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PRIVATE FORESTRY SOUTHERN QUEENSLAND

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CARING FOR OUR COUNTRY

PRIVATE FORESTRY SERVICE QUEENSLAND

Productive Natural Resource Management

Farm Forestry Manual

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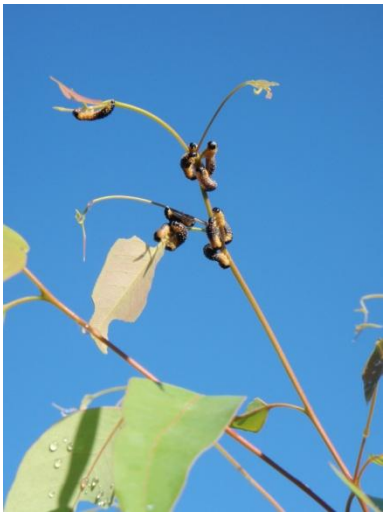

ENQUIRIES

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PFSQ Plantation and Farm Forestry Services

Planning and management

- Business management plans
- Applications for an exercise in Commissioner's discretion
- Property and vegetation management plans
- Property mapping using GIS
- Operational planning and contractor management
- Plantation assessment, valuations and carbon accounting

Design and establishment

- Plantation design and mark-out
- Weed management and slashing
- Infrastructure construction (dams, access tracks, fencing, etc.)
- Site preparation
- Coordination and procurement of high-quality planting stock
- Planting and watering in with 'Aqua Spears'

Long-term maintenance

- Weed control and slashing
- Form and lift pruning
- Pre-commercial and commercial thinning

Integrated project management

- Planning, design, implementation and management of large projects including the integration of
    - timber production, revegetation and native forest management;
    - infrastructure development;
    - carbon and offset management; and
    - the implementation of training and employment programs

THE BASICS

Chapter 1

WHAT IS PLANTED FORESTRY?

Plantations

Plantation timber production is the cultivation and long-term management of trees on agricultural land. Plantations are generally even-aged, planted and managed in rows, consist of a single species (sometimes two or three) and cover a large enough area to provide a suitable return on investment. Many different timber and non-timber products can be grown in a plantation. The type of product that you decide to grow and the characteristics of your site will determine the species, management regime and rotation length of your plantation. As such, it is important to research timber markets and to have an in-depth understanding of your property and climate before you establish your plantation.

Farm Forestry

Farm Forestry is an integrated form of plantation timber production. Forestry on farms is most often only a secondary production enterprise alongside grazing, horticulture or some form of off-farm income. This is where farm forestry distinguishes itself from broad-scale plantation timber production. Forestry on farms is a relatively low-maintenance, productive alternative land-use to provide a long-term supplement to farm income. It generally benefits the overall environmental stability of the property while fitting in with the primary production enterprise or with the lifestyle objectives of the farm.

"A forest is not simply an accumulation of trees, but is itself a society, a community of trees that mutually influence each other, thus giving rise to a whole series of new phenomena that are not the properties of trees alone."

GREGORY FEDOROVICH MOROZOV 1913

LANDSCAPE MANAGEMENT

The rural and peri-urban landscapes encompass a broad mix of social, agricultural, environmental and economic systems. In successful landscape management, each of these components is integrated to complement each other and achieve the best outcome for the sustainability of the whole.

Farm Forestry is a design tool for successful landscape management; planted forests can be designed to link and buffer different land-uses, turn marginal land into productive land, and to stabilise the overall landscape. The result is a system of land management that enhances natural amenity and environmental assets, whilst growing productive primary resources and sustainable communities.

Forest functions

Trees perform multiple functions in the natural landscape. They are a dynamic and resilient land cover. The benefits of forest cover are experienced across the entire catchment with improved water quality, landscape stability, forest connectivity, and the social benefits of increasing the productive potential of marginal rural lands. Similarly, your reforestation can be designed to perform multiple functions on your property.

Some of the many functions of a farm forest include:

- Timber production
- Habitat, shelter and feed trees for wildlife
- Landscape stabilisation
- Shade and shelter for livestock
- Windbreaks
- Increased capital value of lands
- Soil protection and production
- Aesthetic improvements
- Water table and salinity reduction
- A long-term, low management-input land use
- Conservation outcomes such as buffering native forest and wildlife corridors
- Long-term economic and environmental security

The key to successful landscape management is the simple process of property management planning linked with strong community uptake, supported by community organisations.

PROPERTY MANAGEMENT PLANNING

Chapter 2

A farm forestry planting may place an emphasis on a single outcome such as timber production or wind protection or it may seek to balance a range of benefits in a multipurpose planting. Finding the right balance of productivity, environmental and aesthetic outcomes can easily be achieved with the simple process of property planning.

The planning stage is a chance for you to turn all of your goals and lifestyle objectives into a practical operational plan. It means assessing your resources (natural, human and fiscal), identifying your limitations and your potential and then planning your land management so as to turn competing values and constraints into complementary processes and outcomes.

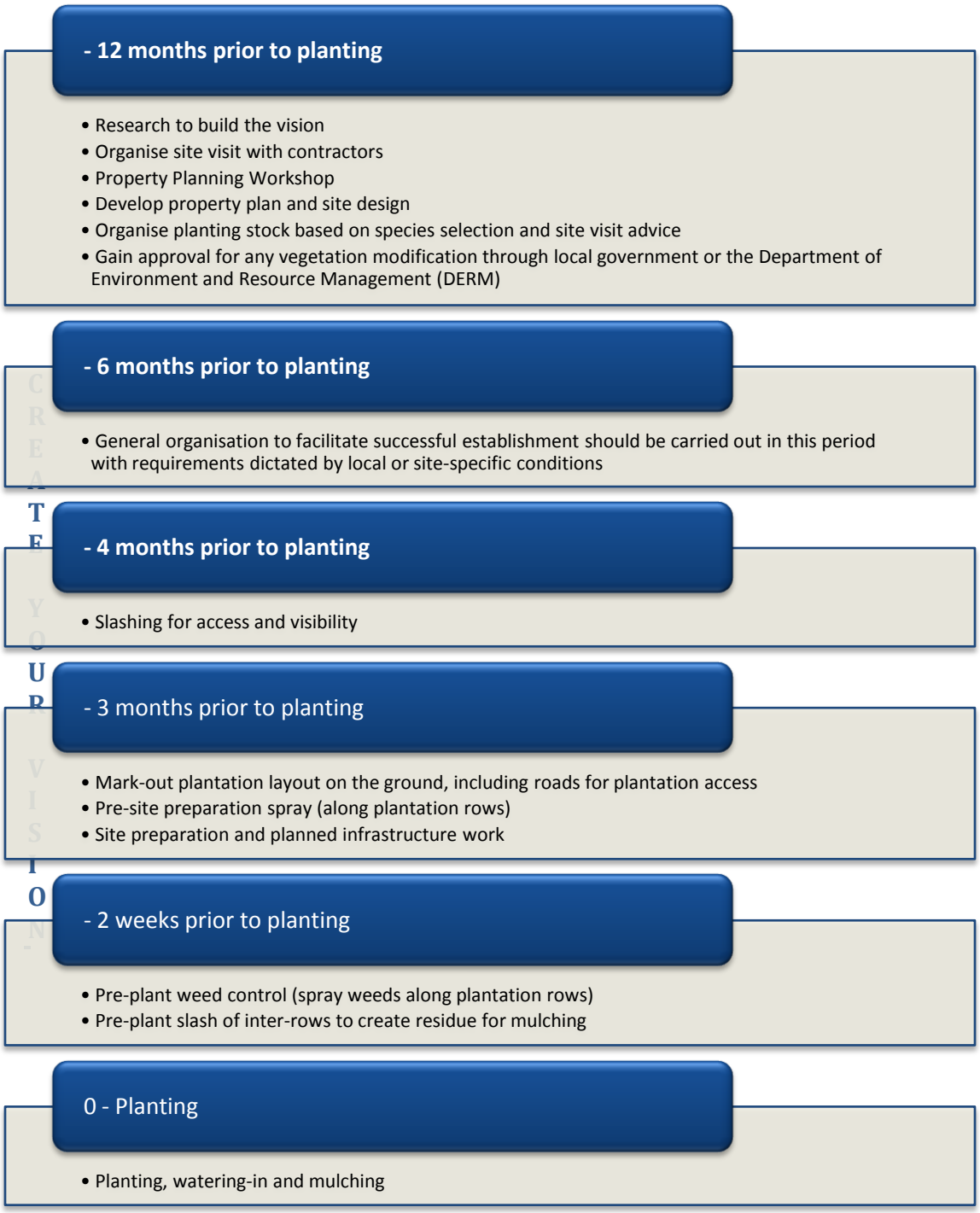
The property planning process

1. Basic understanding
2. Create your vision
3. Research and training
4. Design

BASIC UNDERSTANDING

In order to properly plan and design your farm forest, you need a basic understanding of the processes involved in the establishment phase. Below, is an establishment timeline, starting 6 months prior to planting and finishing 12 months after planting (planting is represented by zero). Variations to the timing, frequency and order of these operations may occur depending on local soil conditions and climate.

