NSW GOVERNMENT

Environment, Climate Change & Water

Private Native Forestry Field Guide for **Cypress and Western Hardwood Forests**

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1. Introduction

1.1 The Private Native Forestry Field Guide for Cypress and Western Hardwood Forests

This Field Guide has been prepared as a supplement to the Private Native Forestry (PNF) Code of Practice for Cypress and Western Hardwood Forests (the 'Code'). Its aim is to assist private native forestry practitioners to implement the Code.

The Field Guide does not replace the Code. Users should always refer to the Code in order to ensure its proper application. The Code can be found at the end of this guide. The Appendix to the Code is not included in this guide. A full version of the Code can be obtained from www.environment.nsw.gov.au/pnf/.

1.2 The Private Native Forestry Code of Practice for Cypress and Western Hardwood Forests

The *Native Vegetation Act 2003 and the Native Vegetation Regulation 2005* regulate the clearing of native vegetation on private land in NSW. The Regulation was amended on the 1st of August 2007 and now requires that Private Native Forestry Property Vegetation Plans (PNF PVPs) be developed, and approved, for forestry operations on private land. Private native forestry operations must now be conducted in accordance with the PNF Code of Practice.

The Code for Cypress and Western Hardwood Forests applies to all forests dominated by White Cypress pine (*Callitris glaucophylla*) and forests consistent with the description of any of the Forest Types 99, 103, 104, 124, 171–178, 180–185, 203–210 and 213 set out in the document called Research Note No 17 Forest Types in NSW, produced by the then Forestry Commission of NSW. These forests are primarily located in North west and South west slopes and plains.

1.3 What is private native forestry?

Private native forestry (for the purposes of the Code) is the management of native vegetation on privately-owned land for the purpose of obtaining, on a sustainable basis, forest products including sawlogs, veneer logs, poles, girders, piles and pulp logs.

1.4 Why are private native forests important?

Private native forests are important for timber production, biodiversity conservation, water quality and yield, enhanced greenhouse gas abatement and their contribution to local economies. Timber products are widely used in the building and housing industries, and by tradespeople, including furniture manufacturers and arts and craft suppliers.

1.5 What does the Field Guide include?

This Field Guide includes:

1. Information and guidance to help interpret and apply the Code
2. Tools to help identify, measure and apply Code requirements
3. References to additional information sources
4. A glossary of forestry terms

1.6 Using the Field Guide

The Field Guide incorporates a number of devices to help users to apply the Code found at the end of this guide.

Ask an expert **FOP note/Note**

Steps to success **How do I…**

➲ **The Code reference: 3.2(a)** refers to a specific section in the Code.

1.7 Additional legislation

By complying with the Code users will be complying with the requirements of the *Native Vegetation Act 2003*. Approval under other legislation may still be required for parts of your forestry operation. Such legislation includes the *Environmental Planning and Assessment Act 1979*, *Water Management Act 2000*, or Council's Local Environmental Plans. Other legislation that may be relevant to PNF operations is included in, but is not restricted to, the list below. It is the responsibility of the user to ensure compliance with all additional legislation.

The Code has been certified by the Minister of Climate Change and the Environment that it meets the conditions of the *Threatened Species Conservation Act 1995*. This means that PNF operations carried out under a PNF PVP will not require a separate approval under that Act.

Legislation
Fisheries Management Act, 1994
Heritage Act, 1977
Local Environmental Plans
National Parks and Wildlife Act, 1974
Occupational Health and Safety Act, 2000
Pesticides Act, 1999
Rural Fires Act, 1997
Soil Conservation Act, 1938
Water Management Act, 2000

2. Planning for forestry operations

2.1 What is a forestry operation?

A forestry operation can include:

- Commercial timber harvesting
- Non-commercial silvicultural operations
- Regeneration and stocking activities
- Construction or maintenance of roads and tracks related to any of the above

Clearing where the forest structure is not maintained over the long-term is not a forestry operation.

2.2 Gaining approval for a forestry operation

2.2.1 Private Native Forestry Property Vegetation Plans

An approved PNF PVP must be obtained from the Department of Environment, Climate Change and Water (DECCW) for any proposed native forestry operation on private land.

A PNF PVP is a legally binding agreement between a landholder and DECCW. A PNF PVP gives approval for forestry operations to occur on an area of land, and the landholder(s) agree to conduct forestry operations in accordance with the Code.

A PNF PVP can be granted for up to 15 years.

2.2.2 Obtaining a PNF PVP

Obtaining a PNF PVP is straight forward. DECCW will assist by providing information and helping you through the process.

Steps to success

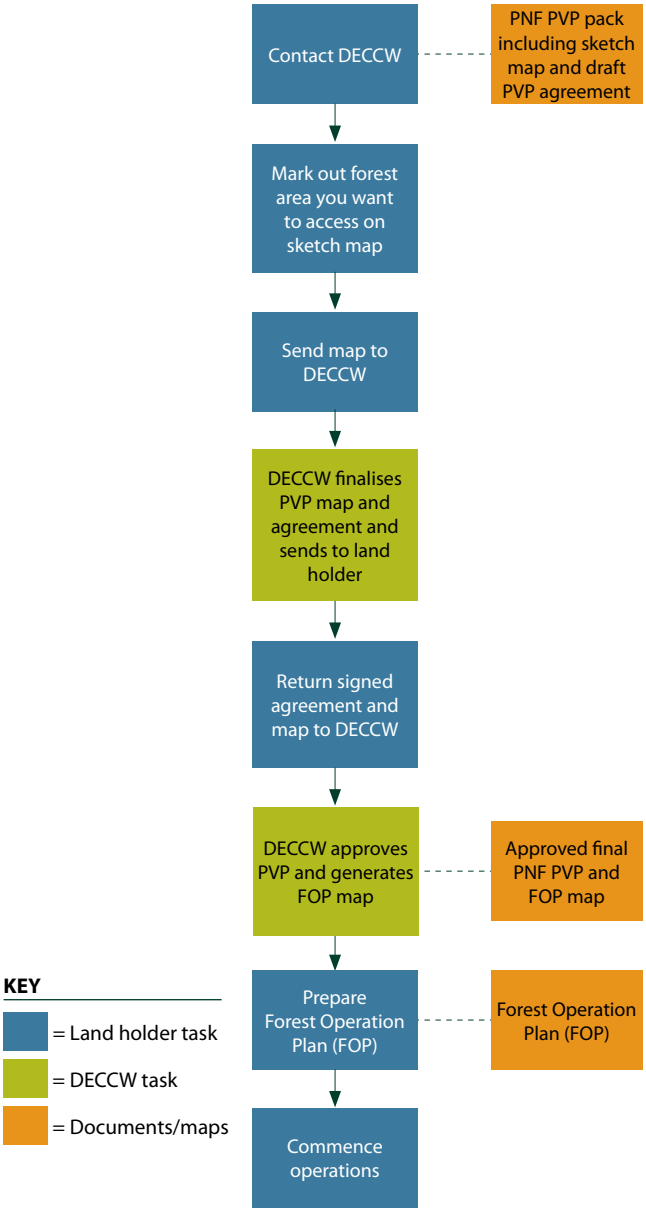
Step 1: **Contact DECCW** to obtain a PNF PVP pack including a draft PVP Agreement and sketch map (DECCW contact details are included on the back page of this Field Guide)

Step 2: Landholder **completes sketch map** showing proposed forest area and returns to DECCW

Step 3: **DECCW prepares final PNF PVP** map and agreement and landholder signs agreement

Step 4: DECCW undertakes final checks, **approves PNF PVP** and forwards it to landholder

PVP approval process flow chart



2.2.3 What is included in a PNF PVP?

The PNF PVP consists of a formal agreement and a map of the property showing the area approved for PNF. The map uses a satellite image or aerial photograph of the property.

2.2.4 When the PNF PVP is approved

The Code requires that a Forest Operation Plan (FOP) be prepared prior to the commencement of any forestry operation.

2.3 Planning the forestry operation on private land

2.3.1 The Forest Operation Plan

➲ The Code reference: 2.1

The FOP consists of a map and a written component. DECCW will provide a base FOP map at the time of final PNF PVP approval. DECCW also supply a template for the written component of the FOP, in accordance with the Code.

The FOP provides details about the proposed activities, where operations can and can't occur, and what procedures are in place to ensure best operational practice and protection of the environment. The FOP is used by everybody involved with the operation so that they understand what is required and where it will occur.

2.3.2 What is included in the Forest Operation Plan

➲ The Code reference: 2.1(5)

In summary, the FOP requires a description of:

1. Property ownership and description (Lots/DPs)
2. PNF PVP approval area(s)
3. Forest type, species, condition, and past disturbance
4. Timber species and products to be harvested
5. Harvesting and silvicultural methods
6. Proposed regeneration activities (if any)
7. Protection of the environment including general habitat and biodiversity, and drainage feature management
8. Location, construction and maintenance of roads, log landings, portable mill sites and snig tracks
9. Any additional specific threatened species management
10. Any amendments to the FOP during forestry operations

Ask an expert

The planning requirements for PNF operations will vary depending on the complexity of the forest and the proposed operation. If you are in doubt about the planning process, or any specific component, then you should consider engaging expert assistance from a professional forester, ecologist, engineer or environmental scientist to assist you.

2.3.3 Communication of the Forest Operation Plan

➲ The Code reference: 2.1(3&4)

The FOP is the primary set of instructions for the proposed forestry operation. Communication of the FOP is therefore very important. The FOP will need to be used in association with the Code.

The Code requires that:

- A copy of the FOP must be available on-site when operations are being carried out
- The landowner and anyone else carrying out forestry operations must read, sign and date the FOP

2.4 Additional resources

DECCW documents (available on the DECCW website at www.environment.nsw.gov.au/pnf/):

Private Native Forestry Fact Sheet 1

Private Native Forestry Fact Sheet 2

Guideline 1 - Guidelines for assessing regeneration and stocking

Guideline 4 - Techniques for measuring stand height

Guideline 5 - Techniques for measuring stand basal area

Silvicultural guidelines – Private Native Forestry Code of Practice

Routine Agricultural Management Activities on Private Native Forestry Land Fact Sheet

3. Undertaking forestry operations

3.1 Harvesting contractor selection

In most cases, the landowner(s) will need to employ the services of a harvesting contractor who has the skills and machinery needed to fell, load and transport logs. Although there is no requirement within the Code, many harvesting contractors have completed training to better understand the legislation.

Suggested questions to ask of a harvesting contractor:

- Do you have current insurance, both Public Liability and Workers Compensation? (It may be worth asking for a copy of these certificates)
- Do you have a safety system in place? (This includes safe machinery and substances, safe systems of work, information, instruction, training and supervision, and a suitable working environment)
- Have you and your staff completed any recent training in forestry operations?

3.2 Silviculture

Silviculture is important because it allows commercial forestry to be undertaken in a way that ensures the maintenance of natural species patterns, forest health and vigour, and biodiversity values.

Siviculture requirements for cypress forests and western hardwood forests differ from each other. This section provides guidance about how to select the appropriate silvicultural regime for your forest.

Steps to success

Step 1: Accurately assess the **forest type and condition**

Step 2: Select the appropriate **silvicultural system**

Step 3: Specify the silvicultural system in the **FOP**

Step 4: Undertake **tree-marking** to define the silvicultural system in the field (highly recommended)

Step 5: **Apply** selected silvicultural system

Step 6: Ensure **regeneration**

3.3 Forest types and their identification

Broad forest types are the categories used to classify forests to help manage them. The Code for Cypress and Western Hardwood Forests refers to two broad forest types.

Cypress forests

White cypress pine is the common species in this broad forest type, associated with a wide range of dryland eucalypt species depending on location, soil and climate (Figure 3.1). Black cypress pine is also common but is usually found on steep slopes and ridges where there are shallow soils. These forests can consist of very dense stands of cypress pine where disturbance is necessary to encourage new growth.

Figure 3.1: White cypress pine forest

PHOTO: Forests NSW

Western hardwood forests

These forests are dominated by one of the western species of box and ironbark (Figure 3.2). Either of the cypress pine species can be present, but the western hardwood forests are not dominated by them. These forests usually have an open woodland structure.

Figure 3.2: Western hardwood forest

Note

For more detailed information of forest types, refer to the DECCW Silvicultural Guidelines for Private Native Forests in NSW.

3.4 What silvicultural systems can be used?

Choosing the right silvicultural system is important because it will underpin the future productivity of the forest by contributing to effective regeneration and allowing existing healthy trees to continue growing.

The Code outlines silvicultural options which suit a range of circumstances for cypress and western hardwood forests, and specifies prescriptions to be applied for each one.

3.4.1 Cypress pine – non-commercial thinning

➲ **The Code reference: 3.1.1**

Non-commercial thinning is generally applied to heavily stocked stands of small (4–6 metre stand height) cypress pine which can be described as being in a "locked-up" state.

Stand lock-up is common in this forest type when heavily regenerated forests grow to a point where competition between trees prevents further growth without removal of some trees.

3.4.2 Cypress pine – commercial thinning

➲ **The Code reference: 3.1.2**

Commercial thinning of Cypress Pine is undertaken when stands reach a commercial size. The largest and straightest trees are retained for final harvest and non-commercial trees are felled for by products or to waste. Thinning is regulated by retained basal area limits (Table 1 of this guide).

3.4.3 Cypress pine – release operation

➲ **The Code reference: 3.1.3**

Final harvest of the oldest (largest) class is undertaken when there is a regenerating-age class between 4–6 metres high. The regenerating-age class is made up of younger trees beneath the overstory. This provides an opportunity for the regenerating-age class to respond to site release and grow on. Release operations are regulated by retained basal area limits (Table 1 of this guide).

3.4.4 Western hardwoods – single tree selection

➲ **The Code reference: 3.2**

Single tree selection involves selecting and harvesting individual or small clumps of trees. Trees are selected on the basis of diameter and condition, with smaller and younger trees retained to grow on to the next harvest. By removing competing trees, the retained trees have access to enough light, moisture and soil nutrients to respond and grow larger. Single tree selection is regulated by the Code through the application of retained basal area limits (Table 1 of this guide).

3.5 Silvicultural prescriptions

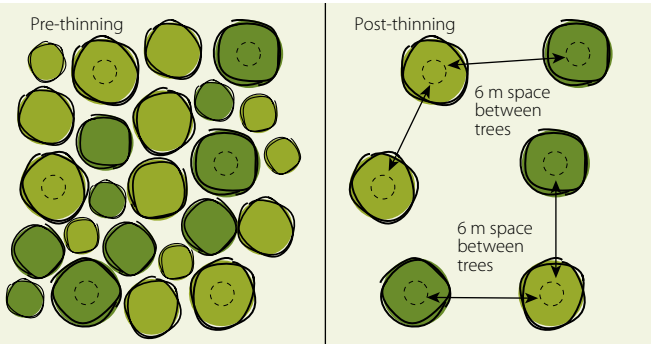
The Code specifies prescriptions to be applied for different silvicultural systems.

3.5.1 Non-commercial thinning

Thinning to waste is conducted with the aim of increasing the spacing between trees to 6 x 6 metres, which equals 280 trees per hectare (Figure 3.3). Selecting the trees to retain should be based on:

- the largest and tallest stems
- the straightest stems
- stems with smaller limbs
- stems without double leaders or bends in the upper crown
- stems that have not been damaged.
- single tree selection and commercial thinning

Figure 3.3: Ideal spacing for non-commercial thinnning



3.5.2 Thinning and Single tree selection

For thinning and single tree selection, the Code requires the retention of a minimum stand basal area after harvesting, as shown in Table 1.

Basal area is the cross-sectional area of a tree measured at breast height (1.3 meters) over bark. Stand basal area is the sum of the basal areas of all trees within the operational area. Stand basal area can be simply measured using a dendrometer (refer to **Section 7 – Tools to help you**).

