa* – Not observed. *E.loxophleba* – 40% dead, some under attack from insects (see below). *H.undulata* – All dead. *K.pulchella* – Many dead. *M.fulgens* - Good survival. **Pests:** Locust damage was observed on some seedlings Rutherglen bug and Strawberry beetle were observed attacking *E. loxophleba, C. rupestris* and *M. fulgens*. Sheep observed in planting area.

Post Establishment/ Monitoring – Site 2

Task	Date	Description
Monitoring	**Aug 15 2000**	**Weeds:** Patchy Guildford grass, otherwise none. **Survival:** *A. acuminata* - Damaged by sheep (see below). *A. saligna* – Damaged by sheep (see below). *C. phoeniceus* – Appear stressed. *C. obesa* – Damaged by sheep (see below). *E. loxophleba* – Appear stressed. *H. undulata* – Appear stressed. **Pests:** Sheep gained unintentional access to site. Extensive grazing damage to Acacia sp. and *C. obesa*.
Monitoring	**Sept 19, 2000**	**Weeds:** Weed control effective on spray strips. **Survival:** All species have survived well, although a large number appear stressed. *A. saligna* seedlings have resprouted following sheep attack, however the new shoots are curly and stunted. The site is very moist, which is likely to be contributing to seedling stress.
Monitoring	**Oct 12, 2000**	**Weeds:** Weed control effective on spray strips. **Survival:** Reasonable overall (rapid assessment only)
Monitoring	**Nov 28, 2000**	**Weeds:** Weed control effective on spray strips. **Survival:** *A. acuminata* – Many dead. *A. saligna* – Some locust damage, but many alive. *C. phoeniceus* – Good survival. *C. obesa* – Major locust damage. *E. loxophleba* – Good survival, a significant number have wavy leaves. *H. undulata* – Good survival.

Post Establishment/ Monitoring – Site 3

Task	Date	Description
Monitoring	**Aug 15, 2000**	**Weeds:** Significant Guildford grass. **Survival:** *A. microbotrya* – Good survival. *C. phoeniceus* – Most alive, some appear stressed. *C. obesa* – Good survival. *E. occidentalis* – Good survival. *H. undulata* – Most alive.
Monitoring	**Sept 19, 2000**	**Weeds:** Minor amounts of Guildford grass on spray strips. **Survival:** *A. microbotrya* – Most alive, some appear stressed. *C. phoeniceus* – Most alive, some appear stressed. *C. obesa* – Many dead or struggling. *E. occidentalis* – Good survival, some observed to be fruiting (stress indicator?). *H. undulata* – Most alive, some appear stressed. The site is very moist, which is likely to be contributing to seedling stress.
Monitoring	**Oct 12, 2000**	**Weeds:** Weed control effective on spray strips. **Survival:** Reasonable overall (rapid assessment only)
Monitoring	**Nov 28, 2000**	**Weeds:** Weed control effective on spray strips. **Survival:** *A. microbotrya* – Good survival, some minor locust damage. *C. phoeniceus* – Good survival. *C. obesa* – All dead, wiped out by locusts. *E. occidentalis* – Good survival. *H. undulata* – Most dead **Pests:** A few locusts sighted.

Post Establishment/ Monitoring – Site 4

Task	Date	Description
Monitoring	**Sept 19, 2000**	**Weeds:** Weed control effective on spray strips. **Survival:** Good survival exhibited by all species. **Pests:** Minor rabbit damage observed on a few seedlings (*A. acuminata, K. pulchella, M. fulgens*).
Monitoring	**Nov 28, 2000**	**Weeds:** Weed control effective on spray strips. **Survival:** *A. acuminata* – 100% dead, locust damage evident. *A. huegliana* – 80% dead, locust damage evident. *C. quadrifidus* – 50% dead, locust damage evident. *E. accedens* – Most (80%+) alive. *E. loxophleba* – Most (80%+) alive. *H. undulata* – Not sighted. *K. pulchella* - Most (80%+) alive. *M. fulgens*– Most (80%+) alive.

Post Establishment/ Monitoring – Site 5

Task	Date	Description
Monitoring	**Aug 15, 2000**	**Weeds:** Patchy weed control, some crop and clover germination especially in outer two rows. **Survival:** *A. acuminata* – Good survival. *C. quadrifidus* – A few dead, otherwise OK. *E. accedens* – Good survival. *E. loxophleba* – Good survival. *E. longicornis* – A few dead, otherwise OK.
Monitoring	**Sept 19, 2000**	**Weeds:** Outer two rows were sprayed in early September with Sertin @ 500ml/ha. Grassy weeds killed in these rows, some capeweed still present. Inner two rows had significant Capeweed, with some Erodium and Annual Ryegrass. **Survival:** Reasonable survival for all species. In over-sprayed rows, *E. accedens, E. loxophleba* and *E. longicornis* all exhibited dead juvenile leaves. *A. acuminata* and *C. quadrifidus* appeared unaffected.
Monitoring	**Oct 12, 2000**	**Weeds:** Outer two rows – all grassy weeds dead, Capeweed yellowing and in some instances dead. Inner two rows – significant weeds: Capeweed, Erodium and Annual Ryegrass. **Survival:** *A. acuminata* – Good survival. *C. quadrifidus* – A few dead, otherwise OK. *E. accedens* – Reasonable survival on inner two rows, nearly all dead on outer two rows. *E. loxophleba* – Reasonable survival on inner two rows, nearly all dead on outer two rows. *E. longicornis* – Reasonable survival on inner two rows, nearly all dead on outer two rows. **Pests:** Locusts (1st and 2nd instar) sighted, no seedling damage observed.
Monitoring	**Nov 28, 2000**	**Weeds:** Patchy weed control, some crop and clover germination especially in outer two rows. **Survival:** *A. acuminata* – 80%+ dead, extensive locust damage. *C. quadrifidus* – 80%+ dead, extensive locust damage. *E. accedens* – 80% dead, others infested with Rutherglen. *E. loxophleba* – 50% survival, many infested with Rutherglen. *E. longicornis* – 50% survival, a few infested with Rutherglen. Many survivors have dead older leaves. **Pests:** Locust damage and Rutherglen attack as above.

Project review and evaluation (as at Jan 2001):

All Sites:

Planting Work:

- Planting a series of clumps and filling the gaps between clumps with lines of different species is relatively easy to implement, but is slower than simply planting all seedlings at a standard spacing. This slower planting rate could increase the cost of using contract labour for hand planting. Planting clumps and varying the spacing between seedlings along the rows is not amenable to machine planting.
- Compared with mixing seedlings of different species prior to planting, planting by the tray (ie each planter reloads using the entire contents of one tray) results in less fine scale species mixing but increases planting speed.
- The method described in points 1 and 2 above represents a compromise between no planting design and designs which seek to emulate the structural characteristics of remnant vegetation stands.

Species Selection:

- The main aim of the species selection was to achieve variety in **vegetation structure** and **species composition**. This aim was underpinned by the assumption that a mixture of species, planted in an appropriate design, will provide better habitat for fauna than single species or single structure plantings.
- This broad objective was then refined based on the availability of different species from nurseries and their ability to grow at the chosen sites. Ideally, a mixture of local provenance species would have been used.
- The aesthetic benefits of using a variety of species were also considered.

SITE 1:

Site Preparation

- The rocky nature of this site made ripping difficult. The site was essentially divided into compartments where tractor/ripper access was possible. The depth of ripping varied but was generally sufficient for planting into.
- Mounding was attempted in some compartments, however the quality of mounds was poor due to the type of mounder used and the nature of the terrain.

Weed Control:

- Initial weed control was effective, however a late germination of Barley Grass was detrimental to seedling survival in patches, especially in mounded areas.

Seedling Survival:

- Rabbits caused significant damage soon after planting. Baiting was carried out by the landowner in early September however further damage was sustained. Acacia species and *A. huegeliana* appeared to be the preferred species for rabbits, although some *E. loxophleba* seedlings were also attacked.
- Weed competition, mainly from Barley Grass, restricted seedling growth in patches where weeds were thick. In some cases seedlings were out competed and died.
- Poor seedling size and vigour was believed to be a contributing factor to mortality in Acacia species. The photograph below shows the contrast between *A. acuminata* planted at Site 1 relative to those planted at Site 5.

Contrast in quality of *Acacia acuminata* seedlings from CALM Manjimup nursery (left) and local nursery (right).

SITE 2:

Site Preparation

- A larger mound size would have been preferred at this site to reduce waterlogging stress.

Weed Control:

- Weeds were effectively suppressed at this site.

Seedling Survival:

- The major causes of mortality at this site were grazing damage from sheep and locusts.
- Many seedlings appeared to be stressed in the first few months after planting. This is believed to be attributable to waterlogging and also residual herbicide effects.

SITE 3:

Site Preparation

- A larger mound size would have been preferred at this site to reduce waterlogging stress.

Weed Control:

- Weeds were effectively suppressed at this site.