Plantation establishment timeline



1 - 2 weeks post planting

- Re-water if major wilting or dieback occurs (more than 10% of plantation)

1 month

- Survival counts and replant if stocking has dropped significantly (e.g. more than 10 % morbidity)
- Also check for herbivore damage and take action if necessary (e.g. patch replant and grazing pest control measures)

2 months

- Inter-row slashing
- Post-plant weed control

4 months

- Form and access prune

6 months

- Inter-row slash

6.5 months

9 months

- Inter-row slash

9.5 months

- 3rd post-plant spray

11 months to 1 year

- Form and first lift prune

CREATE YOUR VISION

Whether you are planting trees exclusively for timber production, environmental outcomes or simply to improve your view, the end goal is successful forest establishment. The same criterion for success applies to all types of forest plantings:

1. Healthy trees,
2. Canopy cover,
3. Structural integrity, and
4. A functional ecosystem.

Therefore, for all farm foresters, successful forest establishment requires:

1. Matching species to soil, climate and desired product range
2. Good design;
3. Timely establishment processes;
4. Consistent maintenance; and
5. Commitment to the project.

Example: Unsuccessful forest establishment

Cause: Poor species selection, design and site preparation.

Example: Successful forest establishment

Cause: Good planning and design; consistent and timely maintenance.

Cause: Consistent and timely maintenance; appropriate species selection; good planning and design.

Assess your human resources

Assess your human resources and ask yourself:

- How will planting or managing trees help to achieve my aims for my property?
- What are the minimum inputs required for successful establishment?
- How much time do I have to devote to the establishment and management of my trees?
- What scale can I efficiently operate at within my constraints?
- Is there labour available to assist me?
- Is contract labour available in the area and what is the quality?
- Do I have the skills and knowledge to grow and manage trees effectively or do I need to acquire more?
- What skills and knowledge do I need to acquire?
- In what areas do I need more information?

Assess your financial resources

Assess your financial resources and ask yourself:

- What are the costs involved in growing and managing trees?
- Do I have sufficient finances available for a long term commitment?
- What cost effective infrastructure improvements can I make that will enhance my success?
- If interested in trees as a business, what are the expected returns?
- What are the taxation implications?
- What financial assistance is available?
- In what areas do I need more information?

Assess your physical resources.

Start with the basics and build from there:

- Property location (shire and region)
- Size of your property (Hectares)
- Average annual rainfall (Bureau of Meteorology)
- What is the soil type, its pH, drainage and nutrient status
- It is also important to check if there are any council zonings or regulations that may affect your development.

HINT: Try the Department of Environment and Resource Management (DERM) website (www.derm.qld.gov.au) where you can access a map of your property with the Regional Ecosystem boundaries overlaid.

RESEARCH AND TRAINING

Education

Create the vision inside your head by actually viewing past forest establishment projects, both successes and failures.

Attend farm forestry field days, workshops and bus trips in your region. This is a particularly good way to meet other people who have been through a similar process. Talk to other landholders about their farm forestry projects; about

constraints and opportunities, about the amount of time that they put into establishment and maintenance, and about the performance of particular plant species. In particular, ask them what they would have done differently in hindsight. Experience is the best kind of knowledge.
Private Forestry Southern Queensland offers adult education, information and demonstration with real landholders and their forests through workshops, field days, festivals, bus trips, networking, displays and demonstration sites.

Private Forestry Service Queensland offer adult education, information and demonstration with real landholders and their forests through workshops, field days, bus trips, networking, displays and demonstration sites. Join the PFSQ mailing list to receive information about upcoming events and publications.

Information

Search the internet for information and examples.

There are a plenty of websites containing a broad range of farm forestry information. Below are a few websites to start with. Remember that information about species and silviculture can be specific to particular regions. Southern Queensland has high rainfall in the summer months when trees and weeds are growing quickly, thus weed control operations and form pruning may have to be carried out more frequently.

Department of Agriculture, Fisheries and Forestry:
www.daff.gov.au/forestry/plantation-farm-forestry

Farm Forest Line (free information service managed by Australian Forest Growers, Melbourne University and Energy Strategies): www.farmforestline.com.au

Cooperative Research Centre -Farm Forestry: www.forestry.crc.org.au/farmfor.htm

Rural Industries Research and Development Corporation – Joint Venture Agroforestry Program: www.rirdc.gov.au/programs/national-rural-issues/agroforestry-and-farm-forestry4

Australian Forest Growers: www.afg.asn.au

Private Forestry Service Queensland: www.pfsq.net

The Australian Tax Office: www.ato.gov.au

Talk to a Forestry savvy accountant.

DESIGN

Nature is unpredictable and dynamic, thus your design must be flexible and always specific to your set of resources; physical (land, climate, and water), human (ability, time, family) and financial (budget).

Step 1.

Take your time to walk over your land; walk up and down each hill and through all of the gullies. Observe your land in different conditions. Watch where the water flows after a large rainfall event and where the water levels come to in a flood? Observe what species grow where, both native and weed species, and which species have survived recent drought conditions? Talk to old or original landholders and neighbours about past land uses and the stature of the original forest cover.

Some important indicators of site quality are the:

1. Height of existing forest cover
2. Type of species that occur naturally on the site
3. Depth of topsoil

While traversing your land, attempt to break your property up into general land types, e.g. alluvial river flats, mid-slope shale. Dig some soil pits in these areas and discover the depth of your topsoil and the structure of your sub-soils.

Step 2

To assist your initial assessment it is a good idea to obtain an aerial photograph of the property (for small properties a cadastral map may be more suitable). These may be obtained from the Department of Environment and Resource

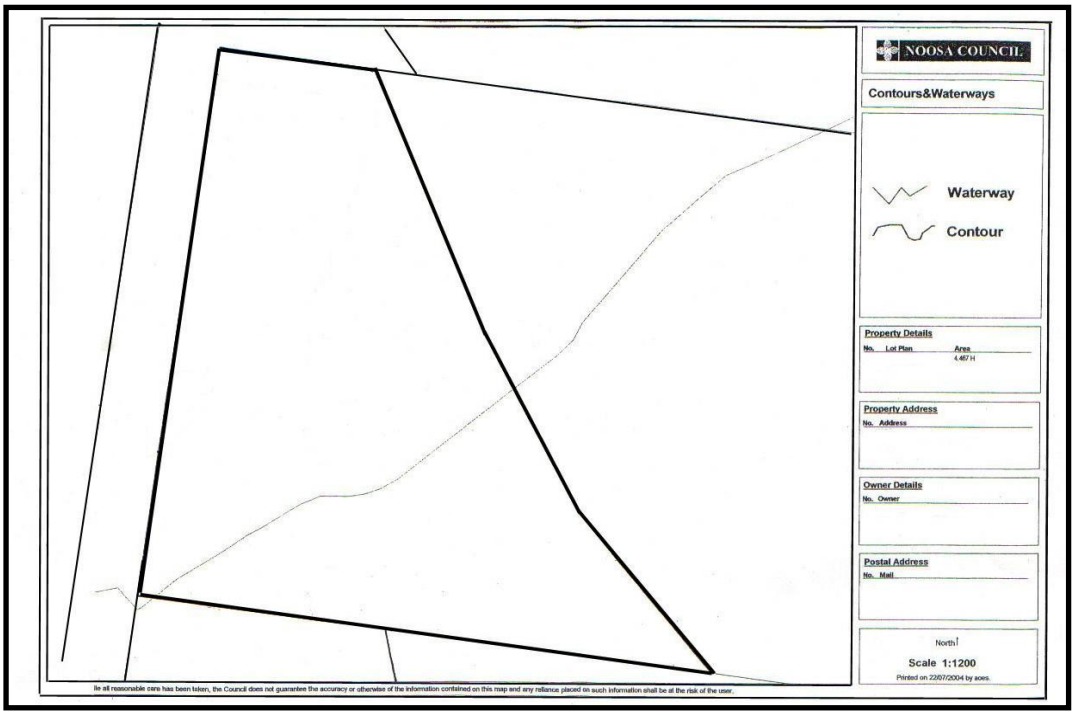
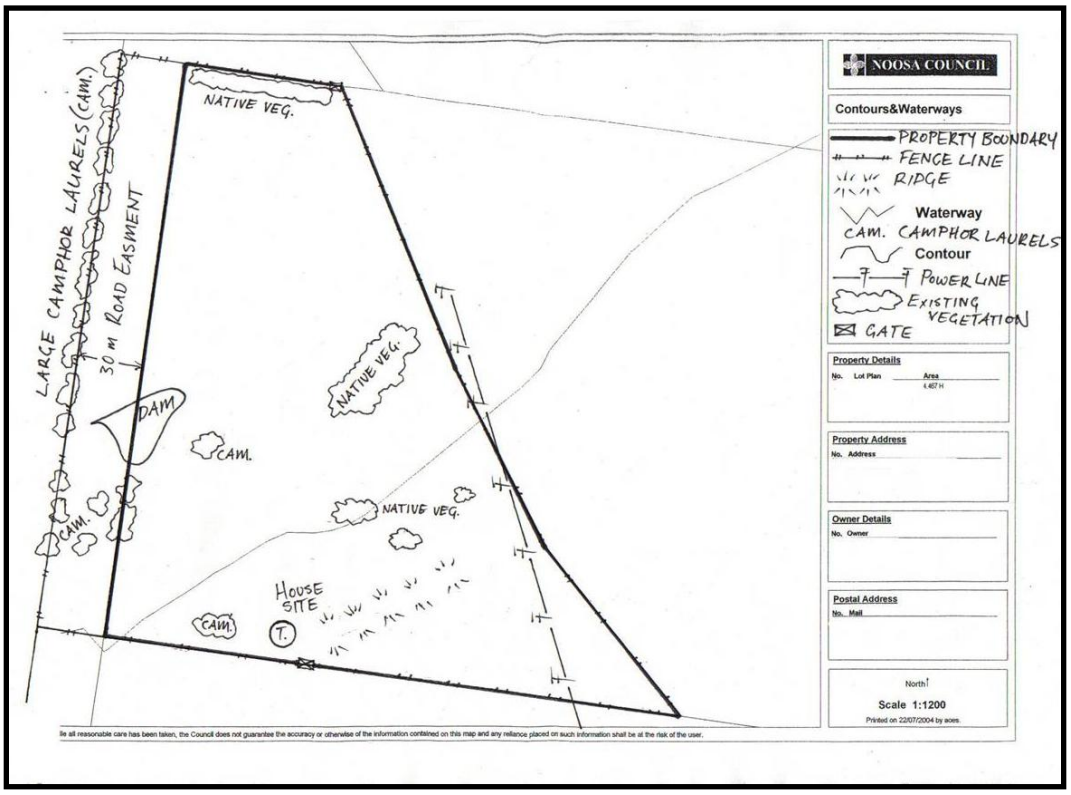