Table 1: Minimum stand basal area (based on forest type) for single tree selection and thinning operations

➲ The Code reference: 3.2, Table A

Broad forest type	Stand height (<25 metres)	Stand height (≥25 metres)
Cypress	6 m^2/ha	6 m^2/ha
Western hardwood	8 m^2/ha	12 m^2/ha

Note

The techniques for measuring stand basal area are described in the DECCW document: *Private Native Forestry Code of Practice Guideline No. 5 – Guideline for Measuring Stand Basal Area.*

3.6 Tree selection and marking

Tree marking prior to harvesting activities is highly recommended particularly for single tree selection, commercial thinning and release operations. Tree marking ensures that operators undertaking forestry operations know what trees need to be kept and removed. There are two approaches to tree marking – marking for retention (trees not to be removed) and marking for removal (trees to be harvested). The two approaches can be used individually or in combination. Trees can be marked with bright paint or tape.

Tree marking can be undertaken for a number of purposes. These include:

- Marking for wildlife purposes, e.g. retention of habitat trees
- Marking trees with good productive potential to be retained for future harvest
- Marking trees for harvesting
- Identifying exclusion and buffer zones

Note

All threatened species exclusion and buffer zones, described in the Appendix to the Code, must be marked in the field and visible during forestry operations.

3.7 Assessing regeneration and stocking after harvesting

➲ The Code reference: 3.3

Forest regeneration is an on-going natural process and is necessary for the long-term maintenance of a forest in a healthy and vigorous condition.

The Code requires that a minimum level of regeneration and stocking (trees of any size) must be achieved within 36 months of a regeneration event. In the Code, harvesting or thinning is a regeneration event for western hardwoods. A regeneration event for cypress forests is the second successive wet summer following harvesting or thinning. The minimum stocking levels for different broad forest types is presented in the Code 3.3, Table B.

Note

Procedures on measurement of regeneration and stocking is available in the DECCW document: *Private Native Forestry Code of Practice Guideline No. 1 – Guidelines for assessing regeneration and stocking.*

If the minimum stock levels are not achieved following a previous regeneration event, then another harvesting event cannot occur until these levels are met. You may also be required to take supplementary actions to regenerate or re-establish the forest if sufficient tree stocking is not achieved within 36 months of a regeneration event. Examples of measures which may be taken to encourage regeneration include mechanical disturbance, fire, direct seeding or planting. The DECCW Silvicultural Guidelines for Private Native Forests in NSW is a good reference for more information.

FOP note

List supplementary actions, if likely to be necessary, to aid regeneration of the forest in the FOP.

3.8 Additional resources

DECCW documents (available on the DECCW website at www.environment.nsw.gov.au/pnf/):

Guideline No. 1 – Guidelines for assessing regeneration and stocking

Guideline No. 4 – Techniques for measuring stand height

Guideline No. 5 – Techniques for measuring stand basal area

Silvicultural guidelines – Private Native Forestry Code of Practice

Other silviculture related information:

Florence, RG 1996, *Ecology and Siviculture of Eucalypt Forests*, CSIRO Publishing, Melbourne.

Baur, G 1989, Siviculture Notes for New South Wales. Forestry Commission of NSW. A CD-ROM available from the Institute of Foresters of Australia.

Baur, G 1965, *Forest Types in New South Wales*. Forestry Commission of NSW, Research Note No. 17. Reprinted and revised 1989.

4. Environmental management for forestry operations

4.1 Protecting and managing landscape features

➲ The Code reference: 4.1, Table C

Landscape features have special conservation value because of their unique characteristics, for example they have high numbers of threatened or rare species, provide critical habitat components, or have special heritage significance. It is the landholder's responsibility to determine if any of these landscape features occur in the area proposed for forestry operations.

4.1.1 Ecological communities and populations

The *Threatened Species Conservation Act 1995* identifies three categories for listing and special protection:

1. Endangered ecological communities (EECs)
2. Endangered populations
3. Vulnerable ecological communities

These require special protection measures to ensure that forestry operations do not result in further risk to the viability of the populations and communities represented.

If any of these ecological communities or populations are present, then specific approvals or prescriptions may be required (e.g. an ecological harvesting plan must be approved prior to harvesting in EECs) or harvesting may be excluded from the area.

As part of the PNF PVP process, DECCW will provide a list of EECs that may occur on your property.

Ask an expert

If you are unsure whether an EEC is on your property then you should seek further advice from DECCW.

4.1.2 Old growth forest

Old growth forests have special biodiversity value because they contain rare habitat elements. These unique elements are important for biodiversity conservation and management. Under the Code, forestry operations, apart from maintenance of existing roads, must not occur in old growth forest.

If old growth forest has been mapped on your property, it will be included on the PNF PVP map provided by DECCW. Where old growth forests have not been mapped by DECCW, they may still be present and must be identified and marked on the Forest Operation Plan.

? How do I…

Review old growth forest on my property.

Where old growth maps have been supplied by DECCW, the Code allows for landowners to request that DECCW review the maps if the landowner considers that they are inaccurate. The landowner must identify the area in dispute and provide evidence to DECCW, including photographs, logging records or other disturbance history. In this case, DECCW will undertake new mapping to identify old-growth. DECCW may also identify old growth during site inspections. In both cases DECCW will identify old growth in accordance with the Code of Practice Guideline No. 2.

4.1.3 Geographic landscape features

A number of geographic features require specific protection under the Code. This is because they represent special habitat elements which can readily be damaged during forestry operations. The Code specifically excludes forestry operations from these areas and prescribes a buffer around them. They include:

- Wetlands (+20 metre buffer)
- Heathland (+20 metre buffer)

- Rocky outcrops (+20 metre buffer)
- Cliffs, caves, tunnels and disused mineshafts (+10 metre buffer)

4.1.4 Cultural heritage

Forest landscapes can be rich in cultural heritage. This can be either Aboriginal cultural heritage, in the form of objects or places of significance, or post-European settlement cultural heritage. Where objects or places of cultural heritage importance are identified, these must be protected by excluding forest operations within:

- 50 metres of a known burial site
- 20 metres of an Aboriginal scarred or carved tree
- 10 metres of a known Aboriginal object or place
- 10 metres of a listed heratige site

Heritage items are listed in Environmental Planning Instruments—check with your local council. DECCW will provide you with information about any known Aboriginal objects or places on your land. If you discover a heritage item or Aboriginal object on your land, do not disturb it, and contact DECCW.

4.1.5 Soils and geology

Some landscape features are important to protect because they represent an increased risk of land degradation, through soil erosion or mass movement. They include:

- Areas of existing mass movement
- Dispersible and highly erodible soils

In these areas, forestry operations must be modified and restricted in order to minimise the risk of soil erosion and subsequent water pollution.

Soil erosion and mass movement are further discussed in Section 4.4.1.

4.2 Protecting habitat features

4.2.1 What is a protected tree?

➲ The Code reference: 4.2, Tables D, E

A protected tree is any tree that needs to be retained by the Code because it provides habitat and/or food for native wildlife. These trees must be protected from forestry operations.

Protected trees include habitat trees (i.e. hollow bearing trees, roost and nest trees, feed trees, food resource trees) as well as old greys, grass trees, forest oaks and *Banksia*. Habitat trees must be retained according to Table 2.

Table 2: Minimum standards for tree retention

➲ The Code reference: 4.2, Table D

Broad forest types	Trees that must be retained
Cypress	» All old greys, and two hollow-bearing eucalypt trees per hectare, where available. » One recruitment tree of the same species from the next cohort must be retained for every old grey and hollow-bearing tree retained. » Where the total old grey and cypress recruitment trees are less than five trees per hectare, additional recruitment trees must be retained to bring the number up to five per hectare. » Where the total hollow-bearing eucalypt and eucalypt recruitment trees are less than four trees per hectare, additional recruitment trees must be retained to bring the number up to four per hectare. » All roost, nest or food resource trees.

Broad forest types	Trees that must be retained
Western Hardwood	» All old greys. » Twenty mature healthy eucalypt trees from the oldest classes per five hectares. Preference must be given to hollow-bearing trees where available. » One recruitment tree must be retained for every hollow-bearing tree retained up to a maximum of ten recruitment trees per five hectares. Retained recruitment trees can be counted towards meeting the requirement of 20 mature healthy trees per five hectares. » All roost, nest or food resource trees.

Hollow-bearing, recruitment trees and old greys

➲ The Code reference: 4.2(6)

Hollow-bearing trees: Many forest-dwelling animals live in hollows in native trees. Hollows or cavities in trees are usually formed as a result of broken branches, lightning strike or fire and/or termite, insect or fungal attack (Figure 4.1). The occurrence of a natural range of hollow sizes, depths, volumes and positions helps to ensure that a diversity of hollows are available for hollow dependent animals.

Figure 4.1 (a) (b) (c) (d): Examples of different types of hollows

(a) Stem hollow

(b) Branch hollow

(c) Fire scar

PHOTO: PF Olsen Australia

Recruitment trees: Some large trees that are likely to develop hollows must be retained. These are called recruitment trees. Retention of recruitment trees is important for the long-term replacement of existing hollow-bearing trees as the older trees die and fall of natural causes.

Old greys: Old greys are cypress trees that regenerated before the 1890s. They are characterised by bark that has bleached to a light grey colour (Figure 4.2) and is weathered to a smoother texture than younger trees.

Figure 4.2: Old grey

Roost and nest trees

➲ The Code reference: 4.2(6)

Roost trees: Roost trees are used by many bird species and bats. They are often identified by the presence of faecal matter on branches where animals have been roosting, and on the ground under the tree.

Nest trees: Nest trees of any large raptor must be retained. Raptor (birds of prey e.g. wedgetail eagle) nests are generally quite large and distinctive (Figure 4.3).

Figure 4.3: Nest tree

PHOTO: Forests NSW

Feed trees and food resource trees

➲ The Code reference: 4.2(6)

The Code 4.2(6), Table E specifies feed tree species which must be targeted for retention. These are tree species that are preferred by specific animals because of their pollen, nectar or sap. Trees with evidence of active sap feeding, specifically V-notch (Figure 4.4) or other incisions which have not healed over, must also be retained.

Figure 4.4: V-notch tree

Other trees to be retained as protected trees

➲ The Code reference: 4.3(3)

All grass trees (any tree of *Xanthorrhoea*) and forest oaks (any tree of *Allocasuarina spp*., except bull oak, *Allocasuarina luehmannii*) and *Banksia* must be retained.

4.2.2 Protection of retained trees

➲ The Code reference: 4.3(1&2)

As far as practicable, retained trees must not be damaged during forestry operations.

There are three specific actions that must be taken:

1. **Do not heap harvesting debris** such as branches, leaves, logs and bark, around protected trees. This increases the risk of the tree being killed or damaged during operations or a fire (Figure 4.5a).

2. **Do not damage trees with machinery.** Careless operation of heavy machinery can damage protected trees, especially during snigging operations (Figure 4.5b).
3. **Use directional felling techniques.** Falling trees can cause significant damage to retained trees. Direct falling trees away from retained trees.

Figure 4.5 (a) (b): How trees can be damaged

(a) Harvesting debris stacked around trees

(b) Machine damaged tree

4.3 Protecting threatened species

4.3.1 What are threatened species?

Threatened species are listed under the *Threatened Species Conservation Act 1995* as being considered in danger of extinction.

4.3.2 Identifying the presence of threatened species

➲ The Code reference: Appendix

The presence or potential presence of threatened species can be identified from:

Known records

DECCW maintains the NSW Wildlife Atlas which is a store of all known records of threatened species in NSW. DECCW will advise you if there are any known listed species records within the property and within 10 kilometres of the property.

Site evidence

Many threatened fauna species leave evidence of their presence. This can include distinctive scats, chewed seed cones (Figure 4.6), nests, roosts, active hollows, latrine sites (where animals defecate and mark scent), fur and bones. Confirmed sightings of a species can also be site evidence.

Figure 4.6: Chewed seed cones

PHOTO, RIGHT: Greg Steenbeeke

Ask an expert

If in doubt about the identification or presence of threatened species you should seek advice from DECCW or other ecological expert.

4.3.3 What to do if threatened species are present

➲ The Code reference: Appendix

The Code Appendix lists threatened fauna (animals) and flora (plants) and their relevant prescriptions which must be applied to the forestry operation to ensure that the habitat requirements for those species are maintained.

The types of prescriptions which apply vary between species. They include, but are not limited to:

- Exclusion and buffer zones
- Additional tree retention
- Increases in width of stream exclusions

Note

Refer to the Code Appendix for specific threatened species prescriptions. The Code Appendix can be found attached to the back of the Code at www.environment.nsw.gov.au/pnf/.

Threatened species exclusion zones

Threatened species exclusion zones are established around known locations of threatened species. Forestry operations are not permitted within exclusion zones. This means that machinery must not enter the zone, new road construction cannot occur and trees must not be felled into or out of the zone. The exclusion zone must be clearly marked in the field. Operators must use directional felling to ensure that trees are felled away from all exclusion zones.

Threatened species buffer zones

Threatened species buffer zones provide additional protection around threatened species exclusion zones. Forestry practices are modified in the buffer zone to ensure that the values of the exclusion zone are further protected. Buffer zones **must** be clearly marked in the field. Modifications to practices can include, but are not limited to:

- Additional retention of trees to meet food or habitat requirements

- Limitations on felling (for example directional felling) and machinery access
- Limitations on roadworks

Additional tree retention

In some cases, threatened species require the retention of additional trees for food or habitat throughout the relevant part of the forestry operations area, to ensure the ongoing viability of the species in the area.

General threatened species prescriptions

Three general conditions apply for threatened species protection. These conditions recognise that habitat elements can be the same for different species in a complex forest system:

- Retained trees can count as habitat trees if they meet the requirements.
- Riparian exclusion zones can count as threatened species exclusions if they overlap and meet the habitat needs.
- Buffer and exclusion zones that form the edge of the forestry operation **must** be marked and the marking must remain visible throughout the operation.

FOP note

The locations of all threatened species records will be provided on the FOP map supplied by DECCW and must be recorded on the FOP template. Exclusion zones related to these recorded locations are to be marked in the field (within the forestry operation area).

4.4 Protecting soil and water resources

Soils contain nutrients, minerals and small organisms that contribute to forest growth and diversity. Careless forestry operations can result in major damage to or loss of soil. Soil erosion is the biggest cause of water pollution in forestry operations and can lead to increased stream sediment and nutrient loads with adverse effects on fish and other aquatic fauna and water quality.

Soil Profiles

A soil profile is the cross-section of soil from the surface to the underlying rock (Figure 4.7). A cut road batter is a good place to see the soil profile. Soil profiles have four layers:

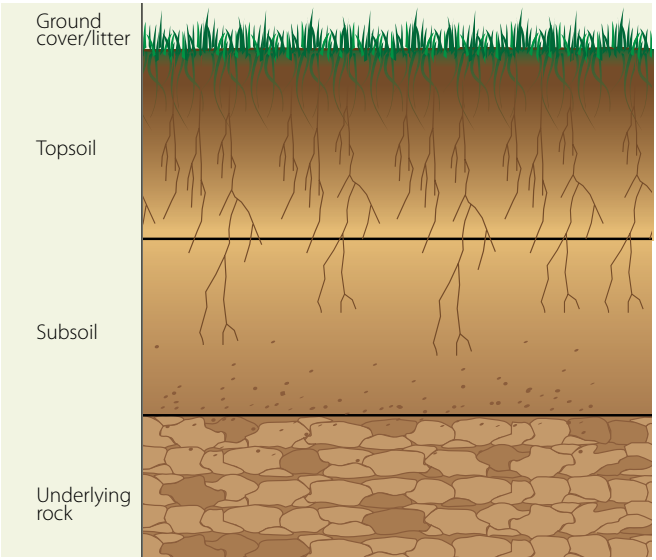
Ground cover/litter: Vegetation on the ground, fallen or dead plant material and rock or gravel. These materials cover and protect the soil surface against erosion.