Seedling Survival:

- The major causes of mortality at this site were grazing damage from locusts.
- Many seedlings appeared to be stressed in the first few months after planting. This is believed to be attributable to waterlogging and also residual herbicide effects.

SITE 4:

Site Preparation

- The rocky nature of this site made ripping difficult. The depth of ripping varied but was generally sufficient for planting into.
- Mounding was attempted in the lower half of the site. The quality of mounds was fairly poor due to the type of mounder used and the nature of the terrain.

Weed Control:

- Weeds were effectively suppressed at this site.

Seedling Survival:

- The major causes of mortality at this site were grazing damage from rabbits and locusts.
- Baiting for rabbits was carried out by the landowner in early September, which appears to have helped prevent significant rabbit damage.

SITE 5:

Site Preparation

- A larger mound size would have been preferred at this site.

Weed Control:

- This site was initially sprayed with Glean® and Diuron®, contrary to the recommended prescription of Glyphosate and Simazine.
- Neither broad leaved or grassy weeds were effectively suppressed.
- The post planting spray of Sertin® effectively killed grassy weeds but also caused high mortality in Eucalypt seedlings.

Seedling Survival:

- Weed competition, herbicides and insect attack (Locusts and Rutherglen) combined to cause high mortality at this site. The stress caused by weeds and herbicides is likely to have increased the susceptibility of seedlings to insects.

Photograph Library

Site 1

February 14, 2000
North eastern component of site 1.

October 12, 2000
Close up showing barley grass germination on previously sprayed strips.

August 24, 2000
North eastern component of site 1.
Little weed germination on sprayed strips.

August 15, 2000
Central west component of site 1.

October 12, 2000
North eastern component of site 1.
Weeds browned off in the inter-rows, however a late barley grass germination has occurred on sprayed strips.

October 12, 2000
Central west component of site 1.

Site 3

August 24, 2000

October 12, 2000

September 19, 2000

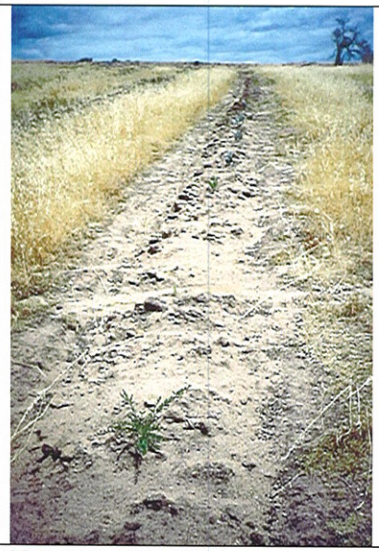
November 28, 2000

Site 4

August 24, 2000

November 28, 2000

September 19, 2000



November 28, 2000

Site 5

August 24, 2000

October 12, 2000

September 19, 2000
Note weed kill on outer two rows, 2 weeks after post planting spray.

November 28, 2000

P2000 Supplementary Species Project Documentation

Property Owner: Vaughn Spooner
Location: Wagin.
Number of sites: 2
Report By: Dan Huxtable (Bushcare Revegetation Development Officer)

Background:

In 1999, the landowner entered into a share-farming agreement with CALM resulting in the planting of 13ha of *Pinus pinaster* on low productivity soils. As a part of the sharefarm agreement, up to 1.3 ha of supplementary species was available for the purposes of nature and land conservation.

This report documents the year 2000 supplementary species planting project. All establishment works were funded by CALM, with the farmer required to provide fencing. The establishment work was coordinated by Dan Huxtable (Bushcare Project Officer).

Underlying Aims (Bushcare Project):

1) To develop revegetation designs that integrate nature and land conservation with profitable agriculture.
2) To implement designs that were compatible with the aspirations of the farmer and the existing farming enterprise.
3) To use a design methodology that could easily be adopted and replicated by large scale commercial revegetation projects, such as the CALM Maritime Pine Project[1].

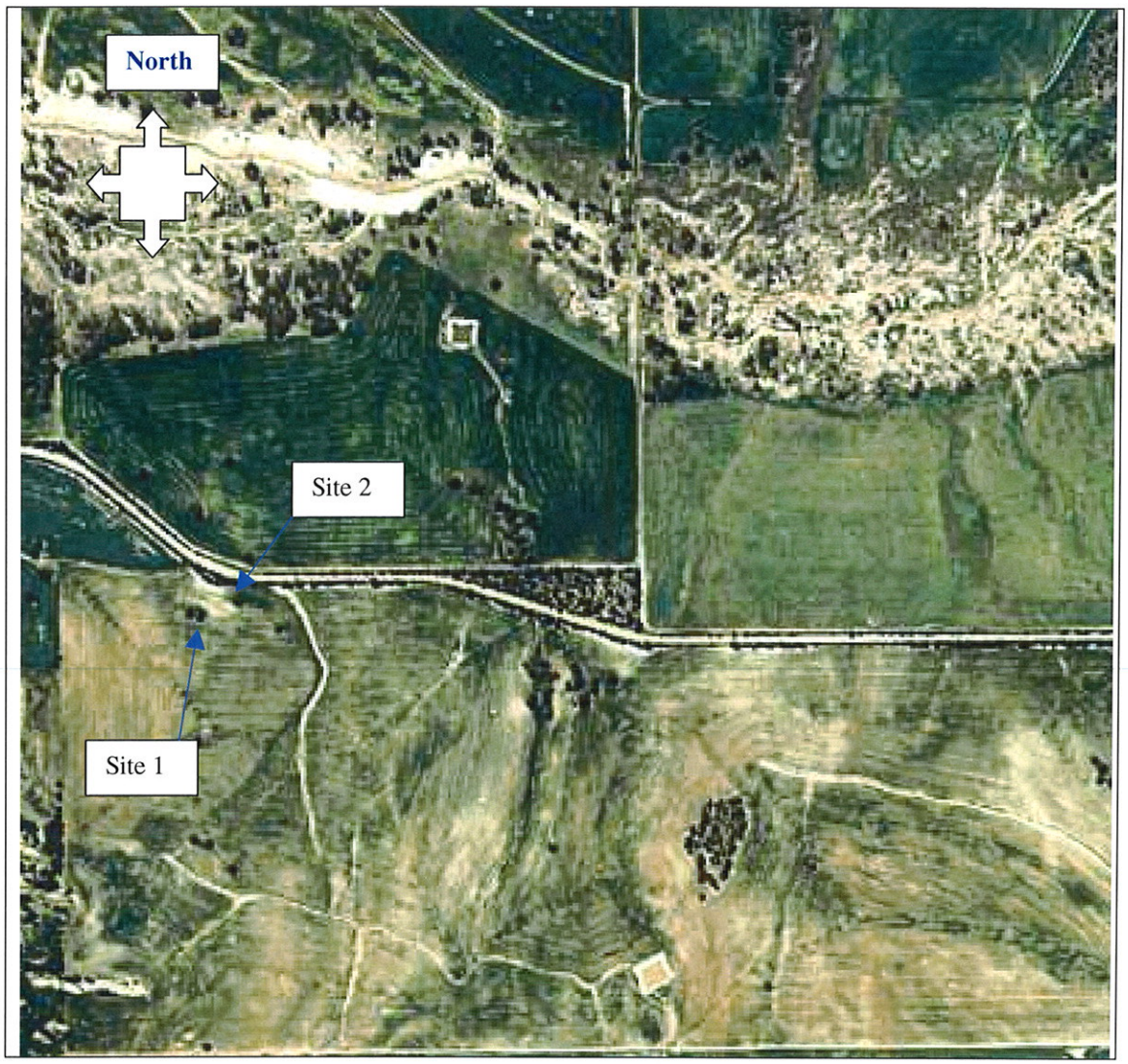
Site Selection:

After a discussing the revegetation options with Dan Huxtable, the landowner selected 2 sites located near an area revegetated in 1997.

Both sites had a history of worsening seasonal dampness and secondary salinity. The landowner hopes that the revegetation will help to prevent this problem from spreading into adjacent cropping land.

[1] In November 2000, responsibility for the Maritime Pine Project was transferred from CALM to the newly created Forest Products Commission.