Figure 1 - Example of a cadastre map obtained from the former Noosa Shire Council as part of a Vegetation Management Kit.

Management or your local council may provide them along with a vegetation management kit. Many local councils have mapping facilities on their websites.

On a copy of your map (or a clear plastic overlay) mark in the fixed features of your property. These will include: your house site, out-buildings, sheds, roads, driveway, power lines, fence lines, creeks, gullies, dams, ridges, hills and large patches of remnant vegetation.

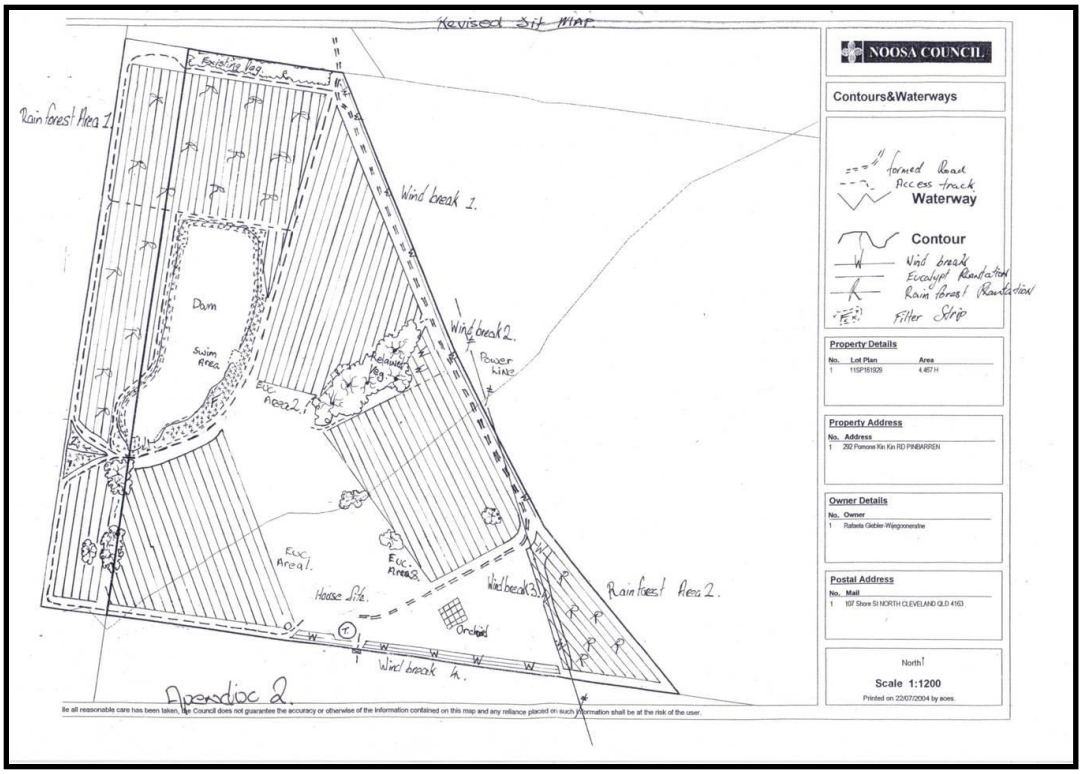


HINT: If you have limited experience in mapping, obtain the 'Guide to Property Mapping' one of the fact sheets available from the DERM website listed above.

Step 3

Draw in your plantation areas.
An effective property plan takes all the information discovered during the concept stages and turns competing values and constraints into complementary processes and outcomes. Your initial plans should be rough and conceptual progressing towards a formal and practical design.

For example: draw a mud map, walk the block, follow through the processes of the various land uses proposed, assessing how they work with each other, how they will work over time, the lay of the land and the infrastructure that exists or may be required.



As the plan takes shape, quantify areas of land use (e.g. plantation), the cost of infrastructure (e.g. road length), and take note of possible implications towards productivity. Quantifying area can be carried out utilizing dot grids as described in the 'Guide to Property Mapping' or by using the track log on a GPS.

The following chapter provides valuable information for the design process.

DESIGN CONSIDERATIONS

Chapter 3

The following aspects should be carefully considered as you design your reforestation project.

INFRASTRUCTURE

Your reforestation project is going to be a **long-term commitment** of resources, mainly your time and effort, but also a significant financial contribution towards maintenance and further development. The efficiency of your establishment and maintenance operations can be optimized by investing in worthwhile infrastructure development right from the beginning. This means:

- access to the site and around it;
- workable row-directions and row-spacing for establishment processes and maintenance;
- fire breaks;
- fencing for future cattle grazing management and conservation of sensitive areas; and
- accessible water points.

HINT: Design and construct your long-term infrastructure at the outset of operations so that your engineering works can perform multiple functions and can all be achieved with a minimal number of contractors and machinery.

For example, one excavator can be used for site preparation, road building, weed removal, dam building, house site preparation and erosion mitigation. Consider the sequence of operations so that each stage of the project flows to the next stage efficiently. Be patient with getting the right combination of contractors; people with the experience and reputation for quality in the forestry industry.

When disturbing any soil for infrastructure development it is imperative that appropriate drainage is constructed to facilitate water flow that minimises erosion and stabilises the earthworks. Spreading grass seed over any disturbed soil will speed up the stabilisation process.

Infrastructure for site access

Initial site access to prepare the site for reforestation.

Some points that you may need to consider:

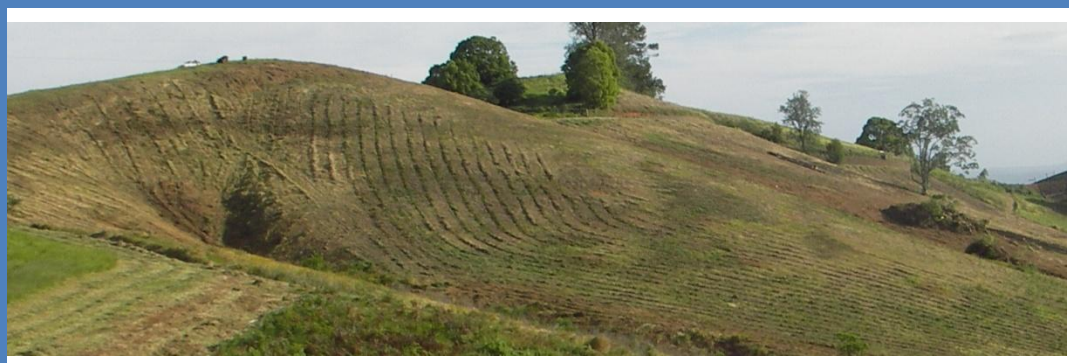
1. Is the site clear enough to assess the land effectively and mark out the design?
   → You may need to do an initial slash so that you and your contractors can see your land properly.
2. Is the site clear enough to begin the preparation processes?
   → You may need to consider removing woody weeds.
3. Is there enough clearance for large machinery to enter your property (gates/driveway/tracks) and access the site?
   → You may need to temporarily remove fences or get permission from neighbours to access the site.

Designed site access for long-term maintenance of the site.

Some points you may need to consider:

1. Is your plantation layout designed for maintenance access?
   → Consider the predominant slope when designing row direction. Will the tractor/excavator/4WD vehicle be able to safely handle the side slope?

HINT: Have your block slashed at the proposed row-direction to check safety and feasibility of maintenance operations.