Topsoil: Contains most of the root mass and is generally less erodible than the subsoil because it is bound together by roots and other organic material.

Subsoil: Has fewer nutrients than topsoil and is more likely to erode when exposed.

Underlying Rock: The original rock which is what the topsoil and subsoil characteristics are based on. Where soils are shallow, the underlying rock may be exposed on the ground surface.

Figure 4.7: Cross-section of soil showing the four layers.



Soil characteristics

Soil is based on the underlying rock that breaks down over time forming soil particles. These particles are different sizes and make up the texture of the soil:

- clay - less than 0.002 mm
- silt - 0.002 to 0.02 mm
- sand - 0.02 to 2 mm
- gravel - greater than 2 mm

The parent material (underlying rock) influences the colour and texture of the soil. Coarse-grained (sandy) soils may come from granite and sandstone. Fine-grained (clay and silty) soils may come from rocks like basalt and shale. The colour of the soil can help to identify erodible soils:

- **Granite** soils tend to be a dull grey or yellow and are generally **highly erodible**
- **Shales**, **slates** and **granodiorites** tend to be yellow and/or red and **moderately erodible**
- **Basalts** are a bright red and normally **stable** or very stable. A bright soil usually indicates high clay content.

4.4.1 Soil erosion and mass movement

Forestry operations can contribute to land degradation if not undertaken appropriately.

Land degradation includes:

- Accelerated soil erosion
- Mass movement
- Degradation to watercourses

Soil erosion

Soil erosion is a natural process resulting from soil particles being dislodged by wind, rain, and frost. Forest operations can increase erosion by removing groundcover, loosening and exposing the soil. It is worse in highly erodible or unstable soil types, and where bare soil is exposed to flowing water.

Forms of soil erosion include:

- Sheet erosion: the removal of surface soil in a thin layer, or sheet. Soil particles are dislodged by raindrop splash and water flowing in a sheet across the soil surface.
- Rill erosion: the removal of soil in small channels (<30 cm deep) caused by the concentration of water flow.
- Gully erosion: the removal of soil in deep channels (>30 cm deep) caused by the continued concentration of water flow over a longer distance.

Soil erosion hazard

Soil erosion hazard is determined from:

- **Rainfall energy** (amount of **rainfall** and frequency of **storms**)
- The **steepness** of the land
- **Soil type** (indicates **erodibility**)
- Amount of **groundcover**

Operational factors which can influence soil erosion include:

- **Timing** of activities
- **Machinery** type
- **Groundcover** and soil disturbance
- Extraction **track and road** patterns

Mass movement

Mass movement is where large amounts (more than 10 cubic metres) of soil and earth shift downslope. It includes land slips and landslides. Mass movement risk can be affected by:

- Past land management practices
- Poor road and track location and construction
- Excessive clearing and removal of groundcover and trees
- Geology (the underlying rocks)
- Soil type and depth
- Rainfall
- Slope

4.4.2 Drainage features

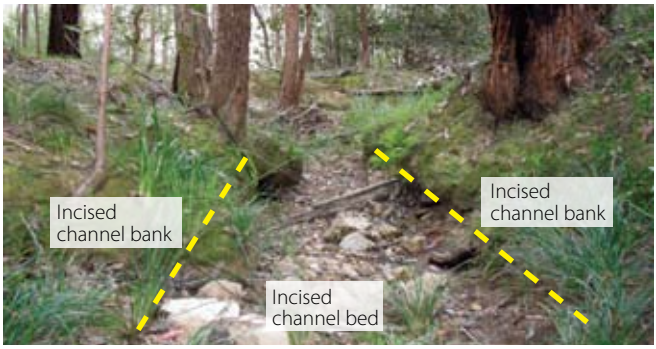
➲ The Code reference: 4.4

A **drainage feature** is any part of the landscape that naturally conveys or holds concentrated water flow. Drainage features include natural drainage depressions (Figure 4.8), which occasionally carry water, through to rivers and lakes which permanently carry water. Drainage features must be protected to:

- Minimise bank erosion
- Minimise pollution
- Provide refuge for aquatic and terrestrial biodiversity

Figure 4.8 (a) (b): Types of drainage features

(a) Drainage depression PHOTO: Greg Steenbeeke



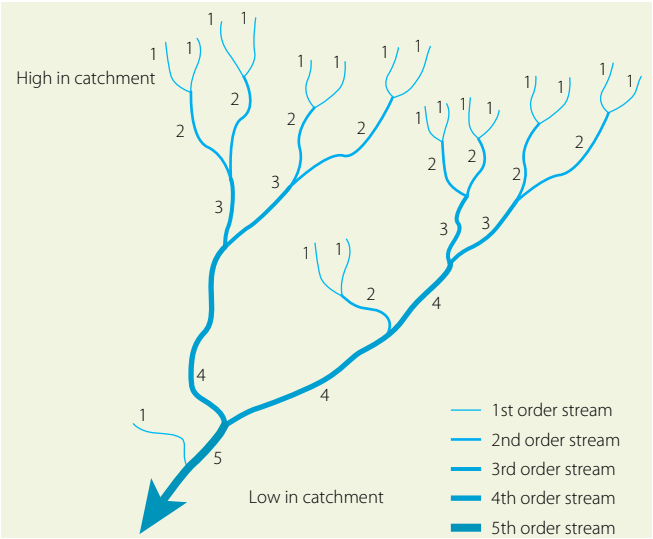
(b) Drainage line PHOTO: PF Olsen Australia

Stream order

➲ The Code reference: 4.4(2)

The natural drainage pattern of catchments is a branching network of drainage features. Stream order refers to the different levels of branching of drainage features that are shown on topographic maps (Figure 4.9). The Code prescriptions to protect streams are based on the level of stream order. Higher stream orders have greater protection in the Code.

Figure 4.9: Stream order



4.4.3 Managing soil and water

➲ The Code reference: 4.4

Prevention of soil erosion and water pollution

Soil erosion and water pollution resulting from forestry operations can be limited by:

- **Minimising** disturbance of groundcover and soil
- **Restricting** the speed and volume of flowing water
- **Protecting** drainage features
- **Minimising** streambed and bank disturbance during crossing
- **Trapping** sediment at the source using sediment traps (although prevention of erosion is the preferred method)

Protection of drainage features

The Code ensures drainage features are protected from soil erosion and water pollution by:

- Listing prescriptions for the construction, maintenance and use of forest infrastructure (see section 5.3 Forest Infrastructure); and
- Limiting forest operations within and around drainage features by applying riparian exclusion and buffer zones.

The intent of these exclusion and buffer zones is to protect habitat features along waterways, and to prevent soil erosion and water pollution from forestry operations.

Riparian exclusion zones

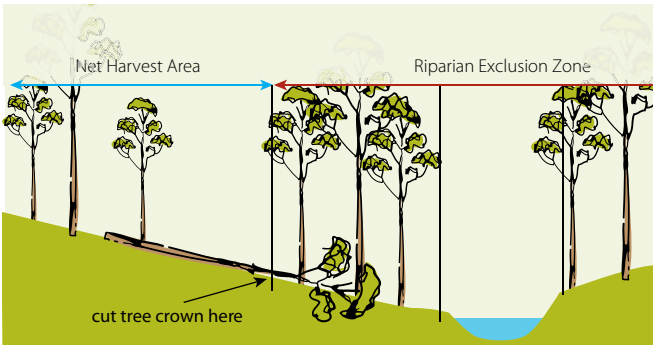
➲ The Code reference: 4.4(1,3,4,5,6,10&11, Table F)

Riparian exclusion zones extend from the banks of the drainage feature out to the distance specified in the Code 4.4(1), Table F (also see Table 3 and Figures 4.11b & 4.12 in this guide). All forestry operations are excluded from riparian exclusion zones, except where specifically permitted for drainage feature crossings and road construction or maintenance. This means that machinery must not enter riparian exclusion zones, and trees cannot be felled into or out of the zones. Debris from tree harvesting must not be allowed to enter riparian exclusion zones. If a tree is accidentally felled into an exclusion zone, the tree crown must be cut off at the boundary of the exclusion zone and left where it fell, before any saleable log can be removed (Figure 4.10). Machinery must not operate in the exclusion zone.

Note

It is recommended that exclusion zones be marked in the field and operators must use techniques such as directional felling to ensure that harvested trees do not enter the zone.

Figure 4.10: Accidental falling into exclusion zone



Unmapped drainage features

➲ The Code reference: 4.4(8,12,13)

Not all drainage features appear on maps.

Unmapped drainage depressions: Machinery can operate in unmapped drainage depressions, however disturbance must be minimised by using walkover techniques, minimising skewing the machinery tracks, operating with the blade up, and not snigging along the depression. Machinery must also not operate in the drainage depression when the soil is saturated (Figure 4.11a).

Unmapped drainage lines: Where an unmapped drainage line is found in the forestry operations area, it must be protected by a machinery exclusion zone of 10 metres from the top edge of the drainage feature bank (Figure 4.11b).

Machinery exclusion zones

➲ The Code reference: 4.4(7,8,9,10,11)

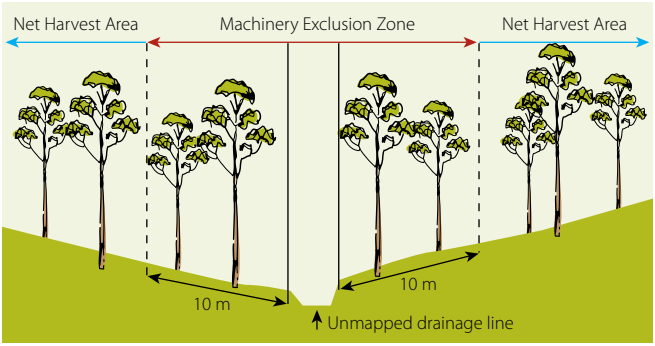
Forestry operations are allowed in machinery exclusion zones; however, specific limitations apply:

- Machinery must be rubber-tyred and can only be operated using walkover techniques, where vegetation and groundcover is retained
- Trees must be felled away from the drainage line
- If a furrow is created from the removal of logs, it must be treated to ensure that concentrated water flow does not occur
- Groundcover (grasses, herbs and forest litter) must be retained, or reinstated

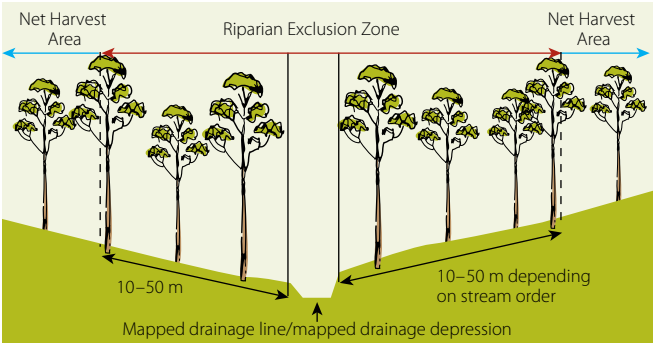
Table 3: Riparian exclusion zones (adapted from the Code 4.4, Table F)

Drainage feature	Riparian exclusion zone distance from drainage feature
Mapped first-order streams	10 metres
Mapped second-order streams	20 metres
Mapped third-order streams	30 metres
Mapped fourth-order streams	40 metres
Mapped fifth-order or higher streams	50 metres

Figure 4.11 (a) (b): Protection of drainage features



(a) Unmapped drainage line showing machinery exclusion zone

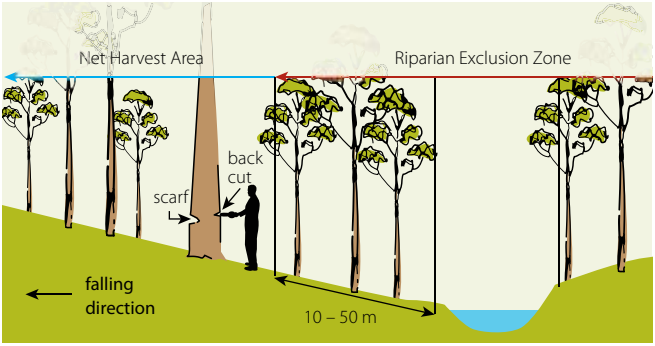


(b) Mapped stream (1st , 2nd , 3rd, 4th, 5th order and greater)

Directional felling

Directional felling is a harvesting technique where an experienced operator is able to guide the falling direction of a tree away from an exclusion zone or similar, by careful placement of the scarf and backcut (Figure 4.12).

Figure 4.12: Directional felling away from a Riparian Exclusion Zone



4.5 Additional resources

DECCW documents (available on the DECCW website at www.environment.nsw.gov.au/pnf/):

Private Native Forestry advisory notes 1 to 15

Identification guidelines for endangered ecological communities

Threatened Species Advisory Notes

5. Forest infrastructure

It is likely that there is existing forest infrastructure (roads, drainage feature crossings, snig tracks, log landings and mill sites) within your forestry operation area. This section outlines what the Code requires to ensure that existing and new forest infrastructure are fit to be used for forestry activities.

Steps to success

Step 1: Identify suitable **existing infrastructure**. Map on FOP.

Step 2: Identify any **new infrastructure** required. Specify location and design in FOP.

Step 3: Undertake **road maintenance and construction**.

Step 4: Ensure ongoing maintenance throughout the operation and keep a **record** in your FOP.

Step 5: When the operation is finished, make sure roads, tracks and landings are **closed or maintained** as required for ongoing property management and record this in your FOP.

5.1 Constructing and maintaining roads

➲ The Code reference: 5.1

It is better that **construction of new roads is minimised** but sometimes it is necessary. This is particularly so where construction of a new road will have less environmental impact than use of an existing road. If new roads are needed, this section will also provide guidance about where they should go and how to ensure that they are built to a suitable standard for forestry operations.

5.1.1 Road maintenance

➲ The Code reference: 5.1

Properly maintained roads reduce soil erosion and water pollution because the road surface is stable and drainage structures divert water to stable areas. Maintenance is also cheaper than either rehabilitation of degraded roads or new construction. Well maintained and drained roads can also be used sooner after wet weather.

Key principles

1. **Plan your road needs** to minimise disturbance and cost, and to maximise usefulness and longevity
2. **Use existing roads** rather than building new ones, where possible
3. **Maintain** as much **vegetation and topsoil cover** as possible
4. Keep roads as far **away from drainage features** as practicable
5. **Choose** the most appropriate **drainage structures** to ensure that water leaves the road with minimal erosion
6. **Avoid** steep slopes
7. **Maintain** road surfaces and drainage structures to avoid the risk of soil erosion and water pollution
8. **Seek expert advice** if you are unsure

Note

Time and effort spent on initial good design and construction will provide major benefits for many years to come.

5.1.2 Road design and location

Important considerations when planning the road network are:

- The location of timber resources
- The location and condition of existing roads
- Where new roads should be constructed
- The amount of traffic that will use the roads
- The slope of the land
- Environmental factors such as highly erodible soils, drainage features and environmental exclusions

Road Design

The characteristics of your property will affect road design.

- Flat or gentle conditions are easier to road than steep slopes
- Steep roads increase erosion and make it more difficult in effectively draining the road
- Stable soils are better to work with than erodible or dispersible soils

Road design will also be influenced by the amount of traffic which is expected.

- Truck traffic has a heavy impact on road condition
- The number of trucks using the road will guide the choice of road surface and road width
- Trucks, especially when fully loaded, have difficulty travelling on steep roads

Ask an expert

Road design can be challenging. If you are unsure about your obligations or how to design your road network, then you should seek the services of an experienced professional forester or engineer.