Location of sites (from photo 5341, Run 4, 06/10/96)



Establishment Tasks Summary – Sites 1 and 2:

Task	Date	Description
Site preparation - ripping	**Early April 2000**	Site ripped by landowner using 500mm ripper and 70hp tractor.
Site preparation - mounding	**May 26, 2000**	Site mounded by landowner, using homemade single disc mounder (no ripper or roller) borrowed from neighbour.
Weed control	**July 25, 2000**	Sprayed by landowner using boomspray. **Rates:** Sprayseed 2L/ha, Simazine 2L/ha.
Planting	**Aug 3, 2000**	Handplanted using Potti-putki's.. **Rates:** 2 planters, 48 trays, 6.5 hrs **3.7 trays/person/hour (approx)**

Species Lists:

Site 1:

Species	Seedlot Number and Location		Number of Trays
Acacia acuminata	98188	Murchison river	7
Allocasuarina huegeliana	97040	Victoria rock	2
Casuarina obesa	99104	Esperance	2
Eucalyptus capillosa	98118	Jaurdi Station	2
E. loxophleba	D11333, PW95	?	3
E. occidentalis	N98100	Grass Patch	4
E. wandoo	K177	Collie	7
Hakea preissii	NS16515	?	1
Melaleuca uncinata	94103	Kalannie	2
TOTAL			**30**

Site 2:

Species	Seedlot Number and Location		Number of Trays
Acacia saligna	C99013	Manjimup	1
Callistemon phoeniceus	D236	Darkin Swamp	2
Casuarina obesa	99104	Esperance	2
E. loxophleba	D11333	?	5
E. spathulata	N16797	?	1
Melaleuca uncinata	94103	Kalannie	6
TOTAL			**17**

Post Establishment/ Monitoring – Site 1

Task	Date	Qualitative Assessment
Monitoring	**Aug 10, 2000**	**Weeds:** Annual Ryegrass germinated in patches. **Survival:** *Acacia acuminata* – Good survival. *Allocasuarina huegeliana* – Good survival. *Casuarina obesa* - Good survival. *E. capillosa* – Good survival. *E. loxophleba* – Good survival. *E. occidentalis* – Good survival *E. wandoo* – Some appear stressed, have discoloured leaves. *Hakea preissii*- Good survival *Melaleuca uncinata* – Some deaths.
Monitoring	**Sept 15, 2000**	**Weeds:** Annual Ryegrass in patches, especially on mound lines. **Survival:** *Acacia acuminata* – Good survival. *Allocasuarina huegliana* – Some appear stressed. *Casuarina obesa* - Some appear stressed. *E. capillosa*– Good survival. *E. loxophleba*– Good survival. *E. occidentalis*– Good survival. *E. wandoo*– Good survival. *Hakea priessii* – Good survival. *Melaleuca uncinata* – Significant deaths.
Monitoring	**Oct 22, 2000**	**Weeds:** Some Annual Ryegrass in patches, also low numbers of Barley Grass and Capeweed. **Survival:** *Acacia acuminata* – Good survival, except in weedy patches. *Allocasuarina huegliana* – Good survival, except in weedy patches. *Casuarina obesa* – Good survival. *E. capillosa*– Good survival. *E. loxophleba*– Good survival. *E. occidentalis*– Good survival. *E. wandoo*– Good survival. *Hakea preissii* – Many appear stressed. *Melaleuca uncinata* – Most dead. **Pests:** Chrysomelid larvae found on one *E. occidentalis* seedling.
Monitoring	**Nov 29, 2000**	**Weeds:** Annual Ryegrass in patches, browned off. **Survival:** Weed competition has killed seedlings in patches. Where weeds were not thick, most species have survived well. The exceptions are *Hakea preissii* and *Melaleuca uncinata* which performed badly despite the presence or absence of weeds. Overall survival (all species) 60% approx. **Pests:** Adult locusts at site, but no damage to seedlings observed.

Post Establishment/ Monitoring – Site 2

Task	Date	Qualitative Assessment
Monitoring	**Aug 10, 2000**	**Weeds:** Weed control effective overall. **Survival:** *Acacia saligna* – Good survival. *Callistemon phoeniceus* - Good survival. *Casuarina obesa* - Good survival. *E. loxophleba* - Good survival. *E. spathulata* - Good survival. *Melaleuca uncinata* - Good survival.
Monitoring	**Sept 15, 2000**	**Weeds:** Patchy grassy weeds have emerged. **Survival:** *Acacia saligna* – Good survival. *Callistemon phoeniceus* - Some deaths. *Casuarina obesa* – Significant deaths. *E. loxophleba* - Good survival. *E. spathulata* - Good survival. *Melaleuca uncinata* – Some dead, many stressed.
Monitoring	**Oct 22, 2000**	**Weeds:** Patchy Annual Ryegrass, Barley grass and Capeweed. **Survival:** *Acacia saligna* - Some appear stressed, probably salt and/or weeds. *Callistemon phoeniceus* - Some appear stressed, probably salt and/or weeds. *Casuarina obesa* - Some appear stressed, probably salt and/or weeds. *E. oxophleba* - Some appear stressed, probably salt and/or weeds. *E. spathulata* – Some appear stressed, probably salt. *Melaleuca uncinata* – Many dead.
Monitoring	**Nov 29, 2000**	**Weeds:** Patchy Annual Ryegrass, Barley grass and Capeweed (browned off). **Survival:** *Acacia saligna* – 30% survival. *Callistemon phoeniceus* – 30% survival. *Casuarina obesa* – 40% Good survival. *E. loxophleba* – 50% survival. *E. spathulata* – 40% survival. *Melaleuca uncinata* – 5% survival. **Pests:** Adult locusts at site, but no damage to seedlings observed.

Review and Evaluation (as at Jan 2001):

SITES 1 and 2:

Planting Work:

- Planting a series of clumps and filling the gaps between clumps with lines of different species is relatively easy to implement, but is slower than simply planting all seedlings at a standard spacing. This slower planting rate could increase the cost of using contract labour for hand planting. Planting clumps and varying the spacing between seedlings along the rows is not amenable to machine planting.
- Compared with mixing seedlings of different species prior to planting, planting by the tray (ie each planter reloads using the entire contents of one tray) results in less fine scale species mixing but increases planting speed.
- The method described in points 1 and 2 above represents a compromise between no planting design and designs which seek to emulate the structural characteristics of remnant vegetation stands.

Species Selection:

- The main aim of the species selection was to achieve variety in **vegetation structure** and **species composition**. This aim was underpinned by the assumption that a mixture of species, planted in an appropriate design, will provide better habitat for fauna than single species or single structure plantings.
- This broad objective was then refined based on the availability of different species from nurseries and their ability to grow at the chosen sites. Ideally, a mixture of local provenance species would have been used.
- The aesthetic benefits of using a variety of species were also considered: in terms of foliage colours, flower colour, time of year when in flower and structural variety.

Site Preparation

- A "cropping" style configuration was used by the landowner for the riplines, whereby a spiral type pattern was achieved. This was intended to produce a more natural looking planting once the plants have grown.
- Ripping and mounding were done in two separate passes. In some instances, the mound did not align with the riplines. This appears to have been exacerbated by the non-linear ripping configuration.
- Both the ripping and mounding were of substandard quality. This can be attributed to the low quality of equipment used for these tasks
- The rows were spaced at 3-4m apart.

Weed Control:

- Initial weed control and suppression was good on both sites. However, the residual herbicide was only partially effective in controlling weed germination in the mounded zone where soil had been disturbed.
- Weed competition restricted seedling growth in patches where weeds were thick. A significant number of seedlings were out competed and died.
- Over-spraying the seedlings with grass selective herbicides would have been warranted at this site, given that the major competitive weed was Annual Ryegrass.

Seedling Survival:

- The major factor contributing to seedling mortality was weed competition.
- Simazine toxicity is believed to be a factor contributing to seedling stress, especially before weed competition set in.

Photograph Library

Site 1

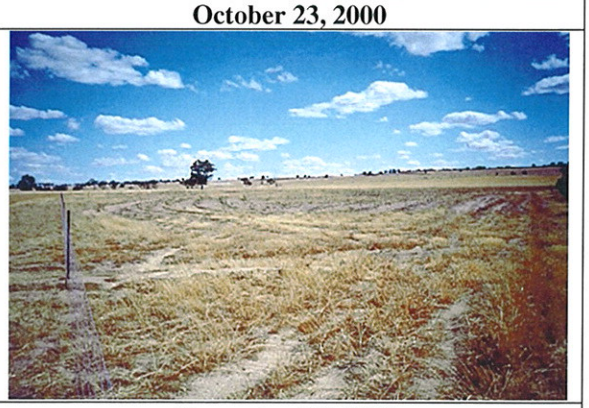
June 29, 2000

September 15, 2000

August 3, 2000

October 23, 2000

August 10, 2000



November 29, 2000

Site 1

August 3, 2000

November 29, 2000

September 15, 2000

Site 2

August 3, 2000

November 29, 2000

September 15, 2000

Site 1 – August 10, 2000

***E.wandoo* seedling exhibiting deformed growth.**

Copy of Appendix in "Middle Balgarup Catchment Action Plan" Bulletin 4441, Agwest, December 2000

Appendix D:

Farm Forestry options for the Middle Balgarup Catchment.

Prepared by: Dan Huxtable (Farm Forestry Unit) CALM Guildford
Michael Power (Farm Forestry Unit) CALM Albany

Revegetation and Farm Forestry

Revegetation is the general term used to describe the establishment of trees and shrubs on cleared farmland. It encompasses a wide range of practices including: saltland revegetation, shelterbelts using endemic species, wildlife corridors, wetland and riparian buffer strips, fodder shrubs and farm forestry. In farm forestry the primary objective is to integrate trees into existing farming systems to obtain multiple benefits including commercial return. Farm forestry differs from other forms of revegetation in that wood products are harvested from the trees.