Remember, efficiency is gained with the longest possible rows but several different row directions may be required across an undulating slope (see row design below) in order to make as much country as slashable as possible.

→ Consider the size of the tractor being used for slashing - you need enough room at the end of rows for the tractor to turn around into the next row. Where the plantation is surrounded by a fence line or adjoining forest, a minimum headland (turnaround area) of seven metres is recommended.

HINT: You may have a small farm tractor that you will use to slash your plantation. Consider designing your plantation for larger machinery in case you decide to hire contractors in the future.

→ Consider the equipment that you will use to maintain weed control in your plantation. If you are maintaining weed control with a hose-based operation you may need to break your plantation up into

management units based on the maximum length of the hose. Plantation areas can be divided with bay roads (vehicle access tracks) as shown to the left.

Fencing and grazing infrastructure

Perimeter fencing should be high quality so as to ensure that the total property is secure from both external and internal breaches.

Crash grazing in an eight year old plantation.

Internal paddock fencing is used to exclude cattle from plantation areas for the first 2-3 years. Grazing by cattle at later stages of plantation development can help to lower maintenance costs (e.g. slashing). Legume infestation of tree crowns can be difficult and costly to control. Cattle seek out the legume, reducing risks of heavy competition and damage to the top leader of the tree. Most eucalypt plantations are suitable for grazing reintroduction by age 2 years after planting and in situations where lower branching has been pruned above grazing and rubbing height.

The grazing should be 'crash grazing' in style to reduce damage to trees (e.g. chewing and rubbing of bark) and to protect the soils from compaction and erosion that comes when vegetation is completely removed by long-term grazing. 'Crash grazing' refers to placing large numbers of cattle into a management cell for short periods of time. Knock it down but don't consume it all!

The placement and standard of your internal fencing should be suitable for the management of grazing animals and, in turn, designed around your forestry management units. For example, plantings over two year periods are surrounded with a high quality fence and internally separated into one year cells with a temporary fence. Electric fencing may be suitable for temporary fencing, however is unreliable and will require monitoring and maintenance, e.g. not suitable for absentee landholders.

The result is a secure property boundary which is internally broken up into forestry cells of two year plantings that are managed for grazing. You should also

consider cattle access from neighbouring properties for further grazing opportunities.

The cells should be designed with a **landscape focus** that incorporates the geographical features of your land into natural management units. For example, avoid fencing mid-slope and, for erosion purposes avoid fences that run directly up and down the hill (cattle will hit the fence line and move up or down causing erosion over time). Instead, fence along ridge lines and natural access ways.

Some things to consider when planning fence placement:

- Safe access for maintenance vehicles
- access for cattle movement, e.g. corridors
- clearance for tractors to turn before coming up against a fence
- fences placed for dual purposes, e.g. exclusion of a riparian zone and delineation of a grazing cell
- fencing along the outside of access tracks so that they can be used as fire breaks and for plantation management.

Water Infrastructure

Water storage on top of hill to gravity-feed plantation and general farm operations.

There are several different levels on which water should be considered on your block in relation to forest management.

For planting of forests
Under present climatic conditions (e.g. no defined wet season giving us saturated soil conditions over several months, Jan, Feb, March), watering-in of plants at planting becomes an imperative to achieve survival. Thus, a good supply of water that is delivered to each planting site in an efficient manner should be designed into the process.

The proposed planting technique will influence how this is achieved. For example, if you plan to plant by hand and water-in by hose, a tank, filled by pumping from a creek, placed at the highest point of the plantation can gravity feed back down the hill with outlets placed at hose-length intervals or at right angles to row direction shall ensure a trouble free and efficient planting process.
If you are using a tractor based or 4x4 planting system, where water will be carried to site, easy access to a water point may be all that is required.

Post planting
Water may be required for re-watering where follow up rain is not forthcoming and plants start to dehydrate. If an efficient system of water delivery has been established, timely re-water can be carried out avoiding costly replanting.

Clean water for herbicide maintenance shall be required for up to three years in eucalypt plantings and possibly 6-8 years for rainforest plantings. This can be streamlined if an efficient delivery system has been established from the outset. Note: **clean** water is required for herbicide application.

Fire protection
Easily available water sources dramatically increase the chances of landholder managing wildfire and control burning operations that protect the forestry investments.

Justifying the investment
Although investment in water infrastructure can be expensive, properly considered materials and placement should pay off in the long run:

- You can save costs in the establishment phase;
- You have water available for grazing and fire fighting; and
- Materials may be relocated to establish 2nd and 3rd stage afforestation projects.

Drainage infrastructure

Long-term stability of roads, access tracks and gulley crossings and house pads is ensured with appropriate design of drainage infrastructure.

Row design infrastructure

Although planting of trees is carried out for many different reasons, the success of all these projects relies on systematic management processes (i.e. site preparation, weed control, planting, replanting, pruning, etc.). Planting trees in rows allows all these processes to be quantified and qualified. Even if random revegetation is the desired outcome, canopy closure and site capture should be the preliminary goal, with thinning and under-plantings at later stages providing the desired final structure.

Row design is determined by the proposed establishment, maintenance and, if relevant, the harvesting systems to be implemented. Broad acre forest establishment will require the use of mechanical processes for management, thus

row direction and design is determined by the safe operating limits and efficiency of the various processes.

Broad guiding principles:

- Steep slopes should be managed perpendicular to main slopes.
- Long, straight rows increase efficiency.
- Maximum row lengths should be designed at between 65-90m.
- Bay roads can be used to break up longer rows or define a change of row-direction.

- Single tree site preparation allows rows to be placed up and down the slope without the risk of erosion.
- Tractors working on slopes over 10° should work directly up and down slopes for occupational health and safety reasons.
- The least amount of row direction changes helps utilize the maximum area of land and increases efficiency of all operations, particularly if outside contracting is to be used.
- Rows should utilize boundary and access breaks as a turn-out area for machinery without creating too much area unmanaged with forestry.
- Where slopes do not constrain row direction, efficient usage of natural landforms and accessibility will determine the best placement of rows, e.g. short rows off access track for riparian revegetation.
- Hose based operations such as watering in at planting and spraying work best up and down the hill with highest point access.
- Harvesting can be carried out most efficiently and with least damage to remaining trees and landscape by working up and down the slopes.
- All rows require access

Handy hints:

Draw a mud map with proposed row placement;

Walk the block, visualizing various operations on proposed layout;

Vary row directions to achieve best outcomes;

Re-do map;

Mark out several rows with pegs at critical points across the landscape and adjust as necessary;

Have block slashed at proposed row direction to check feasibility and safety;

Mark out all rows to ensure a workable design before committing to herbicide mark out.

Designing for connectivity

The layout of your forest can be designed to optimise landscape connectivity. Landscape connectivity is the degree to which the landscape facilitates or impedes movement among resource patches. Connectivity includes both structural connectivity (the physical arrangement of patches) and functional connectivity (the movement of individuals among patches). Landscape connectivity influences gene flow, local adaptation, extinction risk, colonisation probability, and the potential for organisms to move as they cope with climate change.

Timber production benefits from both structural and functional landscape connectivity. Eucalyptus trees are host to a wide variety of insects such as psyllids, scarab beetles, sawfly larvae, scale and various caterpillars that can defoliate canopies and bore into stems. Given the right conditions, insectivorous birds and some mammals will forage through eucalypt forests, keeping the insect populations in-check. Several aspects of the plantation will influence the occurrence of insectivorous birds. These include:

- The size of the plantation,
- The location of the plantation in relation to other vegetation,
- The structure of the plantation (canopy cover), and
- The occurrence of larger, aggressive and territorial birds.

By connecting your plantation with remnant vegetation, you are increasing the likelihood of insectivorous animals colonising your new forest.

SOIL TYPE AND CONDITION

Soil provides the nutrients and water capacity with which to sustain your plantation. The ability of a soil to provide for your trees is determined by its texture, chemical properties and structure that are indicated by the following characteristics:

Is your soil clay, silt, sand or a mixture?
What is the depth of your topsoil?
Does your soil have a tendency to erode?
What is the soil pH?
What is the colour of your soil?
Is your soil compacted?

The answers to these questions should influence your species selection and site preparation. Notice the changes in soil colour and texture below.

SPECIES SELECTION - matching species to site

Accurate species selection is basic to successful tree establishment and growth. Site conditions will determine the most appropriate species to grow. Your species selection should be based on answers to the following questions.

What type of vegetation is growing in the area now?
The most successful species will be those that are endemic to the region. That is, the native trees and shrubs that have adapted to the local climate and specific soil types of the area. Have a good look at patches of remnant native forest around your area. The natural distribution of remnant vegetation is a good way to match species to site; e.g. the ridges around your property may support the more hardy eucalypts such as spotted gums and grey gums. It would therefore be inappropriate species selection if you were to plant rainforest species on your ridges. Similarly it would be inappropriate to plant eucalypts that grow naturally on ridges, down in your wet gullies or areas of poor drainage.

→ Consider the composition of species that are growing naturally and the systems that they emulate when planning your own operations and designing your plantation layout.
→ Have a talk to your neighbors who may have remnant vegetation on their property. Ask them what grows well and whereabouts in the profile it grows.
→ The Department of Natural Resources and Mines 'Fact Sheets', available from their website (www.dnr.qld.gov.au), contain lists of native species and where they are most suited to growing
→ Plant identification services are available from The Queensland Herbarium.