Road location

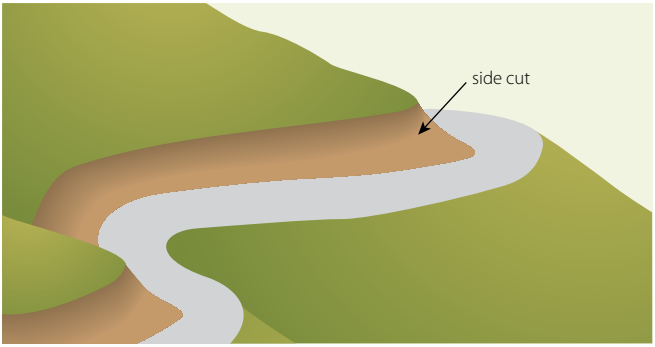
➲ The Code reference: 5.1(3)

Roads are best located close to the crest of a ridge and constructed with outfall drainage (Figure 5.1). This means that less construction effort is required and drainage will be easier to achieve. It also means that you will avoid steep topography.

If you can't locate the road on or close to a ridge, then the best road location is the one which minimises the amount of earthworks and enables the most effective road drainage (Figure 5.2).

Figure 5.1: Ideal road location – ridge crest

Figure 5.2: Mid-slope road with a side cut



5.1.3 Road construction

➲ The Code reference: 5.1

Road construction requires earthworks and vegetation clearing, both of which have the potential to result in environmental harm.

Construction of new roads must be minimised as far as practicable.

Construction methods

There are three main construction techniques for roads. Most road networks will use all three techniques:

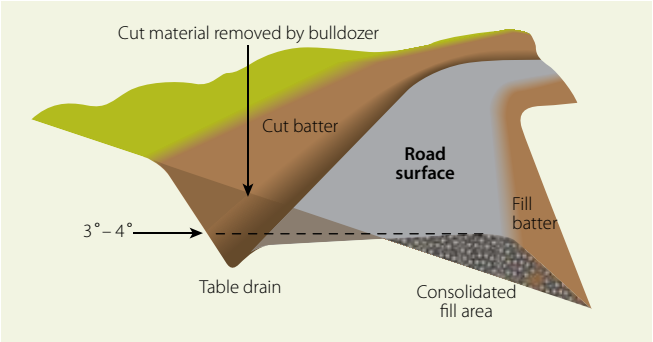
Minimal earthworks – when roads are located on ridgetops or in flat or undulating conditions, minimal earthworks may be all that is required.

Cut and fill (or side-cut) – the most common technique (Figure 5.3). In sloping terrain, material is cut from hillsides and used to level out other areas. The cut batter should be made to a stable grade which depends on the soil type. The fill batter should be well compacted to avoid erosion and slumpage of the batter and loss of the road surface. Drains should be installed as the road is constructed and drains should be located where the fill batter is at the lowest height.

Note

Tree stumps or other woody debris must not be used to provide fill for road construction.

Figure 5.3: Cut and fill road

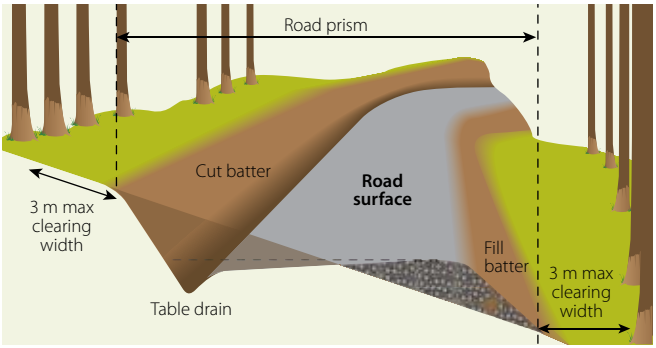


Clearing of vegetation

➲ The Code reference: 5.1(1,4&5)

The Code requires that clearing of shrubs and trees for road construction and maintenance is minimised. Clearing should not be greater than 3 metres either side of the edge of the road prism (Figure 5.4). Cleared trees and debris must not be stacked in any landscape feature (defined in the Code 4.1(1), Table C) or any riparian exclusion zone.

Figure 5.4: The road prism



Maintaining groundcover

➲ The Code reference: 5.1(4)

Groundcover can stabilise soils and prevent erosion and water pollution. Groundcover can be vegetation such as grass and herbs, but can include litter, rock and other material that protects the ground surface. The reintroduction of topsoil is critical for establishing ground cover.

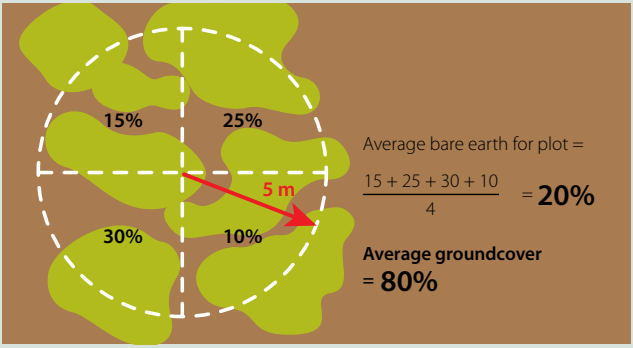
Where clearing for road construction is wider than 3 metres from batters or drains, at least 70% groundcover must be established within 1 month of clearing.

? How do I…

Assess groundcover?

At the assessment point, estimate the proportion of bare earth that is visible within a 5-metre-radius of where you are standing (Figure 5.5). This is best done by dividing the circle into four, estimating the proportion of bare earth in each quarter, then getting the average for the whole circle. Over a number of assessment points, calculate the average proportion of bare earth in the area. This average needs to be less than 30%.

Figure 5.5: Groundcover assessment



Opening existing roads

➲ The Code reference: 5.1(14&15)

Existing roads may have overgrown. Established vegetative groundcover and stable road surfaces are good for preventing soil erosion and water pollution. When re-opening roads, clearing width and disturbance to drainage structures must be minimised to retain the benefits of the established vegetation.

5.1.4 Steep areas

Road grade

➲ The Code reference: 5.1(7)

Roads must be constructed, upgraded and maintained with a maximum grade of 10 degrees. If a steeper grade will result in an improved environmental outcome (e.g. avoiding the need for a drainage feature crossing) or will mean avoiding difficult ground conditions (such as rock), then the road grade can be increased up to 15 degrees.

FOP note

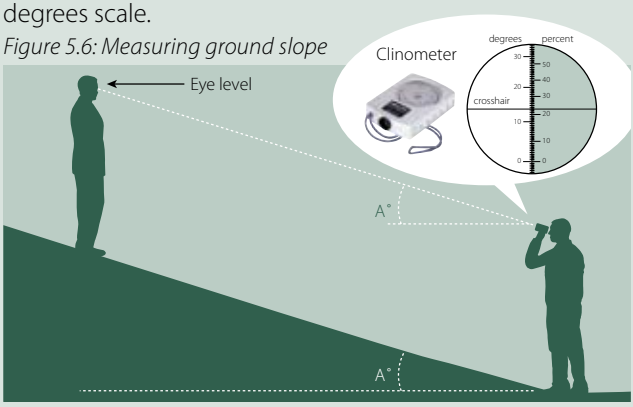
If the road grade is over 10 degrees, then you must note it in the FOP.

? How do I…

Measure road grade or ground slope?

Slope is measured using a clinometer or angle-measuring device (Figure 5.6). A clinometer has a sighting hole with a suspended circular scale within a metal case. Bring the device close to one eye and look into the sighting hole. With both eyes open, tilt the clinometer so that the line in the sighting hole is aligned with a point in the distance that is at the same height as your eye (this can be another person or a mark on a tree). Read off the slope on the degrees scale.

Figure 5.6: Measuring ground slope



Ground slope over 25 degrees

➲ The Code reference: 5.1(17)

There are significant environmental and structural issues with constructing roads on ground slopes greater than 25 degrees, therefore road construction should be avoided. If there is no other practical road location, sections of road over 25 degrees must be designed by a suitably qualified person.

5.2 Draining roads

➲ The Code reference: 5.1.1

Forest roads, if not adequately drained, can erode and lead to land degradation and water pollution. Appropriate drainage structures and outlets built into new roads in the right locations, ensure that water can leave the road surface without causing damage or pollution.

5.2.1 Types of road drains

The type of drainage structures will depend on the type of road you have.

Crossfall drainage

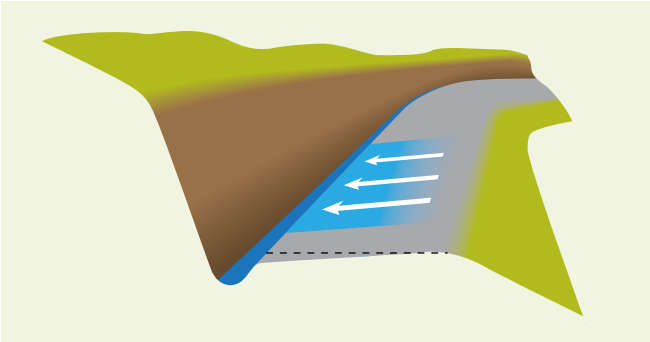
➲ The Code reference: 5.1.1(1)(c&d)

Crossfall drainage uses the slope across the road surface to direct water off the road surface. There are two types of crossfall drainage.

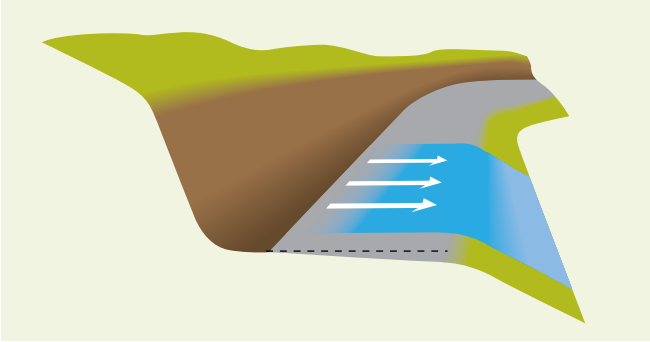
- Infall drainage directs water to a table drain and is generally appropriate for roads in hilly and steep land, or where safe road design requires it (Figure 5.7a).
- Outfall drainage directs water from the road surface to a stable road verge or shoulder (Figure 5.7b).

For effective crossfall, the slope of the road surface (from one side to the other) will be between 3 to 4 degrees (4% – 6%). This equals a 20 to 30 centimetre fall across a road 5 metres wide.

Figure 5.7 (a) (b): Examples of crossfall drainage



(a) Infall drainage



(b) Outfall drainage

Crowned roads

Wider roads and roads on level surfaces are often crowned. A crowned road is higher in the centre than on the sides. The road surface can then shed water in both directions, either to a stable road verge, or to a table drain (Figure 5.8). Generally crowning of roads requires a grader for construction, and requires regular maintenance in very dry or wet conditions unless the road has been sealed with a good quality gravel material.

Figure 5.8: Crowned road

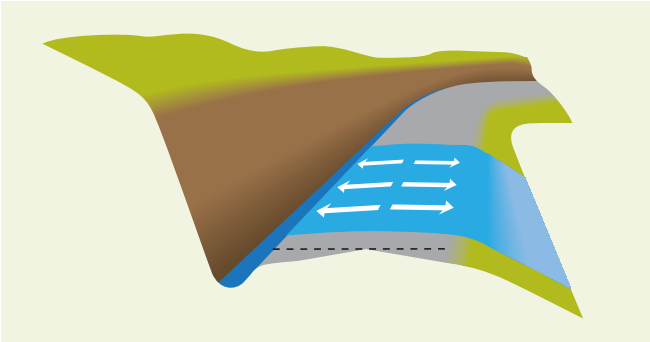


Table drains

A table drain runs parallel with the road and captures crossfall water flow from the road surface. The water is then diverted out of the table drain and across the road at regular intervals using either a relief pipe, a rollover crossbank or a spoon drain. The maximum allowable distance of water flow in between table drains is specified in the Code 5.1, Table G.

Mitre drains

A mitre drain is constructed as a water exit point for crowned roads (Figure 5.9). Mitre drains must divert water onto a stable surface and should be spaced according to the Code 5.1, Table G.

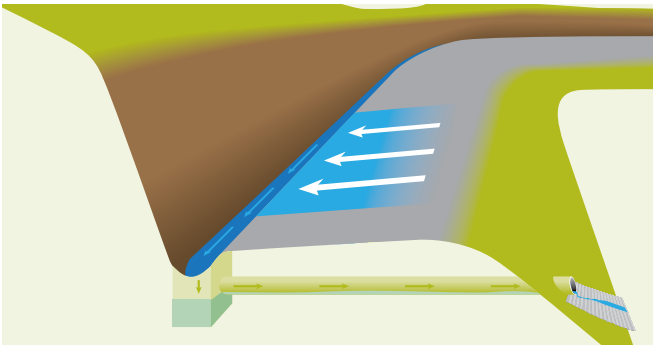
Figure 5.9: Mitre drain

Relief culverts

➲ The Code reference: 5.1.1(8)

Relief culverts divert water from table drains under the road surface to a safe exit point on the other side of the road (Figure 5.10). Relief culverts should not discharge onto fill batters unless the batter is protected from scouring. Pipes can be made from a variety of materials, including concrete, plastic and steel.

Figure 5.10: Relief culverts

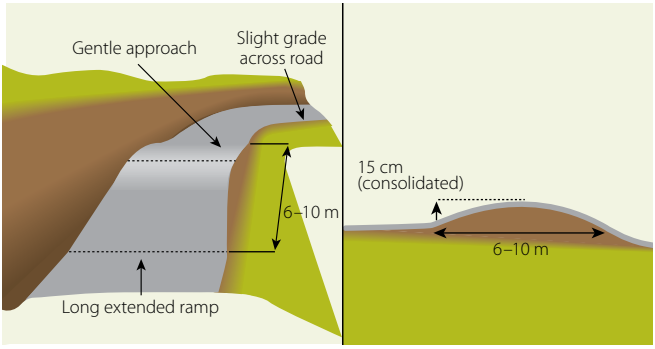


Rollover banks

➲ The Code reference: 5.1.1(6)

Rollover banks are a type of cross drain. They are a low mound constructed across the road surface, which diverts runoff from the road (Figure 5.11). They are a good way of draining roads with a low grade (less than 5 degrees) during timber haulage but can be difficult for trucks to negotiate on steeper grade roads. They are useful structures to build on completion of operations where use of the road in the future is planned. Rollover banks can be used with either infall or outfall drainage and must have an effective height of 15 centimetres (consolidated).

Figure 5.11: Rollover bank

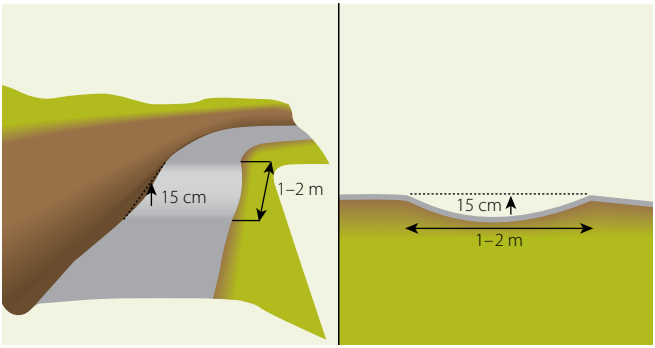


Spoon drains

➲ The Code reference: 5.1.1(6)

Spoon drains are another type of cross drain. They are a shallow ditch in the surface of the road which works in a similar way to rollover banks (Figure 5.12). They are generally not as effective as rollover banks, and so are better used on flatter ground. Spoon drains can be used together with either infall or outfall drainage and must have an effective depth of 15 centimetres.

Figure 5.12: Spoon drain

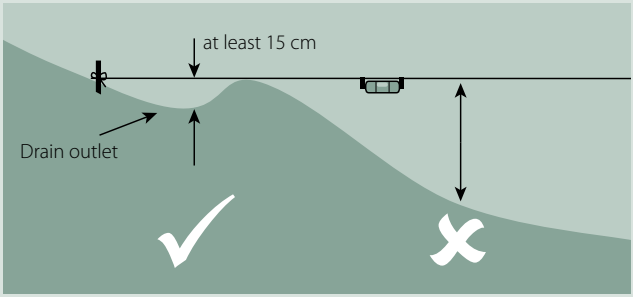


? How do I…

Measure effective bank height or depth for a rollover bank or spoon drain?