Farm forestry for multiple benefits including commercial return

Farm forestry means the integration of trees into farming systems for multiple benefits including commercial return. It simply means 'farmers doing forestry' i.e. farmers incorporating forestry into their farm enterprise. Examples of farm forestry include: timberbelts, woodlots, alley farming, wide spaced trees and plantations on farms. The common factor in all forms of farm forestry is that ***trees are incorporated into existing farming systems to complement the farm enterprise but not to replace it.*** Forestry becomes part of the farm enterprise, with wood products being harvested and sold.

Carefully designed and implemented farm forestry can complement current farming systems and produce multiple benefits including the following.

1. Land conservation benefits
The integration of trees across the farming landscape can help to control large-scale degradation processes such as salinity, wind erosion, water erosion and nutrient run-off.

2. Increase agricultural production
Shelterbelts protect farming systems from extremes in climate and create a better microclimate in which to grow crops, pasture and livestock.

3. Diversify farm income
Tree crops can provide commercial return and diversify the farm enterprise. The various tree crops have specific land capability and rainfall requirements and must be matched to suit the particular site.

4. Revegetation for wildlife conservation
The land conservation benefits of revegetation lead to the conservation and rehabilitation of wildlife habitat. Conservation values of farm forestry can be enhanced by planting buffer zones around remnant vegetation, creating linkages between remnant vegetation and planting species which naturally occur in the area. Commercial tree crops can be complemented by native understorey species.

5. Flexibility
Well designed, integrated farm forestry systems such as alley farming (which allow alleys for conventional agriculture) maintain the flexibility to change agricultural pursuits in the future. For example, crops or pasture can be grown in the alleys depending on the requirements of the individual farmer.

Steps in preparing a revegetation plan

- Identify revegetation options which 1) meet the farmers needs/aspirations and 2) suit the land capability and farming system.

- Consider establishing belts on the contour for water control, belts orientated at right angles to damaging winds for wind erosion control, and belts orientated in a north – south direction on flat land.
- Allow for access and movement of livestock and machinery. Alley widths in between tree belts should be in multiples of the widest piece of farm equipment e.g. the boom spray.
- Seek to link all revegetated areas to minimize gaps in shelter and to avoid creating wind tunnels.
- Schedule the implementation of a farm forestry plan to fit into the farm budget and the availability of time. For example, where fast grown eucalypts are being established for sawlogs then an area of no more than 3-5 hectares per year (for the individual farmer) is recommended because management practices such as pruning and thinning will take time in the future.
- Revegetation and farm forestry should be considered like cropping. It must be done right or the results will be disappointing. Good design, appropriate species selection, excellent site preparation, control of vermin, weeds and insects, and thorough management are all essential.

Farm forestry options (see Table 1)

High-grade sawlogs

A range of tree species have the potential to produce high grade sawlogs in the Middle Balgarup Catchment. These include Monterey Pine (Pinus radiata) and a number of Eucalypt species: Eucalyptus accedens (Powder Bark Wandoo), E.astringens (Brown Mallet), E. botryoides (Southern Mahogany), E. cladocalyx (Sugar Gum), E.grandis (Rose Gum), E.maculata (Spotted Gum), E.occidentalis (Flat Topped Yate), E.saligna (Sydney Blue Gum) and E.tricarpa (Three Fruited Red Ironbark). Different species are suited to different site types.

Trees can be planted in blocks or belts. Belts of trees, 4 to 6 rows wide, should be established at spacings of 100 to 150 metres between belts. Individual species should be planted in separate belts/blocks or separate sections of a belt. This is because the faster growing species will dominate the slower growing ones, and at harvesting the different species must be segregated.

As a general guide, the trees should initially be planted at 1000 trees per hectare (4 metres between rows and 2 ½ metres between trees). The taller, straighter trees should then be selected at age 3 to 6 years and pruned. The poorer trees should be culled leaving only 100-200 trees per hectare standing to grow onto sawlog size (age 25-40 years depending on species). Plant only seedlings grown from selected provenances (seed source) to ensure the trees will grow straight and produce quality sawlogs. Consult your nursery for further information.

The **Tree Notes** series provides further details on how to grow and manage trees for high-grade sawlogs – available from your local CALM or AGWEST office.

Eucalypts for posts and poles

Species such as Powder Bark Wandoo and Red Ironbark can produce highly durable heartwood (heartwood that is naturally resistant to insect and fungal attack), suitable for fence posts and poles. Use a similar layout to that described above for 'Eucalypts for high-grade sawlogs' i.e. belts 6 rows wide, spaced at 100 to 150 metres apart.

For most species, firewood is a potentially salable by-product of thinning and harvesting. In the eastern states, some trees with good coppicing ability (the ability to re-sprout from a stump) are grown specifically to supply firewood markets.

Tasmanian Bluegum

Narrow belts of Tasmanian Bluegum (3 to 4 rows wide) may be suitable in the higher rainfall parts of the Middle Balgarup Catchment. Belts of bluegums should be established on the contour at spacings of 100 to 150 metres apart. Bluegums are only suitable on the better, well-drained country which is not threatened by salinity, and where shallow bedrock is not present. Suitable soil profiles should be at least 10 metres deep to bedrock. Em 38 salinity readings should be less than 50 mS/m.

The economics and profitability of growing bluegums for pulpwood in the Middle Balgarup area is unknown. The transport distance involved and higher harvesting costs associated with belt plantings could make it

unprofitable. Any bluegums may therefore need to be managed to produce high-grade sawlogs. Farmers are advised to seek specialist advice when considering Tasmanian Bluegum.

Maritime Pine Sharefarming Scheme

Maritime Pine or Pinus pinaster is being grown in the region by CALM's Maritime Pine Sharefarming Scheme. Maritime Pine is an excellent landcare tree and will also produce quality timber. It is suited to well drained sites on a range of soil types including deep sands. EM38 salinity readings should be less than 60mS/m.

Under a sharefarming agreement CALM looks after tree establishment and management, while the farmer provides the land and fences off the trees from livestock. In 2000, farmers were offered an up front cash incentive for a total planting area (can be multiple sites) of over 50ha. Maritime Pine can either be established in block plantations or belts which are at least 10 rows wide (30 metres). Purchase a Maritime Pine Information Kit from Agriculture Western Australia ($15 approx). Contact CALM Katanning on 9821 1296 for more details.

Oil Mallees

The Oil Mallee Association (OMA) is developing an innovative industry throughout the wheatbelt where oil mallees are grown on farms for land conservation benefits and to produce eucalyptus oil, charcoal, and biomass for energy production. In the year 2000, a pilot biomass plant at Narrogin to process material from tree harvesting is being keenly discussed.

A range of species are grown which are suitable for a variety of soil types and conditions. The oil mallees are generally not palatable to sheep and lend themselves to alley style layouts with no fencing. Purchase a Eucalyptus Oil Mallee Information Kit from Agriculture Western Australia ($15 approx). Contact the Oil Mallee Association (OMA) in Perth on 9478 0330 for more details.

Sandalwood

Sandalwood is a long term, high value tree crop used in South East Asia for incense sticks. The sandalwood plant is parasitic and requires host plants, which are normally established 1-2 years prior to the sandalwood. The most suitable host species is Acacia accuminata (Jam Wattle); others include Allocasuarina huegliana (Rock Sheoak), Acacia saligna (Golden Wreath Wattle), Acacia pulchella (Prickly Moses) and other deep-rooted nitrogen fixing perennials. To ensure that the sandalwood remains vigorous throughout the 18-25 year rotation, 2-4 host plants per sandalwood are recommended. Purchase a Sandalwood Information Kit from Agriculture Western Australia ($15 approx).

Important Issues to Consider

Site capability

The key factors which determine what species are suitable for any given site within the catchment are:

1. Landscape position or land form element;
2. Land management unit; and
3. Hazards to farm forestry such as salinity or shallow bedrock.

Table 2 outlines farm forestry recommendations for the major land management units within the catchment. The recommendations are based on the three factors listed above. Firstly, the land form element is critical because it determines the depth to bedrock and the underlying hydrology. For example, ridge tops exhibit shallow bedrock (within 3 to 5m of the surface) with no permanent aquifer. Suitable farm forestry species for ridge tops must therefore tolerate shallow soils and drought. The second factor is the land management unit which describes the surface soil. Characteristics such as non-wetting sand and shallow clay will affect species selection and site preparation. Thirdly, hazards such as shallow bedrock, salinity and waterlogging will determine what species, layout and site preparations are appropriate.

Note that on salt affected sites, the provenance (seed source) of a given species is important for determining it's ability to tolerate salinity. Consult your nursery for further information.