Specific species suitable for plantation timber production in parts of south-east Queensland

Gympie messmate (*Eucalyptus cloeziana*)
Spotted gum (*Corymbia citriodora sub species variegata*)
Grey gum (*Eucalyptus propinqua/longirostrata*)
Grey Ironbark (*Eucalyptus sideraphloia*)
Blackbutt (*Eucalyptus pilularis*)
Red mahogany (*Eucalyptus resinifera*)
Tallowwood (*Eucalyptus microcorys*)
Hoop pine (*Araucaria cunninghamii*)

Research the timber market demands and trends.

The area of native species plantation in Queensland is dominated by a significant, though unimpressive pulp based MIS plantings. The 2009/10 financial year has seen the MIS companies abandoning pulp based plantations in the region due to a variety of poor management decisions. In addition, in 2010 the Queensland State Government sold Forestry Plantations Queensland's Hardwood Program. The failure of MIS plantations in Queensland in conjunction with the timing of the sale of FPQ's Plantation program and the South East Queensland Regional Forest Agreement has resulted in:

- A greater demand for farm forestry extension and silvicultural services from landholders;
- Increased uncertainty in the future of the hardwood plantation resource base;
- Increased reliance on the plantation resource as a result of RFA process;
- Increased community perception that a plantation resource should replace native forest harvesting;
- Lack of product diversification in MIS and state initiated plantation resource.

The Queensland Department of Primary Industries and Fisheries Horticulture and Forestry Science (DPIF&HFS) has conducted an extremely diverse range of research into the establishment and management of hardwood plantations. Research has provided promising data on a range of species relating to growth rates, adaption to a wide range of site characteristics such as rainfall, soil fertility, site drainage, salinity, pH and susceptibility to frost.

What market are you growing the final product for?

Currently in Queensland there is high demand for hardwood sawlogs and poles. There are many sawmills and pole yards such as Dale and Meyers, Parkside Group, Koppers, Enrights, Muckerts, Brisbane Valley Timbers, Gympie Timber Company, Robinsons, Mary Valley Timbers, Proveneer and many others that continually seek hardwood resources.

The major two grades of sawlog that are purchased from native stands are generally graded to the Queensland Government specifications. A compulsory grade sawlog i.e. min 2.4 m x 30 cm sedub is graded in 0.3 m increments and in accordance with a wide range of defect limitations. The average royalty/stumpage paid is \$100/ m^3 and up to \$150/ m^3 for larger logs. A salvage grade log is a lower grade specification with limitations on grade often determined by the individual mills. The average royalty/stumpage for salvage grade logs is between \$25/ m^3 and \$48/ m^3

In addition to sawlogs and salvage logs, other products such as poles, girders, rounds, piles and veneer are also sought after. There is a detailed list of products and indicative prices available from: http://www.ProductsAndMarketingGuide.pdf

The websites mentioned earlier are a good place to start. Each of these web pages also contains links to other relevant pages which should be explored.

Of particular interest will be the ANU web page where you will find a quarterly timber market report (http://sres.anu.edu.au/associated/marketreport/index.html).

Determine,

→ What are the available markets?
→ What quality and quantity of products are required?
→ What species are required?
→ What processing is required?
→ What are the future local, regional and global trends?
→ Are there any marketing groups for your product?
→ What silvicultural practices will suit the forest type chosen and produce the desired products over time.

ESTABLISHMENT & MANAGEMENT

Chapter 4

Once you have finalized your design and committed to the project it is time to plan your operations. An operational plan is a chronological list of activities that need to be carried out in order to successfully establish your planted forest. Start with the 'Establishment Timeline' on page 9 and modify it to suit your site.

Step 1.

Set a planting date and order your seedlings

Perfect planting conditions are:

2. Warm weather (not too hot and dry);
3. Moderate rainfall (occurring just before and just after you plant); and
4. A nice light breeze to make planting comfortable (not gale-force winds).

The reality is that weather is unpredictable and, whilst long-term forecasting can guide us it can never be depended upon. The only thing that you can guarantee in your operational plan is that the date you set for site preparation and planting will not be the date that you site prep or plant. However, you must set a date and work towards it with the flexibility to adapt your plan along the way.

In much of south-east Queensland we are able to plant all year round. The best growth rates will occur in spring and summer months, however our trees don't stop growing in winter, they merely slow down. If your plantation site does not receive winter frost then your planting date can be relatively flexible. If your

plantation site is susceptible to frost then you should plan your planting to occur very early in spring, as soon as possible after the last frost. This will ensure that your trees have the maximum window of opportunity to establish before the next frost.

The one thing that is set in stone is the time that it takes to germinate and grow a seedling so that it is ready for planting. In winter you should allow approximately 5-6 months for your seedlings to grow, whilst in summer you should allow 4-5 months. Talk to a specialty forestry nursery about the timeframe for seedling growth and discuss the possibility of the nursery holding your stock for longer if your site preparation activities are behind schedule.

Seedling quality

High quality seedlings are essential to successful plantation establishment. Seedlings that are too large are often root bound and have lost their early growth vigour. Small, well formed and robust seedlings develop vigorously after planting and help to reduce plant failure and the need to re-plant.

The characteristics of a good seedling are:

- The seedling height should be approximately $1^{1}/_{2}$ times the height of the pot (20-40 cm).
- Stem should be straight and sturdy with no pathogen or mechanical damage.
- Foliage needs to be healthy, free of substantial insect, fungal or physical damage.
- The seedling should have at least 6 healthy leaves with two or more of the lower leaves partially formed adult leaves.
- Plant tubes should encourage downward root development via root training ridges.
- Plant root system should be dense, fibrous with white root tips. The roots must not protrude from the tube and should not be spiralling, coiling or J-rooting.
- Roots must be air-pruned and not curled or root-bound.
- The root mass should hold the potting mix firmly together when the plant is removed from the planting tube.
- The age of the planting stock should be the current season stock.
- Planting stock should be hardened off in order to improve their resistance to shock when being planted out.

Step 2.

Site preparation

Site preparation is a term that includes a number of treatments and activities that ready the site for the demands of plantation growth. At a macro scale, site preparation improves plantation maintenance access, water course protection, minimisation of erosion and reduces competition from other trees and invasive weeds. At the planting scale, site preparation improves the soil for plant root development, nutrient and water availability and drainage.

Broad acre slashing

To aid the process of marking-out it is advisable to have your plantation site slashed. Slashing will improve visibility and access. Ask the tractor driver to slash the block as close as possible to 'straight up and down the hill'. This will give you an idea of optimum row direction.

Tree Spacing

Initially, sufficient trees need to be established to provide mutual shelter and to promote stem form. As the trees grow, the plantation must be progressively thinned to reduce competition as well as to concentrate the available light, moisture and nutrient on the superior formed trees.

The most common plantation stocking is 1000 stems per hectare and a tree spacing of 4 m between rows and 2.5 m intra-row. This regime is designed for sawlog and pole production as the tree spacing encourages bole extension, reduces weeds and branching. The higher stocking rate is required due to erratic and unpredictable growth and form of genetically unimproved stock. The higher stocking allows for selection of superior stems based upon criteria such as their form, growth vigour and distribution of growing space.

Marking-out

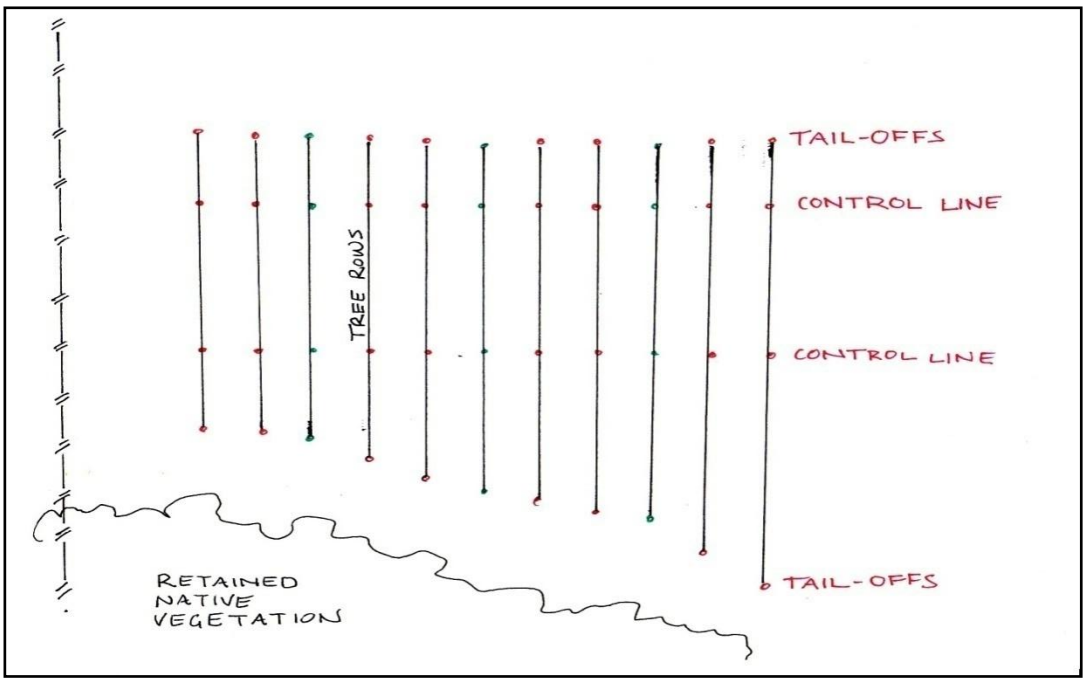
Single-tree site cultivation is done with an excavator which travels up and down the hill ripping three rows at a time. The best results from cultivation are achieved in bare earth or where the grass is dead. Before cultivation occurs, the plantation rows need to be sprayed into the grass, allowing the excavator driver to clearly see where the rows are and optimising the benefits of ripping. The photo below shows the excavator following sprayed rows as it spot rips. Grass is left between the rows throughout the life of the plantation to stabilize the soil. This photo also shows soil that has been brought in to fill old erosion channels.