Put the end of a tape measure into the lowest part of the drain outlet (Figure 5.13). Hold the tape vertically and, using a string-line held level with the top of the bank, measure from the string-line to the lowest part of the drain. Where this line hits the tape is the effective height.

Figure 5.13: Measuring effective bank height



5.2.2 Where should drains be located?

➲ The Code reference: 5.1.1(3&7)

The Code specifies the maximum allowable distance of water flow along roads according to the grade of the road (Table 4). The steeper the grade of the road, the more often runoff needs to be diverted from the road surface. Runoff must be diverted onto a stable surface, which will not erode. Runoff should not be diverted onto other roads, snigtracks, log landings and portable mill sites, or other disturbed areas.

Table 4: Maximum distance that water may travel along road surfaces and table drains

➲ The Code reference: 5.1(Table G)

Road grade (degrees)	Maximum distance (metres)
0 to ≤ 3	175
> 3 to ≤ 5	100
> 5 to ≤ 8	80
> 8 to ≤ 10	60
> 10 to ≤ 15	40
> 15 to ≤ 20	25
> 20 to ≤ 25	20

Earth windrows

➲ The Code reference: 5.1.1(4&5)

Earth windrows along the road shoulder often result from road construction, maintenance activities and high traffic flow in very dry or wet conditions (Figure 5.14). In some instances windrows are effective in channelling water flow along the road shoulder above high fill batters, to prevent erosion from concentrated water flow. The water flow can be diverted from the road surface at a point where the fill batter is not as high. However, earth windrows must be cut through at regular intervals related to the grade of the road (Table 4) or removed from the road shoulder.

Figure 5.14: Earth windrow

5.2.3 Sediment and erosion control

➲ The Code reference: 5.1.1(7)

Drainage structures concentrate water. Therefore the exit point of the drainage structure (outlet) must:

- Slow the water down – slowing water flow helps to prevent erosion
- Be a stable surface
- Disperse water via silt traps or ground cover – this allows sediment and nutrients to be filtered out of the water and reduces pollution (Figures 5.15a&b)

What is a stable surface?

A stable surface is able to withstand erosion and damage from concentrated waterflow. Stable surfaces at a drainage structure outlet include:

- Good ground cover (established grass and vegetation)
- Natural rock or artificially rocked surfaces
- Concrete
- Fill batter drop down structures

Poor outlet protection can result in severe erosion (Figure 5.16).

Figure 5.15 (a) (b): Examples of good outlet protection

(a) Establishing groundcover

(b) Artificially rocked surface

Figure 5.16: Example of poor outlet protection

Protection of fill batters and unstable surfaces

➲ The Code reference: 5.1(6&7) & 5.1.1(8)

Fill batters are a high risk area for potential soil erosion.

To protect fill batters:

- Do not leave tree stumps and vegetation in fill
- Compact the fill with multiple passes of a dozer or roller
- Sow sterile or native grass to stabilise the face of the batter
- If the fill batter is higher than 1 metre, install a drop-down structure and dissipater at drainage outlets (Figure 5.17)

Protection of cut batters

Cut batters are also a risk area for soil erosion. To protect cut batters:

- Ensure the grade of the cut batter is appropriate for the soil type to avoid erosion or slumping
- Minimise disturbance above the cut batter (this will reduce water flow down the batter)

Figure 5.17: Drop-down structure and dissipater

5.2.4 When you've finished

➲ The Code reference: 5.1(9&11)

At the end of the operation roads must be assessed for their ongoing use.

If not needed for ongoing property management, roads must be stabilised, have effective drainage structures put in place and be allowed to revegetate.

If needed for ongoing property management, roads must be maintained to remain stable with functional drainage structures and sediment controls.

5.3 Constructing and maintaining drainage feature crossings

➲ The Code reference: 5.1.2

Crossings are where roads and snig tracks cross drainage features. Crossings increase the potential for erosion and water pollution. It is important that extra care is taken when dealing with drainage feature crossings.

Key principles

1. **Minimise construction of** new drainage feature crossings
2. **Choose the right crossing type** and design it to suit the circumstances
3. **Avoid disturbing** the banks and bed of watercourses to avoid **changing** the natural flow of the watercourse
4. Use **construction materials** that will not cause water pollution and will stay in place during storms
5. **Stabilise** any disturbed areas after construction and maintenance

Ask an expert

Seek expert advice if you are unsure about drainage feature crossings.

5.3.1 Crossing design and location

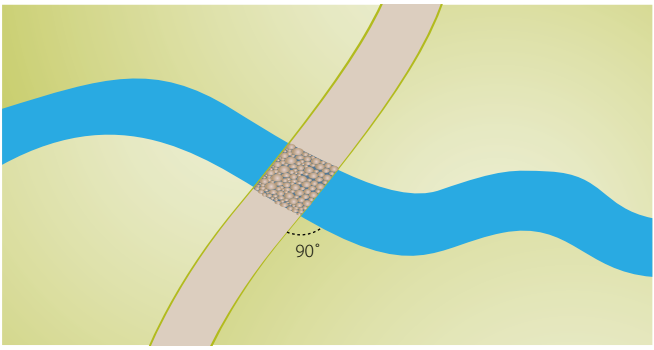
Design requirements

Crossing design

➲ The Code reference: 5.1.2(3)

Crossings must be constructed at right-angles to the flow of water in the drainage feature wherever possible (Figure 5.18). In some circumstances using an angled approach may improve environmental outcomes, but this should be avoided.

Figure 5.18: Crossing approach at right angles



Crossing design must:

- Take account of the requirements of fish and other aquatic animals
- Limit disturbance to the stream banks and stream bed
- Limit changes to the natural flow of the stream

Design capacity

➲ The Code reference: 5.1.2(6)

The design capacity of the crossing is a measure of its ability to convey and withstand the water flow from storm events of a particular size.

If the crossing is permanent it must be designed so that it can carry the water that results from a one-in-five-year storm event (i.e. the heaviest storm that can normally be expected in any five-year period). It must also be able to stay in place in the event of a one-in-ten-year storm event. Bridges must be designed and constructed so the natural stream flow is not restricted and erosion is minimised.

Crossing location

➲ The Code reference: 5.1.2(2)

Crossings should be located where construction will cause minimal disturbance to stream banks, stream beds and natural flows. Drainage feature crossings should be minimised.

FOP note

Drainage feature crossings should be recorded in the FOP.

5.3.2 What types of crossings can be used?

➲ The Code reference: 5.1.2(1)

Crossings must be stable causeways, culverts or bridges. Gully stuffers may be used if stable but **must not** be constructed.

Causeways

➲ The Code reference: 5.1.2(8)

Causeways are a natural or constructed crossing that enables vehicles to cross a drainage feature with minimal disruption to the stream bed (Figure 5.19). The water flows over a causeway. Causeways must be constructed of non-soil material to minimise soil turbidity. For example crushed gravel, rock, bitumen, concrete or logs.

Figure 5.19: Causeway

Culverts

Culverts are constructed crossings that allow water to pass under the road formation (Figure 5.20). They are commonly constructed using round pipes with a layer of fill over the top of the pipe. This fill is compacted and leveled to form the road surface.

Figure 5.20: Culvert crossing

Bridges

Bridges are constructed over a watercourse, and allow the streamflow to pass under the structure (Figure 5.21). Generally, bridge timber (logs) can be accessed on-site. Bridges can be constructed with limited or no disturbance to the drainage feature banks or bed.

Figure 5.21: Bridge

Gully stuffers

New gully stuffers are not to be constructed under any circumstances. A gully stuffer is where logs, debris or soil material have been placed to fill a gully at the crossing point (Figure 5.22). There is limited capacity for water to exit along the natural stream course. Existing gully stuffers can be used if they are stable and require no additional maintenance work.

Figure 5.22: Gully stuffer

PHOTO: PF Olsen Australia

5.3.3 Crossing construction and maintenance

When constructing or maintaining crossings you must:

- **Prevent** erosion and water pollution
- Ensure fish and other aquatic animals can continue to **travel up and down** the water course
- **Minimise changes** to the natural flow of the stream and the shape and condition of the stream banks and stream beds
- **Minimise disturbance** to soil and streamside vegetation
- **Not place** fill material **into** the **watercourse**
- **Store fill material outside** the **exclusion zone** for the watercourse

Crossing and approach material

➲ The Code reference: 5.1.2(2,7&8)

The material that is used on the crossing surface and on the approaches to the crossing must be stable so that it won't be displaced during normal use of the crossing, or by the water flow resulting from a one-in-ten-year storm event.

The base of the crossing must be made of erosion-resistant material.

Disturbed areas

➲ The Code reference: 5.1.2(4)

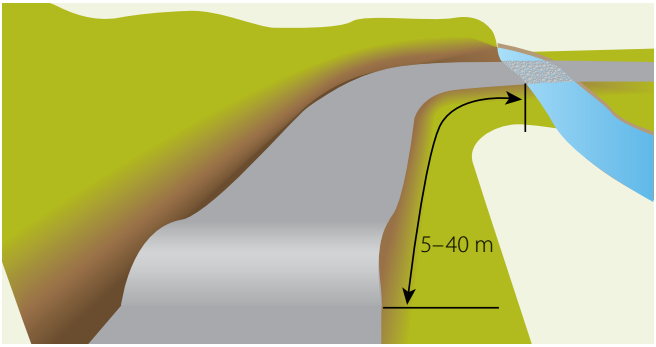
If the bed and banks are disturbed during construction and maintenance, they must be reshaped and stabilised as soon as possible. Stabilisation techniques can include the use of rock, gabions, reno mattresses, geotextile and revegetation.

Road drainage approaching crossings

➲ The Code reference: 5.1.2(5)

Drainage feature crossings are critical sites for preventing sediment pollution of streams as roads can be a major contributor of sediment. Approaches to the crossing must be drained effectively at a point between 5 and 40 metres of the drainage feature crossing (Figure 5.23). This is to ensure that polluted water is prevented from entering the drainage feature at the crossing.

Figure 5.23: Draining crossing approaches



When you've finished

Crossings must be able to continue to withstand storm events and carry water without polluting after the operation is completed. It is important to decide whether the crossing will be removed (if it can be done safely), stabilised and put out of service or maintained for ongoing property management.

5.4 Snig tracks

➲ The Code reference: 5.2.1

Snig tracks are used to transport logs from the harvest site to the log landing or portable sawmill site.

Extra care must be taken because snig tracks are subject to heavy machinery traffic, which results in increased ground and soil disturbance, and therefore a greater risk of soil erosion and water pollution.

Key principles

1. **Use existing** snig tracks and log landings wherever possible
2. **Use walkover techniques**
3. **Maintain** as much **ground cover** as possible
4. **Minimise** damage to other trees and vegetation
5. **Retain logging slash** on snig tracks
6. **Avoid drainage feature crossings** if possible
7. **Avoid steep slopes** wherever possible
8. **Maintain drainage structures**

5.4.1 Snig track design, location and layout

➲ The Code reference: 5.2.1(6,7&11)

The location of snig tracks should reflect the location and distribution of log landings or portable sawmill sites in relation to the location of timber resources.

- **Consider the number** of snig tracks needed:
  - **Too few**: higher machine costs (have to travel further for logs) and more potential for concentrated soil damage and compaction
  - **Too many**: higher construction costs and greater widespread disturbance
- **Use** an **uphill snigging** pattern wherever possible
- **Downhill snigging** patterns are a **greater erosion risk** because they concentrate water and are harder to effectively drain
- **Downhill snigging is unsafe**
- Where downhill snigging is necessary, ensure snig tracks **enter the log landing from the side or from below** to prevent runoff discharging onto the log landing site
- **Locate tracks** where the groundslope allows them to **drain naturally**
- **Avoid drainage feature crossings** wherever possible
- Locate tracks away from exclusion zones

5.4.2 Construction and maintenance of snig tracks

Environmental protection

➲ The Code reference: 5.2.1(2)

Avoid groundcover and soil disturbance and soil exposure when constructing, maintaining and using snig tracks.

Snig tracks must not be constructed or used within exclusion zones except where explicitly permitted by the Code.

Walkover extraction

Walkover extraction is where harvesting machinery extract logs without the need for earthworks, and without removal of underlying soil and vegetation (Figure 5.24). This is the preferred technique, as it reduces the need for snig track construction.

Figure 5.24: Slash and groundcover retention from walkover extraction

Re-opening old snig tracks

➲ The Code reference: 5.2.1(4&5)

Minimise soil and vegetation disturbance. Old snig tracks must not be re-opened and used if they cannot be drained properly.

Note

During all forestry operations, the use of bulldozer and skidder blades should be restricted to the minimal removal of obstructions (which include logs, tree heads and rocks) and the construction or maintenance of drainage.

Steep areas

➲ The Code reference: 5.2.1(10)

Snig track grade must not be greater than 25 degrees except where the Code allows it for improved environmental outcomes. If the track is greater than 25 degrees:

- It must **improve** the environmental outcome (compared to alternatives)
- It must not be greater than **28 degrees**
- **Effective drainage** must be achieved
- It must be **less than 75 metres** long

FOP note

If the track grade is greater than 25 degrees, you must note it in the FOP.

5.4.3 Draining snig tracks and log landings

Where should drains be located?

➲ The Code reference: 5.2.1(14)

Drainage structures must divert water onto a stable surface such as ground cover that can withstand concentrated waterflow without eroding and can trap sediment.

Snig track drainage spacing

➲ The Code reference: Table G

Table 4 specifies the maximum allowable distance of water flow along snig tracks, which is dependant on the snig track grade. The steeper the grade, the more often runoff needs to be diverted from the snig track. Runoff must be diverted onto a stable surface, which will not erode. Runoff should not be diverted onto other snig tracks, roads, log landings and portable mill sites or other disturbed areas.

Size and types of snig track drainage structures

Snig track drainage techniques

➲ The Code reference: 5.2.1(15)

Snig tracks can be drained using any of the following techniques:

- Retain the existing groundcover using **walkover** techniques
- **Retain or install slash** and harvesting debris on snig tracks
- Construct or maintain **outfall drainage** on the snig track
- Construct **crossbanks**

Crossbanks

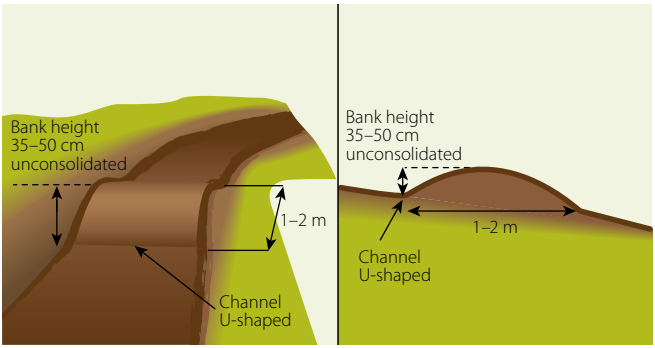
➲ The Code reference: 5.2.1(17&18), 5.2.2(5)

Crossbanks must have an effective height of at least 35 centimetres if the soil has not been compacted, or 25 centimetres if the soil has been compacted (Figure 5.25). As a guide, crossbanks should not be higher than 50 centimetres.

A crossbank must be constructed between 5 and 40 meters of a drainage feature crossing.

They must be constructed from earth, rock or gravel, without any bark or organic material, although bark and other forest debris can be retained on snig tracks between drainage structures.

Figure 5.25: Snig track cross bank



5.4.4 Snig track crossings

➲ The Code reference: 5.2.2

When planning the location of snig tracks, the number of crossings must be minimised.

Machinery must not cross a drainage feature which has running water or when the soil is saturated, except by means of a stable crossing.

The types of snig track crossings that can be used include stable causeways, culverts or bridges (see section 5.3.2). Existing, stable gully stuffers can be used; however, **no new gully stuffers can be constructed.**

The snig track approach must be as close as possible to right angles to the flow of water.