Vermin

Rabbits destroy young trees and there is little point in establishing trees and shrubs until an area is rabbit free. A lead time of 18 months is required to effectively control rabbits. Baiting over summer and autumn, warren destruction and bait stations are all necessary.

Parrot damage causes deformed and multiple stem trunks. It can render tree crops worthless. When growing tree crops for sawlog, posts and poles, and pulpwood it is essential that parrot damage be controlled. Consult Treenote nos. 26 & 29 for additional information, available from your local CALM or AgWA office.

Establishment & Management

Good site selection, site preparation, weed control and pest control are essential when establishing tree crops. Table 3 provides some indicative costs for tree establishment.

Tree crops require regular management inputs such as vermin and insect control, firebreaks, pruning, thinning and fertilizing. These operations take time and resources and must be done on time. If the necessary management inputs cannot be achieved then the grower is well advised to grow the trees purely for land conservation benefits and forgo commercial harvests.

Further Information:

If you are contemplating a farm forestry venture, it is recommended that you seek additional information from the various agencies/organisations cited in this appendix.

For further background information on planning, site selection and species selection, contact:

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Department of Conservation and Land Management
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Telephone: (08) 9279 4088
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Email: danielhu@calm.wa.gov.au

Michael Power
Farm Forestry Adviser
Department of Conservation and Land Management
C/- Agriculture Western Australia
444 Albany Hwy ALBANY WA 6330
Telephone: (08) 9892 8418
Fax: (08) 9841 2707
Email: mpower@agric.wa.gov.au

Recommended sources of farm forestry information

Design principles for farm forestry published by Rural Industries Research and Development Corporation 1997, Canberra.

REX'96 (Revegetation Expert System CDROM) published by PCWARE Australia Pty. Ltd. 1996, Sydney.

Trees in agriculture Internet Web Site, address: http://agweb/progserv/natural/trees

Tree Note series published by the Farm Forestry Advisory Service. Obtain free copies from AGWEST and CALM offices. List of TreeNotes available:
No. 1 Growing eucalypts for high-grade sawlogs
No. 2 Preparing sites for tree planting in the greater than 600mm rainfall zone of Western Australia

The Farmers Log, Rowan Reid and Peter Stephen, RIRDC Publication 99/81, 1999. Contact Australian Master TreeGrower Program on 03 9344 5011 to purchase a copy.

Table 1: List of tree species suitable for farm forestry in the Middle Balgarup Catchment.

Name, common name	Tolerances			Uses				Notes
	Salt	W/log	Drought	Timber	Posts and poles	Fire-wood	Other	
Corymbia maculata, Spotted Gum				✓		✓	Treated posts	Frost tender when young. Potential to become a weed and invade bushland. Susceptible to insect attack. Huntley provenance has superior form and growth (CALM Seed Centre).
Eucalyptus accedens, Powder Bark Wandoo			✓	✓	✓	✓		Frost tender when young. *E.accedens* has straighter form than *E.wandoo* (Wandoo). Relatively slow growing.
E.atringens, Brown mallet	1		✓	✓		✓	Treated posts	Relatively slow growing.
E.botryoides, *Southern Mahogany*		✓		✓				Frost tender when young
E.cladocalyx, Sugar Gum			✓	✓		✓ ©		Frost tender when young
E.globulus Tasmanian Blue Gum				✓			Pulp	Careful site selection is necessary to reduce drought risk.
E.grandis Rose Gum		✓		✓			Treated posts	Relatively slow growing.
E.occidentalis, Flat Top Yate	2	✓	✓			✓		Grass Patch provenance has superior form and growth (CALM Seed Centre)
E.saligna Sydney Blue Gum				✓		✓	Treated posts	
Pinus radiata Monterey Pine				✓			Treated posts	
E.tricarpa, Three-fruited Red Ironbark				✓	✓	✓ ©		Formerly named *E.sideroxylon* subspecies *tricarpa*, it has straighter form than the more common Red Ironbark (*E.sideroxylon* subspecies *sideroxylon*)
Oil mallees – several species	1	✓	✓				Eucalyptus oil, biomass for energy production, and charcoal	A range of species is available, most native to WA, which are suited to a range of soil types and conditions. Contact the Oil Mallee Association in Perth by phone: 9478 0330.
Pinus pinaster, Maritime Pine				✓			Treated posts and poles, chipwood	Contact CALM Sharefarms in Katanning by phone: 9821 1296
Santalum spicatum, Sandalwood							Scented wood and essential oil	Sandalwood is parasitic and requires a host. The most suitable host species is *Acacia acuminata* (Jam Wattle); others include *Allocasuarina huegliana* (Rock Sheoak), *Acacia saligna* (Golden Wreath Wattle) and *Acacia pulchella* (Prickly Moses). Purchase a Sandalwood Information Kit from AGWEST.

Key to Table 1:

Suitable for this purpose:	✓
Waterlogging:	W/log
Coppicing species (regrows from cut stump):	©
Salt tolerance:	1: moderate 2:very

Table 2: Farm forestry recommendations for major land management units in the Middle Balgarup Catchment.

Land management unit	Hazards to farm forestry	Layout	Species
Gravelly ridges and slopes (well drained)	• Shallow bedrock • Shallow cemented laterite layer restricting rooting depth. Deep ripping with bulldozer if practical • Tight subsoil clay. Tendency for roots not to penetrate clay, therefore deep ripping into clay horizon is essential	• Small blocks or belts of trees • distance between belts should be no more than 150 metres • contact the Oil Mallee Association	*C.maculata, E.accedens, E.astringens, E.cladocalyx, E.globulus, E.saligna, E.tricarpa, Pinus radiata* Oil mallees
Moderately drained sandy duplex soils	• Non-wetting sand on the surface may make establishment difficult	• 3-10 row belts of trees • distance between belts should be no more than 150 metres • contact the Oil Mallee Association • 10 row belts of pines • distance between belts should be no more than 150 metres	*C.maculata, E.accedens, E.astringens, E.botryoides (wetter sites), E.cladocalyx, E.globulus, E.grandis, E.occidentalis (wetter sites), E.saligna, E.tricarpa, Pinus radiata* Oil mallees Maritime Pine
Poorly drained sandy duplex soils	• Non-wetting sand on the surface may make establishment difficult • Waterlogging, particularly in depressions • Tendency for tree roots not to penetrate clay, therefore deep ripping into clay horizon is essential	• 3-10 row belts of trees • Integrate belts with surface drainage • distance between belts should be no more than 150 metres • drain and block plant depressions • contact the Oil Mallee Association	*E.botryoides, E.grandis, E.occidentalis* Oil mallees
Red Soils	• Tight subsoil clay. Tendency for roots not to penetrate clay, therefore deep ripping into clay horizon is essential	• 3-10 row belts of trees • distance between belts should be no more than 150 metres • contact the Oil Mallee Association	*E.accedens, E.astringens,, E.cladocalyx, E.tricarpa,* Sandalwood Oil mallees
Broad valleys (non saline)	• Waterlogging • Tight subsoil clay. Tendency for tree roots not to penetrate clay, therefore deep ripping into clay horizon is essential	• 3-10 row belts of trees • distance between belts: 50 to 100m • contact the Oil Mallee Association	*E.botryoides, E.occidentalis* Waterlogging tolerant oil mallee species

Table 2 (cont): Farm forestry recommendations for major land management units in the Middle Balgarup Catchment.

Land management unit	Hazards to farm forestry	Layout	Species
Grey Clays	• Waterlogging • Salinity • Tight subsoil clay. Tendency for tree roots not to penetrate clay, therefore deep ripping into clay horizon is essential	• Non commercial revegetation • contact the Oil Mallee Association	Revegetate with WA Flooded Gum (*E.rudis*) Oil mallee species
Salt affected land	• Waterlogging • Salinity • Tight subsoil clay. Tendency for tree roots not to penetrate clay, therefore deep ripping into clay horizon is essential	• 3-10 row belts of trees • distance between belts: 50 to 100m • contact the Oil Mallee Association	Salt tolerant species: *E.cladocalyx, E.occidentalis* Salt tolerant oil mallee species
Hillside Seeps	• Salinity • Waterlogging	• Small block plantation, or belt.	Salt tolerant species: *E.cladocalyx, E.occidentalis*
Quartz Veins	• Shallow soil profile • Drought stress	• Commercial species not recommended	Establish locally occurring trees and shrubs.
Rock Outcrops	• Shallow soil profile • Drought stress	• Block plantation	Sandalwood, if soil depth >2m.
Mallet Hills	• Drought stress	• Block plantation	***E.astringens***
Deep Sands	• Non-wetting sand on the surface may make establishment difficult	• Block plantation • 3-10 row belts of trees • distance between belts: 50 to 100 metres • contact the Oil Mallee Association	Maritime Pine *E.cladocalyx* Oil mallees

Table 3: Approximate cost of implementing farm forestry options in the Middle Balgarup Catchment.