Marking out can be done in any number of ways. The goal of marking out is to provide yourself with a guide to the placement of tree rows so that you can spray and cultivate straight rows that are evenly spaced. It is important that tree rows are both straight and even so that maintenance off the plantation is efficient and so that each tree has an equal amount of space and resources.

PFSQ mark out plantations using timber and bamboo stakes in 'control lines' running perpendicular to the row direction. Each tree row is represented on the control line by a stake which is four metres (row spacing) away from the next stake. Each stake lines up with another stake in a parallel 'control line' 30 m away. By lining up the two corresponding stakes you get a straight line which can be extended in either direction to mark un-even boundaries. Flagging tape is tied to the end of the stake in alternating colours. To spray the row, you line up the corresponding stakes.

Once you have determined your row direction (up and down the hill), use a compass to get a bearing and then set up your control line 90° off your row direction bearing. Run a 50 m measuring tape out along the control line bearing and push in bamboo stakes every 4 m.

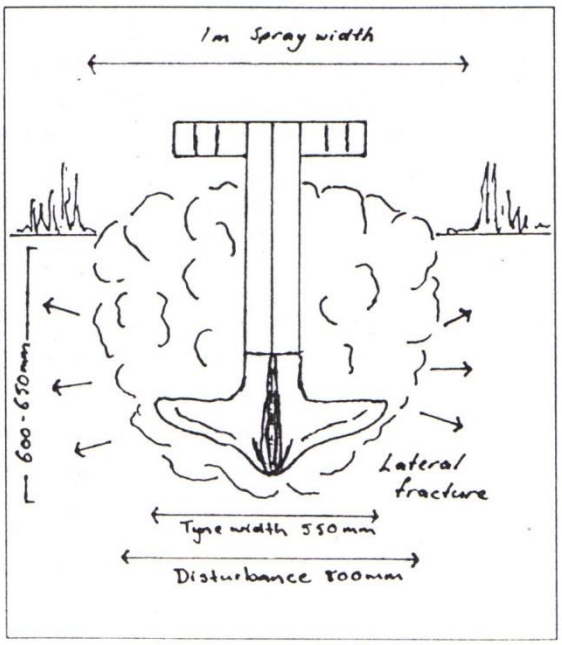
Example: Marking out with stakes



Cultivation

The majority of sites proposed for plantation establishment in south-east Queensland and northern New South Wales have highly degraded soils; they are either compacted from livestock; have lost their top soil from past clearing; or have sub-surface compaction layers from annual cultivation. PFSQ use two specific methods of cultivation which

optimize planting conditions; improving tree access to water and nutrients, and improving drainage conditions.



Spot ripping has been developed specifically for the steep, erodible hillsides of the coastal hinterland. A winged ripper is mounted on an excavator and is used to fracture the soil in a single spot to a depth of 600 mm. Each tree has its own spot rip allowing unimpeded root development in the zone surrounding the young root system.

Historically, site cultivation has been done with a ripper mounted on a dozer fracturing a continuous line of soil. This form of cultivation cannot run up and down the hill as it creates erosion by collecting and concentrating water. Heavy rain can result in deep trenches and the loss of soil. Alternative practitioners run the continuous rip line along the contour. This method has its own problems; the rip lines become miniature dams, collecting water as it runs down the hill until it breaks through the rip in large concentrations. Contour rows also hinder maintenance activities. Slashing the inter-row with a tractor is almost impossible on the contour of a steep hill, not to mention extremely dangerous; the trees grow straight while the tractor works on a dangerous angle; unless the rows are placed a long way apart, the tractor cab will damage the trees.

Spot ripping reduces soil disturbance and does not concentrate water. Tree rows can therefore run up and down the hill, making maintenance activities safer and more efficient. In a sense, spot ripping is like aerating your lawn with spikes.

On sites that are subject to regular inundation, such as floodplains and low-lying areas, a method of continuous cultivation is more appropriate. As the ground is inevitably flat, there is no concentration of fast-moving water. The aim of cultivation in these areas is to improve drainage by raising the root zone out of stagnant water. An implement that combines deep ripping and high mounding is preferable. The Savannah plough towed behind a dozer is a good example.

In the photos above, the Savannah plough is used for two-passes on ex-cane land; the first pass with a deep ripper and the second pass without the deep ripper to gain more elevation in the mounds.

Pre-plant weed control

The pre-plant weed control should take place within the final week before planting. This is your last chance to spray the tree rows without having to worry about accidently hitting your new seedlings.

Pre-plant slash

The aim of the pre-plant slash is to create mulch and to provide access for planting. Slashing residue (cut grass) is perfect for mulching around the newly planted trees. You may need to allow extra time between site preparation and planting for the grass to grow to height that is useful for mulching.

Fertilising

On severely degraded sites that have been continuously cropped for many years you may need to consider adding nutrients to the soil. A soil test and analysis will determine the nutrient status of your soil. In some cases you may need to add lime to lower the pH and improve nutrient availability.

In most cases, fertilisers have been shown to help with initial establishment, but their benefits are lost down the track. Eucalypt trees are native to our soils and in most cases will overcome minor nutrient deficiencies once their root systems penetrate to the lower soil profile. On sites that require fast establishment, such as frost-prone sites, it may be beneficial to apply fertiliser at establishment.

Step 3.

Planting

The aim of planting a tree is for initial survival and fast establishment. There are many different methods and tools that can be used to plant a tree but the fundamental principles are all the same:

1. Use good quality, hardened planting stock;
2. Look after the trees whilst in transit;
3. Provide water to the planting site in dry conditions;
4. Provide maximum soil contact to the roots;
5. Make sure that the tree is planted as straight as possible;
6. Cover the top of the root system with soil; and
7. Mulch around the base of the tree.

Quality plants

The hardening off of seedlings is required to reduce the incidence of planting shock. Planting shock occurs when seedlings are taken out of a controlled environment, where their every need is met with regular watering and nutrients, and planted into reality, where rain is variable and they have to look for their own nutrients.

Ensure that the nursery growing your plants properly prepares them for your site.

Handling

The covering of seedlings during transportation will avoid trees being wind burnt. Wind burnt trees will either die or take a long time to establish. Pre-soaking seedlings in their

The way we do it.

pots just prior to planting out ensures the root mass is fully saturated and aids in the initial establishment of the seedling.

Watering

The optimum planting site is wet before you plant the tree. If planting during a wet period you should be able to plant the tree without additional water. In most cases, however rain is unpredictable. Tree roots grow towards water. Wetting the planting site before planting allows the roots to quickly establish, taking up the water they need. Watering the plants after they have been planted is not an efficient or successful way to apply water; the water soaks in from the top of the plant aiding the surface roots and does not encourage the young roots to grow down in search of their own water.

Sandy soils will require more water than heavy clay soils.

Root to soil contact

Roots use soil as a medium to take up water and nutrients. Large air gaps around the roots will cause them to dry up. Ensure that the entire root system is in contact with the soil. Pack wet soil around the root system.

Plant the tree straight

If you plant the tree at an angle it will spend its first independent days straightening itself up. You want the tree to put all its energy into establishing its root system, so do the tree a favour and give it a head start by planting it straight.

Cover the roots

Do not leave the top of the root system exposed to the air. By covering with a significant layer of soil, the roots will be protected from drying out and the tree will be more stable in the ground. Deep planting (4 cm up the stem) helps with the development of lateral roots. Lateral roots give the tree stability in its later years.

Pack the soil firmly around the roots but be careful not to press too hard on top of the roots. Too much downward pressure can break the lateral roots from the tap root.

Mulch

Mulching around the base of the tree has two major advantages:

1. The mulch prevents surface moisture from evaporating and protects the soil around the young tree from extreme heat. Months after planting and no rainfall, mulch has been lifted to find the ground beneath moister than the surrounding bare soil. The mulch eventually breaks down and adds organic carbon to the soil.
2. Mulch around the base of the tree prevents weed competition. Young eucalypt trees are particularly sensitive to competition from weeds and can be quickly smothered in their early development. The mulch helps to make early weed control (spraying) quicker and results in less collateral damage as you don't have to spray close to the young trees.