When you've finished

➲ The Code reference: 5.2.1(16), 5.2.2(7)

The most important action is to install effective drainage. This should occur immediately, and must occur within two days unless the soils are saturated. Effective drainage is either crossfall drainage, or crossbanks at the spacings specified in Table 4.

If practical, you must reshape the snig track to remove all earth windrows, wheel ruts and log furrows. Recoverable topsoil must be spread back over the surface of the track to assist revegetation.

Note

It is recommended practice to drain snig tracks progressively as you complete operations in any particular area. Therefore you should install effective drainage on a specific snig track when you have finished using it.

Parts of the snig track approaching crossings must be reshaped to match the original natural ground surface as closely as possible. If vegetation groundcover will not grow back naturally, a suitable sterile seed or native seed with fertiliser must be sown to establish effective groundcover.

5.5 Log landings and portable mill sites

➲ The Code reference: 5.2

Log landings and portable sawmill sites are used to sort, process and load logs or sawn wood onto trucks for transport (Figure 5.26).

Extra care must be taken in these areas because they are subject to heavy traffic. This results in increased ground disturbance and water runoff, and therefore a greater risk of soil erosion and water pollution.

Figure 5.26: Log landing

5.5.1 Design and location

Size

➲ The Code reference: 5.2(2)

Log landings and portable sawmill sites must be no larger than the minimum size necessary for efficient operations.

The size of log landings and portable mill sites should cater for:

- **safe operation** of harvesting and loading machinery and trucks
- the amount of **truck traffic** using the site
- the **volume of logs** and/or timber which is expected to be serviced, processed and loaded on the site
- any relevant **environmental requirements**

Location

➲ The Code reference: 5.2(1&5)

Wherever practicable, log landings and portable mill sites must be located on ridge-tops. Consider the location of existing roads, snig tracks and timber resources.

Log landings and portable sawmill sites must be located at least 10 metres away from any exclusion zone.

Managing water flow

➲ The Code reference: 5.2(4&6)

Log landing and portable mill sites must be located and constructed to ensure that they drain naturally using crossfall. Runoff must be diverted to a safe point where it can discharge onto established vegetation away from any drainage feature.

Debris management

➲ The Code reference: 5.2(7,8&9)

Large volumes of tree waste and sawdust are generated at log landings and portable sawmill sites. This waste can:

- Create a fire risk
- Affect soil quality
- Lead to water pollution
- Damage retained trees (protected vegetation)

This tree waste and sawdust must be removed as harvesting operations progress, and be distributed through the harvest area in small volumes. The waste must not be stacked against any retained trees, as this creates a fire risk that could result in the tree being damaged or destroyed.

Vegetation and debris from these sites must not be deposited in a riparian exclusion zone.

When you've finished

➲ The Code reference: 5.2(10)

Any topsoil that has been removed from the log landing or portable sawmill site must be respread from the stockpile over the site at the completion of harvesting.

Mill sites and log landing sites must be drained and reshaped so that water runoff can safely disperse from the site into surrounding undisturbed vegetation.

5.6 Using forest infrastructure

Forest infrastructure is subject to heavy use by trucks and harvesting equipment which can result in rapid deterioration, particularly in wet conditions. The Code addresses this by identifying circumstances when forest infrastructure cannot be used.

Key principles

1. **Avoid** operating in **wet weather**
2. **Maintain** stable and effective **drainage structures** and surfaces
3. **Choose** the right machinery
4. **Remedy damage** to infrastructure as soon as possible

5.6.1 Wet weather limitations for forestry operations

➲ The Code reference: 5.2.3

Harvesting on wet and saturated soils is likely to cause environmental harm and damage to forest infrastructure (Figure 5.27). The Code includes specific limitations for operations.

General harvesting limitations

➲ The Code reference: 5.2.3(1)

Harvesting operations must not occur when:

- There is runoff from the snig track surface
- Soils are saturated
- Soil is rutted to a depth of more than 200 millimetres below the track surface over a 20-metre section or longer

Figure 5.27: Consequences of using roads in wet weather

5.6.2 Maintaining Stable Surfaces

Blading off

➲ The Code reference: 5.1(16) & 5.2.1(9)

Blading off must not be undertaken under any circumstances. It is a technique where the wet, soft, top layer of a road, snig track, log landing or portable sawmill site, is removed using a grader or bulldozer, to reveal a firm surface underneath. Blading off results in greater water concentration, soil compaction, progressive degradation and environmental harm and can mean that the road is impossible to effectively drain.

Impacts of log trucks on roads

➲ The Code reference: 5.1(12)

Log trucks are heavy and can easily damage poor road surfaces.

Trucks cannot use forest roads where the surface of the road has broken down (Figure 5.28). Road surface breakdown is defined as rutting of more than 150 millimetres deep for a distance of more than 20 metres.

Figure 5.28: Example of road surface breakdown

Trucks cannot use natural surface roads where there is water runoff from the road surface, as there is an increased risk of soil erosion. If the truck is already loaded or partially loaded, it can travel to its destination using the road.

Note

If there is any water runoff from the log landing, all machines must remain stationary. You can still use forwarders, excavators and truck-mounted loaders to load trucks, but these machines must remain stationary. The only exception to this is if the log landing is constructed of gravel or other stable material.

6. Ensuring outcomes

6.1 Auditing of forestry operations

An audit is a planned activity involving staff from DECCW and the landholder or their representative. The landowner can request an audit from DECCW at any stage. DECCW may undertake audits at anytime during, post or pre forestry operations, with or without the landholder's or contractor's consent.

DECCW will contact the landholder or their representative and arrange a suitable time for the audit. Audits will be conducted by trained and experienced DECCW officers, who will discuss the landholder's operations and inspect the property to examine aspects of the forestry operations being conducted.

Aspects to be examined may include the protection of environmental values, retention of residual basal area, and regeneration. The results of the audit will be discussed with the landholder.

The aim of the audit is to:

- Ensure the landholder and operator comply with the Code
- Gather information to support any audit findings
- Discuss audit outcomes and any follow-up actions with the landholder and contractor where necessary
- Improve operational best practice

6.2 Reporting requirements

➲ The Code reference: 2.2

The Code requires landholders to report to DECCW if they have carried out PNF operations in the previous year, or if they plan to undertake PNF operations in the current year.

Landholders do not need to provide a report if they have not carried out any PNF operations in the previous year, and have not carried out (or intend to carry out) PNF operations in the current year.

A sample report is available at www.environment.nsw.gov.au/resources/pnf/annual_reporting_template.pdf

Reports may be submitted by post, via email to pnf@environment.nsw.gov.au, and are **due at the end of March each year**.

6.3 Forest management certification

Many markets for forest products are increasingly demanding timber that has been produced under a forest management system which has been certified to either the **Australian Forestry Standard** (AFS) or the **Forest Stewardship Council** (FSC). Forest management certification offers landowners the opportunity to access a wider range of markets by implementing and having certified a system of operations. This ensures that operations are undertaken legally, to the highest standards and under a regime of continuous improvement.

It is possible for smaller owners to participate in Group Certification schemes (for AFS or FSC or both), which reduce certification costs while still offering the additional environmental management and product marketing advantages.

6.4 Additional resources

DECCW document (available on the DECCW website at www.environment.nsw.gov.au/pnf/):

Sample 'Annual Reporting Template'

Certification:

Australian Forestry Standard – www.forestrystandard.org.au

Forest Stewardship Council – www.fscaustralia.org

7. Tools to help you

7.1 Equipment

There is a range of equipment which is recommended or useful to assist you to plan, undertake and monitor native forestry operations.

Equipment that you should have:

- 30 metre tape for measuring distance and tree height
- A compass
- Clinometer for measuring ground slope, road grade and tree height
- Dendrometer/relaskop or basal area prism for measuring basal area
- Diameter tape for measuring trees
- Global Positioning System (GPS) for locating mapped features in the field
- String line and string line level
- Binoculars (for locating nesting sites in trees)
- Field note book
- Tree marking tape or paint

7.2 Mapping skills

Running a native forestry operation requires skills in map reading and interpretation. Maps assist the reader to locate themselves, features and details of the forest operation.

7.2.1 Map Reading

The Forest Operation Plan map

The main map you will use during the PNF operation is the FOP map (Figure 7.1). The base FOP map is provided by DECCW and will include the following features:

- Property boundary
- Boundary of the approved PNF area
- Areas excluded from operations
- Contours
- Drainage features
- North arrow
- Map scale
- Legend

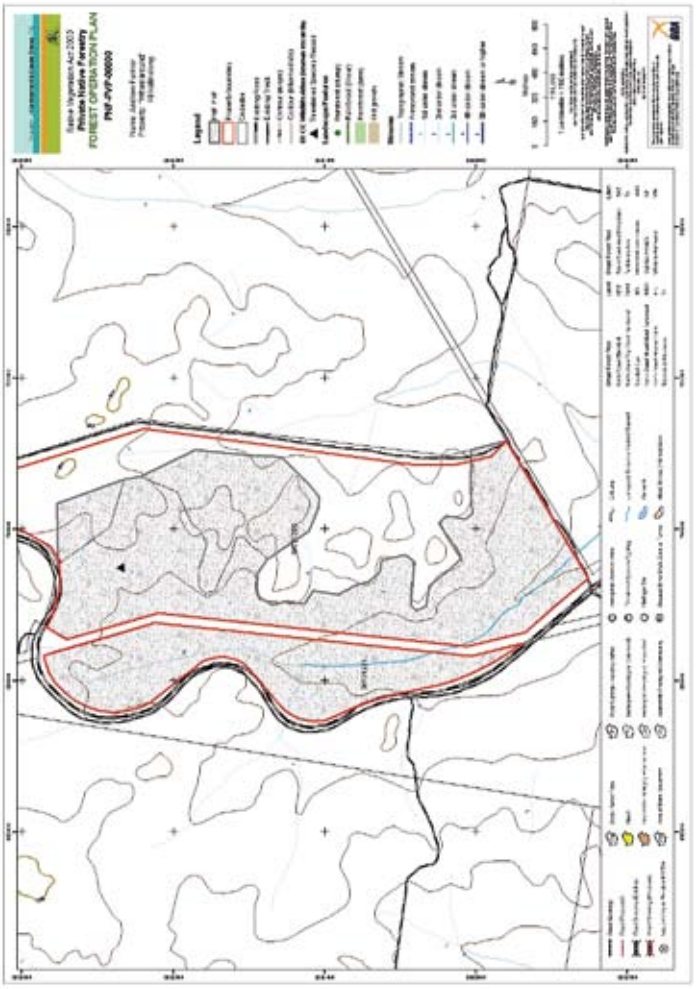
Additional features must be marked on the FOP by the person planning the forestry operation. These features include, but are not limited to,

- Existing and proposed roads
- Existing and proposed drainage feature crossings
- Log landings and portable mill sites
- Landscape features

The FOP map is based on a topographic map. If the forestry operations area for the current operation does not include the entire approved PNF area, the FOP map will show the area covering the current operation. This is referred to as the FOP area in the FOP.

Symbols are used on maps to represent features which exist on the ground. These symbols are shown in the FOP map legend.

Figure 7.1: An example of a FOP map



7.2.2 Interpreting the Forest Operation Plan map

Direction

The FOP map is aligned with the top to the north and the bottom to the south.

Orientating a map

The map is oriented when it is placed in the same alignment as features on the ground. This is done by rotating the map until identifiable features lie in the same direction on the map as on the ground. Alternatively, orientation can be achieved by aligning the top of the map with the north end of the compass needle.

Orienting the map when it is being read is a good habit to get into. It helps with interpreting features on the map and finding those same features on the ground.

Scale

The map scale is the relationship between distance on the map to the actual distance on the ground.

? How do I…

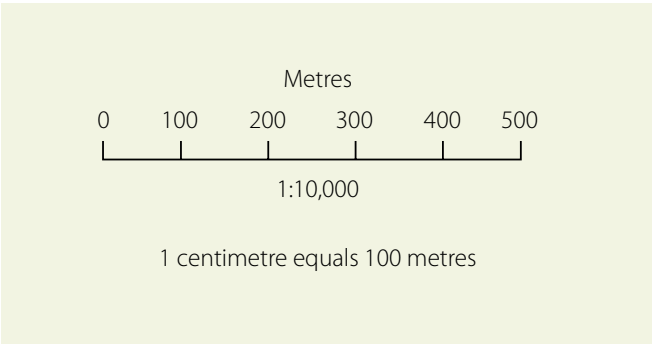
Use the map scale

A scale of 1:25,000 means that 1 unit of distance on the map represents 25,000 units on the ground.

So, 1 centimetre on the map = 25,000 centimetres on the ground (this is the same as 250 metres or 0.25 kilometres)

A scale bar on the map is another way to determine distance on the ground (Figure 7.2).

Figure 7.2: Example of a scale bar from a FOP map

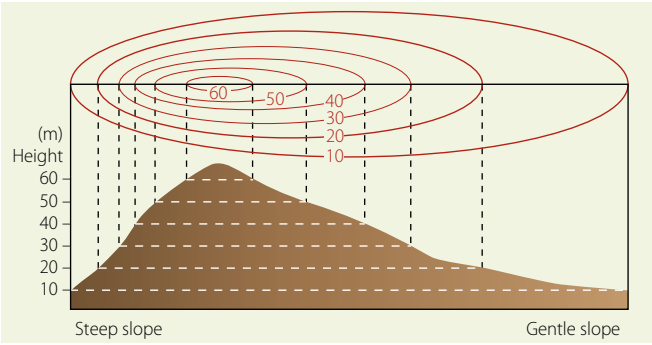


Contour lines

Contour lines are drawn on the map to connect points that are the same height above a known point. On the map, each contour is drawn at a specific height above sea level, with the vertical distance between contours being the same distance. This difference in height is called the **contour interval**. The contour interval on the FOP map varies depending on the source mapping. Some contour lines have the height above sea level printed in places along the line.

The height and spacing of contours relates to the shape (topography) of the ground (Figure 7.3).

Figure 7.3: The relationship between contour lines and slope

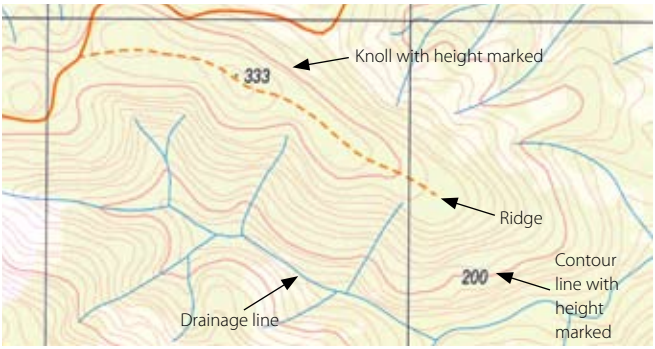


The most important points to remember about contour patterns are:

- contour lines close together indicate steep slopes
- contour lines far apart indicate gentle slopes
- evenly spaced contours indicate uniform slope

Each topographical feature such as a ridge, knoll or stream is represented by characteristic contour patterns (Figure 7.4).

Figure 7.4: Topographic map with features labelled



7.3 Measuring trees and stands

Measuring trees and stands provides useful information about how much wood is present on your property. These measurements are also required to ensure that you comply with a number of sections of the Code.

7.3.1 Height

Measuring tree height

There are a number of ways to measure tree height using a variety of measuring tools from a tape measure, a clinometer and tape measure, to a Vertex. Each method varies in its accuracy and ease of use.

The easiest technique is by using a tape measure and two people. The first person stands well back from the tree, and the second person stands at the base of the tree.

Holding a 40 centimetre section of tape vertically out in front of them, the first person closes one eye and looks past the edge of the tape so the tree appears next to the tape. Moving the tape so the end (0 centimetre) lines up with the base of the tree, they can then measure the apparent height to the top of the tree.