Farm forestry option	Contractor rate *(per ha of trees, notincluding fencing)*	Farmer rate (per ha of trees, not including fencing)		CALM Sharefarming
		Item	Cost	
• Monterey Pine/ Eucalypts for high-grade sawlog • Eucalypts for posts, poles and firewood.	$900-1,000 per hectare of trees (includes site preparation, planting & fertilizing) Additional costs (materials only): Rabbit control: $20 per ha Insect control: $50 per ha	Rabbit control: baits Seedlings: 1000 per ha Weed control: chemical Insect control: chemical & baits **Total materials**	$20 per ha 24c each or $240 per ha (>10,000 seedlings) $40 per ha $50 per ha **$350 per ha**	Not applicable
• Maritime Pine	No local contractor offering this service at present	Rabbit control: baits Seedlings: 1515 per ha Weed control: chemical Insect control: chemical & baits **Total materials**	$20 per ha 25.2 cents each (>10,000 seedlings) $382 per ha $30 per ha $50 per ha **$480 per ha**	• Provide minimum of 20 ha per year • Provide fence if required
• Oil mallees	No local contractor offering this service at present	Rabbit control: baits Seedlings: 1333 per km of 2-row hedge. Assume 1333 per ha (10m alleys between hedges) Weed control: chemical Insect control: chemical & baits **Total materials**	$20 per ha 33 cents each or $440 per km of 2 row hedge or $440 per ha $40 per ha $50 per ha **$550 per ha**	Not applicable
• Sandalwood	Direct seeding hosts and sandalwood in two separate operations: $600 per ha in total Additional costs (materials only): Rabbit control: $20 per ha Weed control: $30 per ha Insect control: $50 per ha	Rabbit control: baits Direct seeding hosts: Knock down herbicide Seed: 1 kg per ha Insect control: chemical & baits Direct seed sandalwood in 2nd year:Knock down herbicide Seeds: 1.6 kg per ha **Total materials**	$20 per ha $20 per ha $250 per ha $50 per ha $10 per ha $80 per ha **$430 per ha**	Not applicable

Copy of Appendix in "Queerfellows Creek Catchment Action Plan" Bulletin 4442, Agwest, December 2000

Appendix D:

Farm Forestry options for the Queerfellows Creek Catchment

Prepared by: Dan Huxtable (Farm Forestry Unit) CALM Guildford
Michael Power (Farm Forestry Unit)CALM Albany

Revegetation and Farm Forestry

Revegetation is the general term used to describe the establishment of trees and shrubs on cleared farmland. It encompasses a wide range of practices including: saltland revegetation, shelterbelts using endemic species, wildlife corridors, wetland and riparian buffer strips, fodder shrubs and farm forestry. In farm forestry the primary objective is to integrate trees into existing farming systems to obtain multiple benefits including commercial return. Farm forestry differs from other forms of revegetation in that wood products are harvested from the trees.

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Carefully designed and implemented farm forestry can complement current farming systems and produce multiple benefits including the following.

1. Land conservation benefits

The integration of trees across the farming landscape can help to control large-scale degradation processes such as salinity, wind erosion, water erosion and nutrient run-off.

2. Increase agricultural production

Shelterbelts protect farming systems from extremes in climate and create a better microclimate in which to grow crops, pasture and livestock.

3. Diversify farm income

Tree crops can provide commercial return and diversify the farm enterprise. The various tree crops have specific land capability and rainfall requirements and must be matched to suit the particular site.

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The land conservation benefits of revegetation lead to the conservation and rehabilitation of wildlife habitat. Conservation values of farm forestry can be enhanced by planting buffer zones around remnant vegetation, creating linkages between remnant vegetation and planting species which naturally occur in the area. Commercial tree crops can be complemented by native understorey species.

5. Flexibility

Well designed, integrated farm forestry systems such as alley farming (which allow alleys for conventional agriculture) maintain the flexibility to change agricultural pursuits in the future. For example, crops or pasture can be grown in the alleys depending on the requirements of the individual farmer.

Steps in preparing a revegetation plan

- Identify revegetation options which 1) meet the farmers needs/aspirations and 2) suit the land capability and farming system.
- Consider establishing belts on the contour for water control, belts orientated at right angles to damaging winds for wind erosion control, and belts orientated in a north – south direction on flat land.
- Allow for access and movement of livestock and machinery. Alley widths in between tree belts should be in multiples of the widest piece of farm equipment e.g. the boom spray.
- Seek to link all revegetated areas to minimize gaps in shelter and to avoid creating wind tunnels.
- Schedule the implementation of a farm forestry plan to fit into the farm budget and the availability of time. For example, where fast grown eucalypts are being established for sawlogs then an area of no more than 3-5 hectares per year (for the individual farmer) is recommended because management practices such as pruning and thinning will take time in the future.
- Revegetation and farm forestry should be considered like cropping. It must be done right or the results will be disappointing. Good design, appropriate species selection, excellent site preparation, control of vermin, weeds and insects, and thorough management are all essential.

Farm forestry options (see Table 1)

Eucalypts for high-grade sawlogs

A range of tree species have the potential to produce high grade sawlogs in the Queerfellows Creek Catchment. These include: *Eucalyptus accedens* (Powder Bark Wandoo), *E. astringens* (Brown Mallet), *E. botryoides* (Southern Mahogany), *E. cladocalyx* (Sugar Gum), *Corymbia maculata* (Spotted Gum), *E.loxophleba* subsp. *loxophleba* (York Gum), *E. occidentalis* (Flat Topped Yate), and *E. tricarpa* (Three Fruited Red Ironbark). Different species are suited to different site types (see Table 1).

Trees can be planted in blocks or belts. Belts of trees, 4 to 10 rows wide, should be established at spacings of 100 to 150 metres between belts. Individual species should be planted in separate belts/blocks or separate sections of a belt. This is because the faster growing species will dominate the slower growing ones, and at harvesting the different species must be segregated.

The trees should initially be planted at 1000 trees per hectare (4 meters between rows and 2 ½ meters between trees). The taller, straighter trees should then be selected at age 3 to 6 years and pruned. The poorer trees should be culled leaving only 100-200 trees per hectare standing to grow onto sawlog size (age 25-40 years depending on species). Plant only seedlings grown from selected provenances (seed source) to ensure the trees will grow straight and produce quality sawlogs. Consult your nursery for further information.

The Tree Notes series provides further details on how to grow and manage trees for high-grade sawlogs – available from your local CALM or AGWEST office.

Eucalypts for posts, poles and firewood

Species such as Powder Bark Wandoo and Red Ironbark can produce highly durable heartwood (heartwood that is naturally resistant to insect and fungal attack), suitable for fence posts and poles. Use a similar layout to that described above for 'Eucalypts for high-grade sawlogs' i.e. belts 10 rows wide, spaced at 100 to 150 metres apart.

For most species, firewood is a potentially salable by-product of thinning and harvesting. In the eastern states, some trees with good coppicing ability (the ability to re-sprout from a stump) are grown specifically to supply firewood markets.

Maritime Pine Sharefarming Scheme

Maritime Pine or *Pinus pinaster* is being grown in the region by CALM's Maritime Pine Sharefarming Scheme. Maritime Pine is an excellent landcare tree and will also produce quality timber. It is suited to well drained sites on a range of soil types including deep sands. EM38 salinity readings should be less than 60mS/m.

Under a sharefarming agreement CALM looks after tree establishment and management, while the farmer provides the land and fences off the trees from livestock. In 2000, farmers were offered an up front cash incentive for a total planting area (can be multiple sites) of over 50ha. This incentive will also be available in 2001. Maritime Pine can either be established in block plantations or belts which are at least 10 rows wide (30 metres). Purchase a Maritime Pine Information Kit from Agriculture Western Australia ($15 approx). Contact CALM Katanning on 9821 7022 for more details.

Oil Mallees

The Oil Mallee Association (OMA) is developing an innovative industry throughout the wheatbelt where oil mallees are grown on farms for land conservation benefits and to produce eucalyptus oil, charcoal, and biomass for energy production. In the year 2000, a pilot biomass plant at Narrogin to process material from tree harvesting is being keenly discussed.

A range of species are grown which are suitable for a variety of soil types and conditions. The oil mallees are generally not palatable to sheep and lend themselves to alley style layouts with no fencing. Purchase a Eucalyptus Oil Mallee Information Kit from Agriculture Western Australia ($15 approx). Contact the Oil Mallee Association (OMA) in Perth on 9478 0330 for more details.

Sandalwood

Sandalwood is a long term, high value tree crop used in South East Asia for incense sticks. The sandalwood plant is parasitic and requires host plants, which are normally established 1-2 years prior to the sandalwood. The most suitable host species is *Acacia accuminata* (Jam Wattle); others include *Allocasuarina huegliana* (Rock Sheoak), *Acacia saligna* (Golden Wreath Wattle), *Acacia pulchella* (Prickly Moses) and other deep-rooted nitrogen fixing perennials. To ensure that the sandalwood remains vigorous throughout the 18-25 year rotation, 2-4 host plants per sandalwood are recommended. Purchase a Sandalwood Information Kit from Agriculture Western Australia ($15 approx).