Wherever possible, on-site mulch should be used. Grass growing between the rows should be slashed prior to planting to provide a close, handy supply of mulch.

Form pruning

Form pruning begins from planting. As you plant the trees check for any obvious double leaders and nip them off with your fingernail or some secateurs. Be careful not to tear the stem.

Monitoring

Keep a careful eye on the trees that you have planted. The tips (young shoots) will inevitably wilt with the shock of planting but should recover in a few days. If you have effectively watered the site before planting then the trees should not need any more water. Slight stress (such as wilting) helps the tree to adapt to the site and encourages it to search for water. If wilting still occurs after approximately four days and conditions are hot and dry you should consider supplementary watering. Whilst not ideal, this method will save your trees from dying.

Step 4.

Post-plant weed control

Weed control is essential to reduce competition for water and nutrients between trees and weeds. As most hardwood species used in plantation have an open and narrow crown, there are substantial tree growth benefits by maintaining a weed-free strip along each planting row for the first 2 years. In poorer quality sites the length of time weed control needs to be performed may need to be extended due to the slower growth of the trees.

On most site types, glyphosate (Roundup® 4 L/ha) has proven to be the most effective treatment for achieving high levels of weed control with minimal affects on tree health. Weed control has shown to be most effective when applied at a frequency where the weed coverage does not exceed 20% of the ground cover. Depending upon the season, rainfall, weed spectrum and effectiveness of the previous spray applications, weed control may need to be performed every 4 months. As the plantation grows and achieves a higher degree of site capture and shading of the ground, the frequency of weed control reduces.

1st post-plant spray

The 1st post-plant weed spray is the most critical. Not only are the young green stems very sensitive to broad spectrum herbicides (glyphosate), they are also still very small, with the majority of their biomass close to the ground where you will be spraying.

Mulching at planting will make this initial spray easier as you won't have to spray close to the tree. You should be very aware of conditions when spraying. Wind will blow spray mist onto the young plants and kill them or severely stunt their growth. Early morning is the best time of day to spray, before wind speed picks up. Carry secateurs with you when spraying; if you accidently hit a branch with glyphosate you can cut it off before it translocates to the rest of the plant.

The initial width of your weed-free strip should be approximately 1.2 metres.

On-going weed control and access pruning

The width of your spray band should be widened with each spray in line with crown development (width). This will ensure that lateral roots developing outwards with the drip line will not be in competition with weeds.

Before each spray (after the initial spray) it is recommended that an access prune is carried out to remove low hanging branches. As branches grow, their weight causes them to hang low to the ground. By removing the low hanging branches and throwing them into the inter-row you will be able to spray weeds beneath the canopy without hitting the tree.

Until the tree bole develops a brown woody stocking (bark) you should avoid spraying close to the base of the tree. Once this woody stocking develops (no longer green) you can spray closer to the tree without the risk of the tree taking up the herbicide.

PFSQ use low-volume 'Dribble Bar' spray technology developed by the Department of Primary Industries. Micro-holes drilled in the base of a T-bar allow the glyphosate to dribble out in a curtain. The droplet size is larger and the flow-rate is lower than spray nozzles, therefore spraying can be carried out in relatively windy conditions without the risk of spray drift. The 'Dribble Bar' is attached to a Quik Spray Unit which avoids the necessity of carrying heavy spray packs on your back.

Pruning

Trees are pruned in a number of stages based upon their height and branch development. The six outcomes achieved via pruning are;

- Improved tree form (removal of double leaders) for the sake of longer bole length.
- Improved plantation access for spraying around the tree base.

- Increased air circulation around and through the crown to reduce the occurrence of leaf diseases or pathogens.
- Reduction of stem defects (rot, doze, encased bark, etc) caused by poor branch stub occlusion when the branches are naturally shed.
- Concentration of branch stub (knot) occlusion is kept to a minimal diameter core of the final product.
- Reduction of suspended fuel and opportunity for ground fire to link to tree crowns.

The pruning of branches when they are alive and small in diameter is aimed primarily at reducing impact of knots so as 'clear wood' is produced outside the knotty core as the tree increases in diameter. For some species, clear wood (knot free) is often sold to higher value markets for uses such as flooring and furniture. In some species, unpruned timber only allows access to lower value markets.

Some species have inherent self pruning capabilities due to their intolerance to competition for light and growing space. As the plantation canopy closes, lower branches gradually have less light available and eventually die and fall off (senesce) leaving a self pruned stem. Depending upon inter-row spacing, the branches adjacent to the inter-row may take longer to self prune due to the longer period of available light.

When pruning is performed the appropriate technique is necessary to ensure that pruning does not negatively impact upon plantation health. The following points need to be considered:

- No greater than 40% of the live canopy should be removed at any single pruning stage. Before pruning the tree it is advisable to estimate the height limit of pruning.
- If pruning using a ladder, avoid the ladder causing damage to the tree bark.
- Undercutting the branch slightly first before making the top cut aids in avoiding tearing of the bark under the branch.
- The wounds formed from pruning should be cut at approximately 80 degrees to allow water to flow off and have as little surface area as possible for fungal infection.
- Branches should be pruned close after the branch collar, but avoid cutting into the meristematic tissue within the branch collar. The meristematic tissue is able to rapidly divide and therefore occlusion of the stub is more efficient.
- Long branch stubs 'coat-hangers' that protrude from the branch collar should be avoided as it will take a long time for the tree to grow over.

To minimise the opportunities for fungal attack it is best not

to prune when it is wet or there is a high humidity. Pruning in late winter is also useful as pruning is hot and strenuous work. Late winter pruning will aid rapid occlusion as the tree growth progresses into spring.

Thinning

As plantation managers, the biggest challenge is to effectively manage competition between your trees. Initial stocking rates of hardwood plantations are usually at 1000 stems per hectare. This high stocking rate is essential for the production of tall, straight trees. If you planted at 200 stems per hectare your trees would develop wide, rounded canopies and would grow short and fat.

However, as plantation trees grow in height and diameter competition for light, water and nutrients increases. Too much competition can drastically slow down growth rates and render your trees more susceptible to insect and fungal attack. Most importantly, if you do not thin your trees at all, you will not be able to produce any valuable timber products.

Visible signs of suppression include loss of dominance (some trees are short and have skinny trunks), crown lift (dead lower branches and shallow crown), slow diameter growth, little or no grassy understory and epicormic shoots (new shoots forming on the trunk beneath the canopy).

Thinning a plantation requires a careful balance of height and branch growth versus diameter growth. Thinning progressively retains a selection of superior trees, concentrating growth on the healthiest, straightest and most vigorous trees in order to promote them into higher valued products. Thinning too early may encourage large side branches to develop and increase the cost of pruning. Thinning too late may stunt growth and cause a loss in wood value.

Advantages of thinning: maintain the vigour/growth rate of the stand; maintain the health of the plantation; shorten the rotation length; tailor the stand for the intended market/product; increase the value of the plantation; improve grass cover beneath the plantation.

Trees selected for removal generally have poorer form (e.g. crooked stems, large branches and double leaders), less vigour (small diameter and short stature) or insect damage (borer holes).

Thinning Guide

Step by Step Plantation Thinning

These notes have been written as a brief guide for participants of the Pruning and Thinning Field Day

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Before you start:

- What product are you growing in your plantation?
- Different products have different management requirements. PFSQ recommends growing products in the high-value range (power-poles and veneer). These products require intensive management however, they will also be suitable for lower value products should the demand for power poles or veneer change. If you aim for lower value products, they may not meet the specifications for high value products should the saw-log market change.
- What species are you growing in your plantation?
- Some species have different tolerances for competition, i.e., some species require more space than others.

The following notes and steps assume that you are thinning your plantation for the first time (1st pre-commercial thin) and that you are aiming to produce tall, straight trees with minimum defects for the power pole market.

Plantation stocking

The number of trees that you remove from your plantation will depend on the current amount of competition between your trees. Competition refers broadly to the trees in your plantation competing with each other for available light, moisture and nutrients. It is difficult to measure competition accurately as different sites will naturally contain different levels of these three resources. Instead, you have to look for obvious signs of too much competition (competition will be demonstrated during the field day).

Generally, we will start with an initial plantation stocking of 1,000 trees per hectare. The first pre-commercial thin will take the stocking down to 600 – 700 trees per hectare and the second pre-commercial thin will take the stocking down to 400 – 500 trees per hectare. The timing of these thinnings will vary depending on the growth of your plantation, however a general rule of thumb for fast-growing eucalypt plantations within 100 km of the Queensland coast is a first thin at age 2 – 3 and a second thin at age 4 – 5.

When thinning your plantation for the first time it is helpful to thin in smaller increments (say a first thin down to 700 trees per hectare) and to observe the response of the remaining trees to an increase in space. By observing this response you may increase your confidence to remove more trees during the next thin. If you are not limited by time, then frequent, small thinning operations are the optimum way to control competition and thus, grow tall straight trees with small branches.