The next step is to mark 10% of this apparent height on the tree. The second person puts a mark on the tree where the first person tells them to (the point where 10% of the apparent height is). The height from the ground to the mark on the tree is 10% of the tree height. Measure this height on the tree and multiply the measurement by 10 to get the total tree height. For this method, there is no need to know how far away the first person is from the tree or to worry about sloping land.

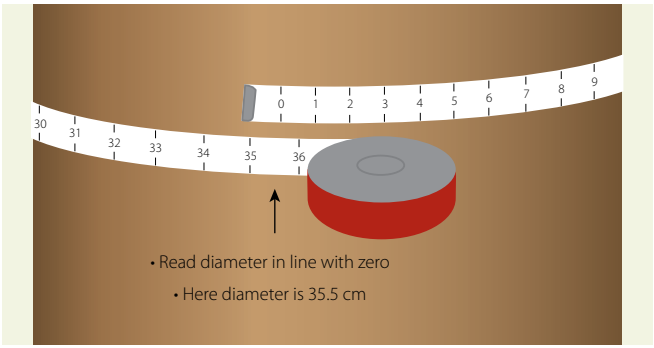
Measuring stand height

Stand height is the average height of five dominant trees within the stand of each broad forest type. These trees must be within the proposed harvest area.

7.3.2 Measuring tree diameter

In Australia it is standard practice to measure the diameter of a tree at 1.3 metres above the ground on the uphill side. This is termed 'Diameter at Breast Height Over Bark' (DBHOB). A height of 1.3 metres is used because it is a convenient height for most people, is usually above any buttressing or fluting at the base of the tree and is usually not obstructed by undergrowth. Diameter is usually measured with a fibreglass or metal diameter tape and is expressed in centimetres, rounded down to the nearest whole centimetre. (Figure 7.5)

Figure 7.5: Measuring tree diameter



7.3.3 Basal area

Tree basal area

Basal area (BA) is the cross-sectional area of a tree measured at **breast height** (1.3 metres) over bark (Figure 7.6). As this is an area measurement, the units are in metres squared.

Figure 7.6: Measurement of breast height

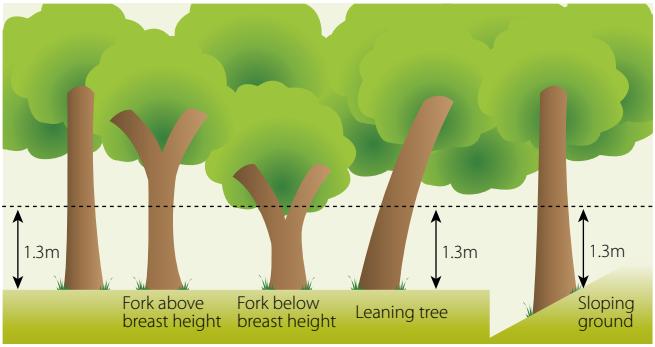
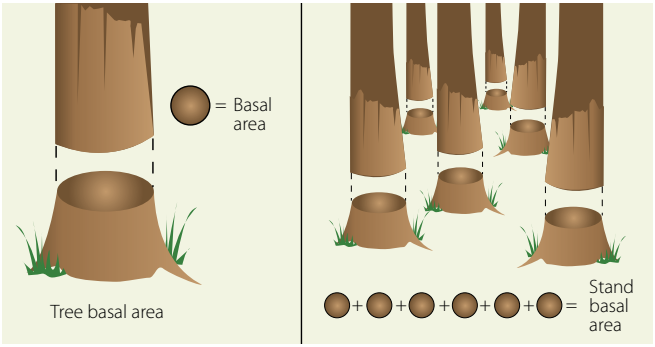


Figure 7.7: Tree and stand basal area

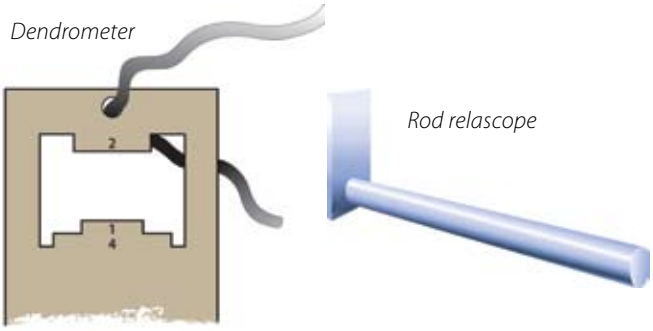


Stand basal area

Stand basal area is the sum of the basal areas of all trees within the operational area expressed in metres squared per hectare (Figure 7.7). Imagine you cut down every tree on a hectare of land and that all the stumps were 1.3 meters high. The stand basal area is the total surface area of all of those cut stumps. Stand basal area can be measured in either of two ways, angle count sampling, or fixed area plot.

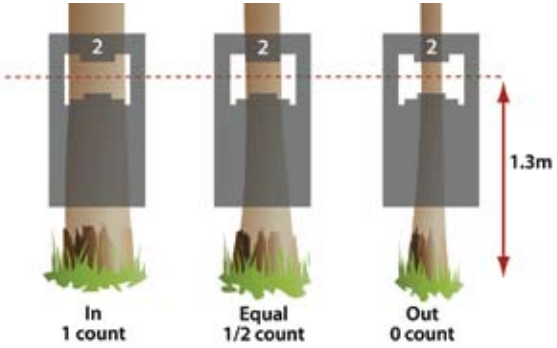
Angle count sampling: This method provides an easy and unbiased measurement of basal area using one of a range of tools (Figure 7.8).

Figure 7.8: Dendrometer and rod relascope for angle count sampling.



The method requires the measurer to stand adjacent to a fixed point and 'sweep' around with the eye above the fixed point, assessing which trees are 'in', 'equal' and 'out'. All the trees that are 'in' and 'equal' are tallied as 1 and 0.5 trees, respectively (Figure 7.9). The final tally is multiplied by a basal area factor (BAF) to determine the basal area for the angle count plot.

Figure 7.9: Assessing 'in', 'equal' and 'out' trees using a BAF of 2



Fixed area plots: This method requires the user to establish a number of fixed area plots within which the diameter of each tree is measured and converted to a basal area. The basal area for each tree is then summed and converted to a basal area per hectare, by adjusting for the area of the plot.

In the Code, stand basal area is assessed by taking an average across the stand in accordance with approved guidelines

(see 'Additional resources' at the end of this section). Angle count sampling is quicker and easier than fixed area plot measurement, but is less accurate.

7.4 Assessing regeneration

The Code requires landowners to assess regeneration and stocking 36 months after a regeneration event occurs. In the Code, harvesting or thinning is a regeneration event for Western Hardwoods. A regeneration event for Cypress Forests is the second successive wet summer following harvesting or thinning. Stocking and regeneration rates must equal or exceed the requirements of the Code.

7.5 Using Global Positioning Systems

Global Positioning Systems are an accurate means of identifying where you are in the forestry operations area and can be of significant value for mapping and for field marking, particularly in dense undergrowth or where topographic features are not obvious. Various hardware and software are used to locate certain points on the earth (e.g. property boundaries, roads). This technology uses a receiver to pick up signals from satellites that orbit the earth and convert these signals to provide the location of the GPS unit. Although they can be very accurate, the accuracy is limited by the quality of the receiver, satellite reception, topography, canopy cover and other factors.

Even if you have a GPS, you still need to be able to understand and interpret topographic maps.

7.6 Additional resources

DECCW documents (available on the DECCW website at www.environment.nsw.gov.au/pnf/):

Guideline 1 – Guidelines for assessing regeneration and stocking

Guideline 4 – Techniques for measuring stand height

Guideline 5 – Techniques for measuring stand basal area (in press)

TAFE NSW offer courses in mapping – www.tafensw.edu.au

Glossary of forestry terms

Term	Description	Page #
Accidentally felled	A tree is accidentally felled into any area of land only if it is apparent that techniques of directional felling were used in an attempt to fell the tree away from the area. Despite the above, a tree is not accidentally felled into an area if the person responsible knew or could reasonably have been expected to know that the tree would fall into the area.	36
Backcut	Relates to tree felling. The backcut is the final cut made to fell the tree. It is on the opposite side of the direction of fall. Also see 'scarf'.	39
Batter	An earth slope formed from fill material (fill batter) or cut into the natural hillside (cut batter) during road construction.	30, 44, 45, 51, 54, 55, 56, 57
Cohort	A group of trees developing after a single disturbance event.	21
Diameter at breast height over bark (DBHOB)	The diameter of a tree measured at 1.3 metres above the ground. Measurements are made over the bark and horizontal to the trunk.	84
Directional felling	The felling of a tree so it falls in a pre-determined direction.	26, 28, 29, 36, 39
Dispersible soil	A structurally unstable soil which readily disperses into its constituent particles (clay, silt, sand) in water.	20, 42
Drainage depression	A shallow depression with a smoothly concave cross-section that conveys runoff only during or immediately after periods of heavy rainfall.	33, 37, 38

Glossary of forestry terms

Term	Description	Page #
Drainage feature	A drainage depression, drainage line, river or watercourse.	8, 33, 34, 35, 36, 37, 38, 40, 41, 42, 47, 58, 60, 61, 63, 64, 65, 68, 69, 79
Drainage line	A channel down which surface water naturally concentrates and flows. Drainage lines exhibit one or more of the following features which distinguish them from drainage depressions: » evidence of active erosion or deposition, e.g. gravel, pebble, rock, sand bed, scour hole or nick point » an incised channel more than 30 centimetres deep with clearly defined bed and banks » a permanent flow.	33, 37, 38, 83
Drainage structure	A structure designed to convey water away from a road, track or area of soil disturbance.	41, 46, 48, 55, 57, 64, 67, 68, 72
Earth windrow	A mound of soil material or gravel on the edge of a road or snig track formed by the spillage from the edge of a blade or similar machine during earthmoving operations.	54, 69
Exclusion zone	An area of land (within a specified distance of landscape features identified in Tables C or F) where forestry operations are prohibited, unless otherwise allowed under the Code.	28, 29, 36, 37, 38, 39, 45, 62, 65, 71
Extraction track	A track constructed for use by forwarding machinery.	32

Term	Description	Page #
Food resource trees	Trees with recent V-notch incisions or other incisions made by a yellow-bellied glider or squirrel glider. Recent incisions are incisions less than two years old as evidenced by the fact the incision has not grown over.	21, 22, 25
Forestry operations	All clearing resulting from activities associated with forest management including harvesting operations, construction and maintenance of roads and tracks, and prescribed burning for regeneration.	1, 4, 8, 9, 10, 15, 16, 18, 19, 20, 21, 25, 28, 29, 31, 35, 36, 37, 40, 66, 73, 76, 78, 79, 88
Gabion	A wire cage filled with rocks used to stablise stream banks.	63
Geotextile	Cloth or clothlike materials intended for use in the soil, usually for filtering or containing soil water. Often used to prevent or control erosion.	63
Girders	High-quality logs used in a round- or flat-faced form to support a deck such as a bridge, wharf or a large end-section; heart-free, sawn timber suitable for heavy construction.	2
Gully stuffer	A drainage feature crossing formed by filling the drainage feature with trees, debris, spoil, soil, rock or other material to the level of the road or track.	60, 62, 69
Habitat tree	A tree retained for habitat purposes under the Code.	15, 21, 29
Harvesting operations	Harvesting operations include: » timber felling, snigging and extraction » construction and maintenance of log landings, snig tracks and extraction tracks.	71, 73

Glossary of forestry terms

Term	Description	Page #
Heathland	Areas dominated (covers more than 50% of the area) by shrubs generally less than 2 metres tall at maturity.	19
Highly erodible soil	A soil where the particles are readily detached and transported by erosive forces. The presence of these soils may be identified by evidence of existing erosion (gully or rill erosion), or by commonly known problem soil types, e.g. some coarse-grained granites.	20, 31, 40
Incised channel	A channel more than 30 centimetres deep with clearly defined bed and banks.	33
Log landing	An area (usually cleared) where timber products are assembled for processing and sorting before being loaded onto a truck.	8, 40, 53, 64, 65, 67, 69, 70, 71, 72, 74, 75, 79
Machinery exclusion zone	Land within 10 metres of the top edge of the bank of any unmapped drainage line.	37, 38
Mass movement	The downslope movement of greater than 10 cubic metres of soil, where gravity is the primary force or where no transporting medium such as wind, flowing water or ice is involved.	20, 31, 32
Nest trees	Trees with nests or roosts of any species of raptor, including powerful owls, barking owls, sooty owls and masked owls. Trees with nests of colonial-nesting water birds (groups of stick-nests).	21, 24
Net harvestable area	The area under the PNF PVP where harvesting is permitted in accordance with the Code.	36, 38, 39

Term	Description	Page #
Old growth	Ecologically mature forest where the effects of disturbance are now negligible. This includes an area of forest greater than 5 hectares where: » the overstorey is in late to over-mature growth stage with the presence of relatively large old trees (many containing hollows and often with the presence of dieback or dead branches in the crown) » the age (growth) structure of the stand measured as relative crown cover consists of less than 10% of regeneration and advance growth and more than 10% of late to over-mature (senescent) growth » the effects of unnatural disturbance are now negligible » Old growth woodlands west of the Great Dividing Range, while comprising a characteristic canopy of late to over-mature trees (many with hollows), may comprise a woodland structure with less diverse or often shrubby understorey and a groundcover of grasses and herbs.	19
Portable mill site	A site where a portable mill (easily movable milling equipment) operates.	8, 53, 64, 65, 67, 70, 71, 72, 74, 79
Protected trees	» trees required to be retained under section 4.2 » plants of the genus *Xanthorrhoea* (grass trees), genus *Allocasuarina* (forest oak) and genus *Banksia* » other trees that are required to be retained by the Code.	21, 25, 26

Glossary of forestry terms

Term	Description	Page #
Pulp logs	Logs cut and prepared primarily to produce wood pulp for the manufacture of reconstituted products including paper and panel board.	2
Recruitment tree	A tree capable of developing hollows to provide habitat for wildlife and which comes from the next smaller cohort than habitat trees.	21, 22, 23
Regenerate	Renewing tree cover by establishing young trees naturally or artificially.	13, 16, 23
Reno mattress	Similar to a gabion, but the wire cage is long and flat (looking like a mattress). Used to stabilise stream crossings.	63
Riparian exclusion zones	Those areas within the distances specified for 'Drainage feature' as listed in Table F where forestry operations are not permitted, unless otherwise allowed by this Code.	29, 35, 36, 38, 39, 45, 71
Road	Any route used for vehicular access to, and the transport of logs from, the point of loading (log landing) within the forest area.	4, 8, 19, 28, 30, 32, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 57, 58, 61, 63, 67, 71, 73, 74, 75, 78, 79
Road prism	That part of the road from the inflexion point at the toe of the fill batter to the inflexion point at the top edge of the cut batter. Where there is no cut or fill batter as part of the road, the road prism is to be taken from the outside edge of the table drain on either side of the road.	45

Term	Description	Page #
Rocky outcrops and cliffs	A 'rocky outcrop' has an area of 0.2 hectares or larger, where 70% or more of the surface is composed of exposed boulders of more than 0.6 of a metre in diameter. 'Cliff' means a rocky slope steeper than 70 degrees and more than three metres high.	20
Rollover bank	A crossbank constructed with a smooth cross-section and gentle batters, which is well-compacted.	51, 52, 53
Roost trees	Trees with nests or roosts of any species of raptor, including powerful owls, barking owls, sooty owls and masked owls, and trees which support maternity bat roosts.	21, 22, 24
Sawlog	Log of a species suitable for processing through a sawmill into solid timber products.	2
Scarf	Relates to tree felling. The scarf is the wedge-shaped piece of wood that is cut from the side of the tree in the direction of fall. It is also known as the face cut or notch cut.	39
Silvicultural operations	The activities associated with the management of trees within a forest for the purpose of meeting sustainable long-term productivity objectives, including thinning, single tree selection and creation of canopy openings.	4, 8, 10, 11, 12, 14
Snig track	A track used by snigging or skidding equipment.	13, 14, 15
Spoon drain	A drain with a semi-circular cross-section, which has no associated ridge of soil. Its capacity is solely defined by the excavated channel dimensions.	8, 40, 58, 64, 65, 66, 67, 68, 69, 71, 73, 74
Stand height	Mean height of the five dominant trees in the stand. Measurement of stand height must conform to methods described in approved guidelines.	50, 52, 53

Term	Description	Page #
Stocking level	A measure of the frequency of occurrence of tree stems assessed as being capable of growing to canopy level. Measurement of stocking levels must conform with methods described in approved guidelines.	9, 13, 15, 17, 84, 88
Thinning	A silvicultural practice where some trees are removed in order to increase the growth of retained trees.	16
Timber products	Commercial timber products removed from or felled within the forest, including sawlogs, veneer logs, poles, girders, piles and pulp logs.	13, 14, 15, 16, 88
Veneer log	High quality logs that are rotary peeled or sliced to produce sheets of veneer.	2
Walkover techniques	Timber extraction or snigging without removing or unduly disturbing the existing natural groundcover, i.e. where no snig track construction involving soil disturbance is required.	2
Wet summer	Summer with above average rainfall persisting through the summer period.	37, 64, 66, 68
Wetland	Includes any shallow body of water (such as a marsh, billabong, swamp or sedgeland) that is: » inundated cyclically, intermittently or permanently with water » vegetated with wetland plant communities.	19

Private Native Forestry **Code of Practice** for Cypress and Western Hardwood Forests

The following section is a direct copy of the February 2008 PNF Code of Practice excluding the Appendix.