Important Issues to Consider

Site capability

The key factors which determine what species are suitable for any given site within the catchment are:

1. Landscape position or land form element;
2. Land management unit; and
3. Hazards to farm forestry such as salinity or shallow bedrock.

Table 2 outlines farm forestry recommendations for the major land management units within the catchment. The recommendations are based on the three factors listed above. Firstly, the land form element is critical because it determines the depth to bedrock and the underlying hydrology. For example, ridge tops exhibit shallow bedrock (within 3 to 5m of the surface) with no permanent aquifer. Suitable farm forestry species for ridge tops must therefore tolerate shallow soils and drought. The second factor is the land management unit which describes the surface soil. Characteristics such as non-wetting sand and shallow clay will affect species selection and site preparation. Thirdly, hazards such as shallow bedrock, salinity and waterlogging will determine what species, layout and site preparations are appropriate.

Vermin

Rabbits destroy young trees and there is little point in establishing trees and shrubs until an area is rabbit free. A lead time of 18 months is required to effectively control rabbits. Baiting over summer and autumn, warren destruction and bait stations are all necessary.

Parrot damage causes deformed and multiple stem trunks. It can render tree crops worthless. When growing tree crops for sawlog, posts and poles, and pulpwood it is essential that parrot damage be controlled. Consult Treenote nos. 26 & 29 for additional information, available from your local CALM or AgWA office.

Establishment & Management

Good site selection, site preparation, weed control and pest control are essential when establishing tree crops. Table 3 provides some indicative costs for tree establishment.
Tree crops require regular management inputs such as vermin and insect control, firebreaks, pruning, thinning and fertilizing. These operations take time and resources and must be done on time. If the necessary management inputs cannot be achieved then the grower is well advised to grow the trees purely for land conservation benefits and forgo commercial harvests.

Further Information:

If you are contemplating a farm forestry venture, it is recommended that you seek additional information from the various agencies/organisations cited in this appendix. For further background information on planning, site selection and species selection, contact:

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Revegetation Development Officer
Department of Conservation and Land Management
Lot 1, 260 Kalamunda Rd
South Guildford 6055
Telephone: (08) 9279 4088
Fax: (08) 9279 5481
Email: danielhu@calm.wa.gov.au

Michael Power
Farm Forestry Adviser
Department of Conservation and Land Management
C/- Agriculture Western Australia
444 Albany Hwy ALBANY WA 6330
Telephone: (08) 9892 8418
Fax: (08) 9841 2707
Email: mpower@agric.wa.gov.au

Recommended sources of farm forestry information

Design principles for farm forestry published by Rural Industries Research and Development Corporation 1997, Canberra.

REX'96 (Revegetation Expert System CDROM) published by PCWARE Australia Pty. Ltd. 1996, Sydney.

Trees in agriculture Internet Web Site, address: http://agweb/progserv/natural/trees

The Farmers Log, Rowan Reid and Peter Stephen, RIRDC Publication 99/81, 1999. Contact Australian Master TreeGrower Program on 03 9344 5011 to purchase a copy.

Table 1: List of tree species suitable for farm forestry in the Queerfellows Creek Catchment.

Name, common name	Tolerances			Uses				Notes
	Salt	W/log	Drought	Timber	Posts and poles	Fire-wood	Other	
Corymbia maculata, Spotted Gum				✓		✓	Treated posts	Frost tender when young. Potential to become a weed and invade bushland. Susceptible to insect attack. Huntley provenance has superior form and growth (CALM Seed Centre). Occurs naturally in higher rainfall areas. Careful site selection important to reduce drought stress risk.
Eucalyptus accedens, Powder Bark Wandoo			✓	✓	✓	✓		Frost tender when young. *E.accedens* has straighter form than *E.wandoo* (Wandoo). Relatively slow growing.
E.atringens, Brown mallet	1		✓	✓		✓	Treated posts	Relatively slow growing.
E.botryoides, *Southern Mahogany*		✓		✓				Frost tender when young
E.cladocalyx, Sugar Gum			✓	✓		✓ ©		Frost tender when young
E.loxophleba subspecies *loxophleba*, York Gum	1	✓	✓	✓				Relatively slow growing.
E.occidentalis, Flat Top Yate	2	✓	✓			✓		Grass Patch provenance has superior form and growth (CALM Seed Centre)
E.tricarpa, Three-fruited Red Ironbark				✓	✓	✓ ©		Formerly named *E.sideroxylon* subspecies *tricarpa*, it has straighter form than the more common Red Ironbark, *E.sideroxylon* subspecies *sideroxylon*
Oil mallees – several species	1	✓	✓				Eucalyptus oil, biomass for energy production, and charcoal	A range of species is available, most native to WA, which are suited to a range of soil types and conditions. Contact the Oil Mallee Association in Perth by phone: 9478 0330
Pinus pinaster, Maritime Pine				✓			Treated posts and poles, chipwood	Contact CALM Sharefarms in Katanning by phone: 9821 7022.
Santalum spicatum, Sandalwood							Scented wood and essential oil	Sandalwood is parasitic and requires a host. The most suitable host species is *Acacia acuminata* (Jam Wattle); others include *Allocasuarina huegliana* (Rock Sheoak), *Acacia saligna* (Golden Wreath Wattle) and *Acacia pulchella* (Prickly Moses). Purchase a Sandalwood Information Kit from AGWEST.

Key to Table 1:

Suitable for this purpose: ✓
Waterlogging: W/log
Coppicing species (regrows from cut stump): ©
Salt tolerance: 1: moderate 2:very

Table 2: Farm forestry recommendations for major land management units in the Queerfellows Creek Catchment.

Land management unit	Hazards to farm forestry	Layout	Species
Gravelly ridges and slopes	• Shallow bedrock • Shallow cemented laterite layer restricting rooting depth. Deep ripping with bulldozer if practical • Tight subsoil clay. Tendency for roots not to penetrate clay, therefore deep ripping into clay horizon is essential	• Small blocks or belts of trees • distance between belts should be no more than 150 metres • contact the Oil Mallee Association	*E.accedens, E.astringens, E.cladocalyx, E.tricarpa* Oil mallees
Moderately drained sandy duplex soils	• Non-wetting sand on the surface may make establishment difficult	• 3-10 row belts of trees • distance between belts should be no more than 150 metres • contact the Oil Mallee Association • 10 row belts of pines • distance between belts should be no more than 150 metres	*C.maculata, E.accedens, E.astringens, E.botryoides* (wetter sites), *E.cladocalyx, E.loxophleba subspecies loxophleba, E.tricarpa, Sandalwood* Oil mallees Maritime Pine
Poorly drained sandy duplex soils	• Non-wetting sand on the surface may make establishment difficult • Waterlogging, particularly in depressions • Tendency for tree roots not to penetrate clay, therefore deep ripping into clay horizon is essential	• 3-10 row belts of trees • Integrate belts with surface drainage • distance between belts should be no more than 150 metres • drain and block plant depressions • contact the Oil Mallee Association	*E.botryoides, E.loxophleba subspecies loxophleba, E.occidentalis* Oil mallees
Red Soils	• Tight subsoil clay. Tendency for roots not to penetrate clay, therefore deep ripping into clay horizon is essential	• 3-10 row belts of trees • distance between belts should be no more than 150 meters • contact the Oil Mallee Association	*E.accedens, E.astringens,, E.cladocalyx, E.loxophleba subspecies loxophleba, E.tricarpa,* Sandalwood Oil mallees

Table 2 (cont): Farm forestry recommendations for major land management units in the Queerfellows Creek Catchments.

Land management unit	Hazards to farm forestry	Layout	Species
Salt affected land	• Waterlogging • Salinity • Tight subsoil clay. Tendency for tree roots not to penetrate clay, therefore deep ripping into clay horizon is essential	• 3-10 row belts of trees • distance between belts: 50 to 100m • contact the Oil Mallee Association	Salt tolerant species: E.loxophleba subspecies loxophleba, E.occidentalis Salt tolerant oil mallee species
Hillside Seeps	• Salinity • Waterlogging	• Small block plantation, or belt.	Salt tolerant species: E.loxophleba subspecies loxophleba, E.occidentalis
Quartz Veins	• Shallow soil profile • Drought stress	• Commercial species not recommended	Establish locally occurring trees and shrubs.
Rock Outcrops	• Shallow soil profile • Drought stress	• Block plantation	Sandalwood, if soil depth >2m.
Mallet Hills	• Drought stress	• Block plantation	*E.astringens*
Deep Sands	• Non-wetting sand on the surface may make establishment difficult	• Block plantation • 3-10 row belts of trees • distance between belts: 50 to 100 meters • contact the Oil Mallee Association	Maritime Pine *E.cladocalyx* Oil mallees
Salt lakes	• Inundation • Salinity	• Establish buffer strips around swamps and along water course banks. • Then further upslope, where the ground is better drained, establish belts of commercial tree species	Establish native wetland tree and shrub species above the high water mark Waterlogging tolerant: *E.botryoides, E.loxophleba subspecies loxophleba, E.occidentalis* Salt tolerant species: *E.loxophleba subspecies loxophleba, E.occidentalis* Oil mallees
Broad valleys (non saline)	• Waterlogging • Tight subsoil clay. Tendency for tree roots not to penetrate clay, therefore deep ripping into clay horizon is essential	• 3-10 row belts of trees • distance between belts: 50 to 100m • contact the Oil Mallee Association	*E.loxophleba subspecies loxophleba, E.occidentalis* Salt tolerant oil mallee species

Table 3: Approximate cost of implementing farm forestry options in the Queerfellows Creek Catchment.