To mark your plantation you need to know exactly how many stems (trees) you have per hectare. You may have aimed to plant 1,000 stems per hectare, but this exact figure may vary depending on the slope or the site-preparation operator. A simple way to measure stocking is to establish a 20th of a hectare plot. This is a circular plot with a radius of 12.6 metres. Follow the steps below:

1. Materials: Measuring tape or 12.6 m string line, can of spray-paint, pen and paper and 2 people.
2. Mark a random spot well within the plantation boundary. This spot will be the centre of the plot.
3. One person will stand on this spot holding the measuring tape at 12.6 m.
4. The second person will circumnavigate the centre of the plot using the tape and the paint can to mark a circle with a radius of 12.6 metres. This is the boundary of the plot. A retractable measuring tape that clips to your belt is very handy for marking circular plots within a plantation.
5. Count all of the trees (and any gaps where trees have died or been removed) that fall within the circle.
6. Multiply this number by 20 and you will have your per-hectare stocking.
7. Measure at least three of these plots within a 1-3 hectare area and average the result. If you have a significant change in topography within your plantation, you should do a separate set of plots for these areas.

Marking your plantation

When marking a plantation or a native forest you always mark for retention. This enables you to visualise the forest as it will look after thinning.

A simple way to mark your plantation for thinning is to mark three rows at a time and 4 trees deep (groups of 12 trees). This method will help you to maintain an even spacing throughout your plantation.

Assume that this is the first pre-commercial thin and that you are thinning from 1,000 stems per hectare (s/p/ha) down to 700 s/p/ha. You have measured three 20th of a hectare plots and your actual average stocking is 1,150 s/p/ha.

This means that you will be removing 450 trees (1,150 minus 700) in one hectare. Working in groups of 12 trees at a time, you will be retaining 7.3 trees in every group of 12.

Example:

1,150 (Initial stocking) / 12 (trees per group) = 95.83 (groups of 12 in a hectare)

700 (desired stocking) / 95.83 (no. of groups in a hectare) = 7.30 (retained trees per group of 12)

So, the process of marking (using the above example) is as follows:

1. Start on the centre row of your group of three.
2. Walk down the row and paint a short line halfway between the fourth and fifth tree.

3. Mark the first and third rows where the paint line intersects with them (perpendicular to the row). There should be approximately 12 trees in this group. It does not matter if there are a few more or a few less.
4. Now walk back through the group and spot mark (approximately three spots per tree so that it can be seen from all sides), at breast height, the best seven trees of the group.
5. Once this is finished, repeat step 2 and 3 to mark your next group. Every 4 groups you should leave eight trees (7.3) so as to maintain your desired stocking of 700 stems per hectare.

How to choose which trees to keep

This is one of the most difficult aspects of plantation thinning. The concept of tree selection will be discussed and demonstrated during the field day. Generally, there are three main aspects that you should consider when selecting trees for retention:

1. Form – will the tree meet product specifications?
2. Vigour – will the tree grow adequately in height and diameter?
3. Spacing – is the plantation spaced evenly?

The trees that you retain in your plantation should have most of the following characteristics:

1. Straight and tall (good form)
2. Vigorous (actively growing and not suppressed)
3. Small branch diameters
4. No double leaders or high-angle branches that are difficult to prune
5. Contain a potential product

Important: In the early stages of thinning, it may be necessary to keep trees that do not fit these criteria so as to maintain healthy competition. For example, your plantation may contain large gaps due to wind blow or death. It may be necessary to retain un-characteristic trees on the edge of this gap so as to maintain healthy competition for surrounding trees.

Case Study

Do the growth rates and product development of a six year old hardwood plantation meet expectations?

By Sean Ryan - Executive Officer of Private Forestry Service Queensland and a private forest grower

In the year 2000 on our property at Cedar Pocket, my wife and I established 8 ha of hardwood plantation, predominantly Gympie messmate and Spotted Gum at a ratio of approximately 2:1 with a scattering of Red Stringybarks on the wetter sites. The property has reasonably deep brown soils predominantly derived from the Granodiorite parent material with areas of red/brown soils of Basalt derivative.

Gympie Messmate is a durability class one timber with a proven plantation performance history and a strong reputation for its strength, durability and workability. Spotted Gum is a durability class two timber, also with a strong reputation for its quality timber. It is the predominant hardwood timber harvested in NSW and Qld. Spotted Gum performs generally well in plantations with strong apical dominance, self-pruning characteristics and propensity for high growth performance on a wide range of soil types and rainfall variability.

Hardwood Plantation Management Plan

The plantation covers areas of flat ground through to slopes of up to 25º and to ensure safe access the rows ran basically up and down the slope. Seedlings were planted on a 5 x 2m grid. Single-tree site preparation was undertaken using a 20 tonne excavator mounted with a 600mm winged ripper to spot rip each site.

Prior to planting each row was given two weed eradication treatments with Roundup® over a three month period to ensure all weeds and the weed seed bank were destroyed.

Seedlings were planted in ideal conditions in April of 2000 with 100mm of rain watering in newly planted stock. This greatly assisted achieving the desired 95% survival rate at the end of year one. The young trees were kept weed free as much as possible for the first 18 months, fertilised at 3 months and form pruned where necessary during the first 12 months.

During the planning stage a time line for future management, predicted growth (estimated 2 cm dbh and 1.3m annual height growth increment/annum) and likely product range was considered to be as follows:

Management Time line

Year 1- 2 – keep weed free, access and form prune, replant any dead stock, slash as required - Completed as planned, severe paropsis beetle and larva attack in first year.

Year 2 - 3 - prune a minimum of 500 stems/ha of premium stock to 3m to ensure a maximum 100mm knotty core – Completed as planned

Year 3 - 4 - prune a minimum of 400 stems to 6m – All available stems were pruned

Year 3 - 5 thin to 500 stems/ha – Completed in two stages in year 3- 5

Year 7 - harvest 150 stems /ha, market as a range of fencing material, grape trellis posts and overhead netting supports for fruit orchards – Considering the present condition of the plantation, competition will start to impact on growth rates if this stage is not undertaken as

Case Study

soon as possible. In reality while there is significant product available, a market for it needs to be found. There is uncertainty on the durability of young fast grown stems which may require the product to be CCA treated to be accepted in the market. The current price for treatment is approximately $100/m³ which could make this a marginal exercise.

Year 7 - prune 200 best stems /ha to a minimum of 12 m, remainder of stand to 8m. Stand needs to be close to 24 m high for this not to adversely impact on growth.

Year 15 - harvest 150 stems/ha, expected product range in descending order of value; 9 -11m poles (8-12Kn) and piles and treatable rounds; Strainers, Light strainers, caps and stays. - At present growth rates this should now be achieved by year 10 or 11; - 11 m 12kn pole requires a 300mm d line diameter under bark.

Six year old Gympie messmate planted along creek flats with an average diameter at breast height of 25 cm.

Year 25 - clear fall remaining 200 stems/ha, product range in descending order
Sliced veneer logs; 15.5 –17m (12-20kN) poles and piles; sawlogs; strainers; light strainers, caps and stays.

Year 26 – Thin coppice from original crop stumps to single stem for next rotation.

Current plantation condition at year 6, stocking 500 stems/ha:

- max dbh 265mm, max height 18m
- min dbh 150mm, min height 14m

Growth Rates, Products, Marketing and Returns

Determining hardwood plantation growth rates is not a definitive science due to the large number of variables influencing the outcome. The predominant two species chosen (Spotted Gum and Gympie Messmate) are proven performers on a range of soil types and rainfall zones.

The first commercial thin is predicted to be year 11, thinning from 350 stems/ha down to 200/ha, assuming a maximum expected average stem size 33 cm dbh over bark and total height 25 m. This translates to a 30cm under bark diameter at the D line. Considering this size class an expected conservative product range and present day value for the 8 ha plantation thinning would be:

30% 11m 8 kN pole = 350 @ $74 / pole including cut and snig	$25, 900
20% 9.5m 12kn pole = 240 @ $69 / pole including cut and snig	$21, 336
25% small sawlog 220 x 3.0 m x 30cm = .2 m³ = 44 m³ due to small size of product the value is unpredictable, assume $60/ m³ + $25 cut and snig	$3, 740
and 25% fencing material 400 strainers, rails and stays	$4, 000

Case Study

An 11m 8kn pole has a D-line diameter of 26.5cm and a 9.5m 12kn 28.4cm. The model assumes 50% pole failure rate due to grub hole and other defects.

This forecast considers current growth rates achieved in the first six years which have averaged 3.3 cm diameter growth and 3m height increments / year. As the trees increase in diameter, the growth increment per year will decline as the wood volume is distributed over a greater diameter. Allowing for this decline is often unaccounted for in growth predictions.

The amount of work still required to ensure optimal growth within environmental constraints as well as expected product development is substantial. To grow quality poles in Gympie Messmate, high pruning is essential and comes at a high labour cost.

A prediction of the final crop at this stage has too many variables to be meaningful. Nevertheless, the growth and product development within our plantation has met expectations and in some areas has been surprisingly beyond.

Do the growth rates and product development of a six years old hardwood plantation meet expectations? They certainly do when thinning and pruning intensity are scheduled appropriately.