Farm forestry option	Contractor rate (per ha of trees, not including fencing)	Farmer rate (per ha of trees, not including fencing)		CALM Sharefarming
		Item	Cost	
• Eucalypts for high-grade sawlog • Eucalypts for posts, poles and firewood.	$900-1,000 per hectare of trees (includes site preparation, planting & fertilizing) Additional costs (materials only): Rabbit control: $20 per ha Insect control: $50 per ha	Rabbit control: baits Seedlings: 1000 per ha Weed control: chemical Insect control: chemical & baits **Total materials**	$20 per ha 30c each or $300 per ha (>10,000 seedlings) $40 per ha $50 per ha **$350 per ha**	Not applicable
• Maritime Pine	No local contractor offering this service at present	Rabbit control: baits Seedlings: 1515 per ha Weed control: chemical Insect control: chemical & baits **Total materials**	$20 per ha 25.2 cents each (>10,000 seedlings) $382 per ha $30 per ha $50 per ha **$480 per ha**	• Provide minimum of 20 ha per year • Provide fence if required
• Oil mallees	No local contractor offering this service at present	Rabbit control: baits Seedlings: 1333 per km of 2-row hedge. Assume 1333 per ha (10m alleys between hedges) Weed control: chemical Insect control: chemical & baits **Total materials**	$20 per ha 33 cents each or $440 per km of 2 row hedge or $440 per ha $40 per ha $50 per ha **$550 per ha**	Not applicable
• Sandalwood	Direct seeding hosts and sandalwood in two separate operations: $600 per ha in total Additional costs (materials only): Rabbit control: $20 per ha Weed control: $30 per ha Insect control: $50 per ha	Rabbit control: baits Direct seeding hosts: • Knock down herbicide • Seed: 1 kg per ha Insect control: chemical & baits Direct seed sandalwood in 2nd year: • Knock down herbicide • Seeds: 1.6 kg per ha **Total materials**	$20 per ha $20 per ha $250 per ha $50 per ha $10 per ha $80 per ha **$430 per ha**	Contact CALM Sharefarms in Katanning on 9821 7022.

Koojan West Rd/Bindoon-Moora Rd Arboretum
Landowner: David McGilvray

Background:

David McGilvray entered into a sharefarming agreement with CALM Sharefarms in 2000, which resulted in the establishment of 70.9 ha of *Pinus pinaster* on his property. As a part of the sharefarm package, David was also eligible to receive assistance for the establishment of supplementary species on other parts of the farm.

David was keen to trial species which may have a commercial potential in the future. In conjunction with Maritime Pine Project staff, an arboretum was designed to meet this aspiration.

The Site:

The chosen site has been partitioned from the rest of the paddock by an erosion gully and is susceptible to waterlogging. The soil is a red/brown clay loam, which is typically associated with Salmon gum (*E. salmonophloia*) in this area.

Surface salt levels were measured with an EM38 on April 13, 2000. Readings ranged from 50mS/m in the South East Corner to 149mS/m in the moister patches, suggesting that some level of salt tolerance may be required by prospective species.

The shape and size of the area was measured using a measuring wheel and compass. This information as used to produce a scale mud map (attached). From this map, the number of rows required, at 4m spacing, was estimated.

Species Selection:

The choice of species for this site was dictated primarily by what species were available from the CALM Manjimup Nursery, as the site was not identified until well after the deadline for placing nursery orders (normally early November of the year prior to planting). No provenance selection was carried out.

The key species planted could potentially be used for a range of timber products such as furniture, paneling and floorboards. York Gum and Fiery Bottlebrush were included for amenity purposes.

See attached list

Establishment Details

Site preparation:
Ripped and mounded by Anspach Agricultural Contracting on 15/5/00, using a twin disc rip/mounder with roller. Rows parallel to Bindoon-Moora Rd at 4m spacing, with 10m firebreak. Cost = $120/ha plus travel costs of $3.80/km.

Spraying:
Pre-planting strip spray by Mark Graves (CALM), using a quad bike on 07/07/00. Application used - Glyphosate 800mL/ha, Simazine 4L/ha, at an output spray rate of 50L/ha.

Monitoring of the site indicated an unacceptable grassy weed burden, consisting mainly of Wild Oats and Annual Rye Grass. Unfavourable weather conditions may have hindered the effectiveness of the glyphosate on small emerged weeds. The site was resprayed with grass selectives by Mark Graves (CALM), using a quad bike on 21/09/00. Application used - *Verdict® 520* 300mL/ha, *Sertin® EC* 300ml/ha, plus penetrant at an output spray rate of 50L/ha.

Planting
The eucalypts were planted by CALM staff on 28/07/00. The Cork Oaks and *Pinus brutia* were planted on 02/08/00.

The main eucalypt blocks were hand planted at 2m along the mounds, using a 50m tape with flagging tape at 2m intervals to maintain accurate spacing. This equates to a stocking density of 1250 stems per hectare (SPH). The salmon gums were planted at 3m spacing, equating to 825 SPH.

The sandalwood hosts (Jam/Manna Wattle) were planted alternately at 3m spacing. If these host species grow adequately, the sandalwoods will be planted as seeds in Autumn 2001.

The Cork Oak and Brutia Pine were planted at 2m and 1m spacing respectively along the mounds.

List of species included in the arboretum:

Species	Common Name	Seedlot Number	Seedlot Location
Acacia acuminata	Jam Wattle	N98188	Murchison River
Acacia microbotrya	Manna Wattle	D886	Narrogin
Callistemon pheoniceus	Fiery Bottlebrush	D236	Darkin Swamp
Eucalyptus accedens	Powderbark Wandoo	D623	Dryandra State Forest
E. citriodora	Lemon Scented Gum	95121	Mundaring
E. cladocalyx	Sugar Gum	C14697	Esperance
E. maculata	Spotted Gum	C13597	Mundaring
E. longicornis	Red Morrel	94255 or N98126?	Harrismith or Tincurrin
E. loxophleba	York Gum	PW95	?
E. occidentalis	Flat Topped Yate	98100	North of Grass Patch
E. salmonophloia	Salmon Gum	N98050	Forrestoniana
Pinus brutia	Brutia Pine	C99180	Rottnest Island
Quercus suber	Cork Oak	BCC81	? – Portugal/Spain.

Nature Conservation and Farm Forestry

The primary objective of farm forestry is to produce a salable product. This is often coupled with benefits to adjacent agricultural enterprises, ultimately increasing overall farm productivity.

However, farm forestry can also contribute to the conservation of native flora and fauna. This is particularly the case if improved nature conservation is incorporated as a stated goal during project planning.

Adoption of the following measures would greatly add to the overall nature conservation value of commercial revegetation projects:

Protection of remnant native vegetation, by...

- Planting "buffer" zones around patches of remnant bushland, affording protection against undesirable "edge effects" such as weed invasion or pesticide drift.
- Increasing the effective size of remnants with commercial plantings.
- Planting on high water recharge sites, which can help to counteract the impact of rising water-tables on remnant vegetation downslope.

Complementing natural ecosystems, by...

- Creating linkages between isolated remnants, or widening existing linkages such as roadside reserves.
- Providing variety in vegetation age, structure and "patchiness" across the landscape.
- Improving water quality in rivers, wetlands and estuaries through the interception of silt and nutrients by trees.

Planting areas of non-commercial species, for example...

- Along rivers and around wetlands.
- On slopes or soil types unsuitable for commercial species.
- To provide habitat for threatened or vulnerable wildlife.
- To improve aesthetic appeal.

Nature friendly management practices, such as...

- Establishing plantations over several years, to create a range of tree age classes.
- Staggering harvesting over several years, such that sections of plantations are left untouched until new areas have been established.
- Careful choice and use of pesticides and harvesting methods, to minimise effects on non-target species.

Clearly, farm forestry has an important role to play in the development of more sustainable land use systems that are compatible with nature conservation and biodiversity protection. For more information, contact Dan Huxtable (CALM Farm Forestry Unit) on (08) 9279 4088 or e-mail: danielhu@calm.wa.gov.au