At the time of publication, the Department of Environment, Climate Change and Water (DECCW) was known as the Department of the Environment and Climate Change (DECC) and the Minister was referred to as the Minister for Climate Change, Environment and Water.

Note: A full version of the Code, including the Appendix, can be found on the PNF webpage www.environment.nsw.gov.au/pnf/

Contents

Introduction

The object of this Private Native Forestry Code of Practice (the 'Code') is to ensure the supply of timber products from privately owned forests at a regular rate that can be maintained indefinitely for present and future generations, while at the same time maintaining non-wood values at or above target levels considered necessary by society for the prevention of environmental harm and the provision of environmental services for the common good.

'Cypress Forests' mean forests dominated by white cypress pine (*Callitris glaucophylla*), being forests in which at least 80% of the stand basal area comprises trees of that species.

'Western Hardwood Forests' mean forests that are consistent with the description of any of the Forest Types 99, 103, 104, 124, 171–178, 180–185, 203–210 and 213 set out in the document called *State Forests of NSW Research Note 17*.

Assessment of broadscale clearing for private native forestry

Under the Code, broadscale clearing for the purpose of private native forestry improves or maintains environmental outcomes if:

- it complies with the requirements of this Code
- any area cleared in accordance with the Code is allowed to regenerate and is not subsequently cleared except where otherwise permitted by this Code.

Note: A landowner may seek development consent to undertake private native forestry (PNF) outside the provisions of the Code under the Native Vegetation Act 2003 (NV Act).

Minor variation of Code

If, when preparing a Forest Operation Plan under the Code, the projected impact on the net harvestable area is greater than 10%, a landholder can request an accredited expert to examine the Forest Operation Plan and determine if it is appropriate to modify the environmental prescriptions of the Code in a specified manner.

A private native forestry Property Vegetation Plan (PVP) may modify in a specified manner the environmental prescriptions of the Code if an accredited officer is satisfied that:

1. the variation of the environmental prescriptions is minor
2. the proposed clearing will improve or maintain environmental outcomes
3. strict adherence to the Code is in the particular case unreasonable and unnecessary.

The Code

1. Property Vegetation Plans

1. Before any forestry operations commence on private land, a Property Vegetation Plan (PVP) under the NV Act must be approved by the Minister for Climate Change, Environment and Water.
2. Forest operations under an approved PVP must be conducted in accordance with all provisions of this Code.
3. For the purpose of preparing a PVP, the Department of Environment and Climate Change (DECC) will provide available digital information of landscape features (as identified in Table C) and any drainage features (as identified in Table F).

2. Forest operation planning and management

2.1 Forest Operation Plan

1. A Forest Operation Plan must be prepared before forest operations commence.
2. A Forest Operation Plan must be in an approved form and consistent with the provisions of this Code and the requirements of the Listed Species Ecological Prescriptions for Cypress and Western Hardwood Forests, which are set out in the Appendix to this Code.
3. The landowner and anyone else carrying out forest operations must read, sign and date the Forest Operation Plan.
4. A copy of the Forest Operation Plan must be available on-site when forest operations are occurring.
5. A Forest Operation Plan must contain the following:

   A. A map (or maps) showing:

      i. the location and boundaries of the area in which harvesting or other forest operations will occur

      ii. recorded locations of any populations or endangered ecological communities listed under the schedules of the *Threatened Species Conservation Act 1995* and species in the Listed Species Ecological Prescriptions for Cypress and Western Hardwood Forests, which are set out in the Appendix to this Code

      iii. the location of landscape features as listed in Table C and drainage features as listed in Table F

      iv. the indicative location of existing and proposed roads and drainage feature crossings

      v. the indicative location of log landings and portable mill sites

      vi. the classification of the forest area into either Western Hardwood forest type, Cypress broad forest type or mixed forest types.

B. A written component that provides:

i. details of ownership of the land

ii. a description of the broad forest types (including overstorey species composition, disturbance history and current condition of the forest)

iii. the estimated stand height and basal area for each broad forest type

iv. details of forest access, including any necessary construction, upgrading or maintenance of forest roads and drainage feature crossings

v. details of harvesting and/or other proposed forest operations

vi. details of flora and fauna management actions

vii. details of tree marking activities (where applicable)

viii. details of activities to promote regeneration

ix. details of relevant silvicultural treatments that may be carried out as part of the Forest Operation Plan.

6. The landowner may amend the Forest Operation Plan at any time, except for matters referred to in clause 2.1(5)(b)(iii). Any amendments to either the map or the written component must be noted on the Forest Operation Plan.
7. The landowner must retain each Forest Operation Plan, including any amendments, for the life of the PVP or for three years after completion of the harvesting operations for which it was prepared, whichever is the later date.
8. The landowner must provide the Forest Operation Plan, including any amendments, to an authorised officer from the Department of Environment and Climate Change if requested to do so.

2.2 Reporting

1. The landowner must lodge a report to the Department of Environment and Climate Change by 31 March each year if:

   A. forest operations have been carried out on the land to which the PVP applies in the previous calendar year, or

   B. if in the current calendar year:

      i. it is intended to carry out forest operations in the next 12 months, or

      ii. forest operations have been carried out.

2. If forest operations have been carried out on the land to which the PVP applies in the previous calendar year, the report must specify:

   A. the approximate volumes of the timber products harvested

   B. the approximate number of hectares on which forest operations occurred

   C. the silvicultural treatments that were applied during that period.

3. Silvicultural operations

3.1 Cypress pine

3.1.1 Non-commercial thinning

1. Non-commercial thinning may be applied to regrowth which is usually about 4–6 metres tall. It is essential to free regeneration that is in a state of 'lock-up'. Stands should be thinned to a spacing of about 6 metres x 6 metres (280 stems/hectare).
2. The stems to be retained should be:
   - » the largest and tallest stems
   - » the straightest stems
   - » stems with smaller limbs
   - » stems without double leaders or bends in the upper crown
   - » stems that have not been damaged.

3.1.2 Commercial thinning

1. Commercial thinning may be undertaken when trees spaced 6 metres apart have reached a commercial size. Residual basal area should be about 6–8 square metres per hectare. Non-commercial trees that are not required for habitat retention may be felled to waste to achieve this basal area.
2. The largest stems (in height and diameter) with the best form (straightest) should be selected for retention.

3.1.3 Oldest age class harvest (release operation)

1. Final harvesting of the largest age class may be undertaken when there is a regenerating age class about 4–6 metres high beneath the overstorey.
2. All trees in the older age class not required for habitat retention may be removed.
3. Damage to the younger age class should be minimised as far as practicable.

3.2 Western hardwoods

1. Single tree selection and thinning operations must not reduce the stand basal area below the limits specified in Table A.
2. The minimum stand basal areas in Table A are to be calculated in accordance with the *Silvicultural Guidelines for the Code of Practice for Private Native Forestry.*

Table A: Minimum stand basal areas for single tree selection and thinning operations

Broad forest type	Stand height (< 25 metres)	Stand height (≥ 25 metres)
Cypress	6 m^2/ha	6 m^2/ha
Western Hardwood	8 m^2/ha	12 m^2/ha

Note: For the purposes of selecting an appropriate silvicultural management regime, reference should be made to the Silvicultural Guidelines for the Code of Practice for Private Native Forestry prepared by Department of Environment and Climate Change available at www.environment.nsw.gov.au/pnf.

Note: This provision:

- *uses stand basal area as a simple tool to determine disturbance thresholds*
- *establishes harvesting limits to both maintain forest biodiversity values and manage forests while considering appropriate silvicultural practices.*

3.3 Regeneration and stocking

1. A landowner must ensure that the minimum stand stocking (as determined by the percentage of stocked plots specified in Table B) has been reached within 36 months of a regeneration event.
2. In this clause, **regeneration event** is:
   A. a harvesting or thinning operation for Western Hardwoods, or
   B. the second successive wet summer following a harvesting or thinning operation for Cypress Pine Forests.
3. A harvesting operation must not occur in a previously harvested area until stocking levels meet the minimum stocked plot requirements in Table B.
4. The percentage of stocked plots is to be measured in accordance with the method for measuring plots for sampling and measuring stocking found in the Department of Environment and Climate Change's *Private Native Forestry Code of Pratice Guideline No. 1: Guidelines for assessing regeneration and stocking*, available at www.environment.nsw.gov.au/pnf.
5. A landowner must comply with any requirements of the Director General of DECC for the purpose of regenerating or re-establishing the forest, if the minimum percentage of stocked plots has not been reached within 36 months of a regeneration event.

Table B: Minimum percentage of stocked plots

Broad forest type	Minimum percentage of stocked plots
Cypress	80%
Western Hardwood	55%

Note: Stocking is a measure of the occurrence and distribution of trees of any age throughout the forest. The simplest way to assess whether a forest is adequately stocked is to sample the level of stocking by measuring a number of plots. Plots will be found to be either stocked or unstocked. The percentage of stocked plots reflects the adequacy of stocking within the forest. Where stocking is found to be inadequate, regeneration will be required to meet the stocking requirements.

4. Protection of the environment

4.1 Protection of landscape features of environmental and cultural significance

1. Forest operations in and adjacent to specified landscape features must comply with the requirements in Table C.
2. Old growth will be identified according to the protocol approved by the Minister for Environment, Climate Change and Water, available at www.environment.nsw.gov.au/pnf.

Table C: Requirements for protecting landscape features

Landscape feature	Operational conditions
Endangered ecological communities listed in the *Threatened Species Conservation Act 1995* at the date the private native forestry PVP is approved by the Minister	Forest operations may only occur in endangered ecological communities as part of an approved Ecological Harvesting Plan approved by the Director General of the Department of Environment and Climate Change, except that existing roads may be maintained.
Endangered populations listed in the *Threatened Species Conservation Act 1995* at the date the private native forestry PVP is approved by the Minister	Forest operations must not result in any harm to an animal that is part of an endangered population, or result in the picking of any plant that is part of an endangered population, except that existing roads may be maintained.
Vulnerable ecological communities listed in the *Threatened Species Conservation Act 1995* at the date the private native forestry PVP is approved by the Minister	Forest operations must not occur in vulnerable ecological communities, except that existing roads may be maintained.
Old growth forest	Forest operations must not occur within old growth forest, except that existing roads may be maintained.
Wetlands	Forest operations must not occur in any wetland or within 20 metres of any wetland, except that existing roads may be maintained.
Heathland	Forest operations must not occur in any heathland or within 20 metres of heathland, except that existing roads may be maintained.

Landscape feature	Operational conditions
Rocky outcrops	Forest operations must not occur on any rocky outcrop or within 20 metres of a rocky outcrop, except that: » existing roads may be maintained » existing snig tracks may be used.
Cliffs, caves, tunnels and disused mineshafts (excluding open pits less than 3 metres deep)	Forest operations must not occur within 10 metres of cliffs, caves, tunnels or disused mineshafts, except that: » existing roads may be maintained.
Aboriginal object or place as defined in the *National Parks and Wildlife Act 1974*	Forest operations must not occur: » within 50 metres of a known burial siten Aboriginal scarred or carved tree. » within 20 metres of an Aboriginal scarred or carved tree » within 10 metres of a known Aboriginal object or place (this requirement does not apply to Aboriginal objects or places that may lawfully be destroyed).
Areas containing items identified as heritage items in an environmental planning instrument	Forest operations must not occur within 10 metres of a listed heritage site.
Areas of existing mass movement	Harvesting operations which create canopy openings must not occur within the area. Harvesting machinery must not enter the area. Existing roads may be maintained. New roads must not be constructed.
Dispersible and highly erodible soils	Existing roads may be maintained. Drainage feature crossings must be armoured with erosion-resistant material. Road batters and table drains must be stabilised using erosion-resistant material, vegetation or slash. Log landings must be stabilised using erosion-resistant material, vegetation or slash at the completion of forestry operations. Measures must be taken to immediately stabilise any erosion of roads or snig tracks.

4.2 Protection of habitat and biodiversity

1. Habitat trees must be retained in accordance with Table D.
2. Hollow bearing trees, recruitment trees, food resource trees, roost trees and nest trees are defined as habitat trees retained for the purposes of this Code.
3. An individual tree may satisfy more than one condition in the tree retention standards (see Table D), if it has the appropriate characteristics.
4. Retained habitat trees should, where possible, represent the range of species in mature and late mature growth stages.
5. Habitat trees should, where possible, be evenly distributed throughout the area of harvesting operations and within the net logging area. Preference shall be given to trees with well developed spreading crowns and minimal butt damage.
6. For the purpose of this clause:
   - A. A **hollow bearing tree** is a dominant or co-dominant living tree, where the trunk or limbs contain hollows, holes or cavities. Such hollows may not always be visible from the ground but may be apparent from the presence of deformities such as protuberances or broken limbs, or places where the head of the tree has broken off. If there are more than the minimum required number of habitat trees, preference should be given to the largest. Trees posing a health or safety risk may be removed and, where possible, substituted with other hollow bearing trees, and if not possible, by recruitment trees.
   - B. **Dead standing** trees cannot be counted as hollow bearing trees.
   - C. A **feed tree** is a tree that provides a source of nectar or other food for wildlife and is listed in Table E.
   - D. A **recruitment tree** is a large vigorous tree capable of developing hollows to provide habitat for wildlife. Preference must be given to trees from the next cohort to that of retained hollow bearing trees.
   - E. an **Old Grey** is a late-mature/over-mature cypress tree that has regenerated before the 1890s, has bark that is bleached to a characteristic light grey colour, and is weathered to a smoother surface texture than is typical of younger trees.
   - F. **Roost, nest and food resource trees** are defined as:
     - i. trees with nests or roosts of any species of raptor, including powerful owls, barking owls and masked owls
     - ii. trees which support maternity bat roosts
     - iii. trees with recent V-notch incisions or other incisions made by a yellow-bellied glider or squirrel glider. Recent incisions are incisions less than two-years-old as evidenced by the fact the incision has not closed.

Table D: Minimum standards for tree retention

Broad forest types	Trees that must be retained
Cypress	» All Old Greys, and 2 hollow-bearing eucalypt trees per hectare, where available. » One recruitment tree of the same species from the next cohort must be retained for every Old Grey and hollow-bearing tree retained. » Where the total Old Grey and cypress recruitment trees are less than 5 trees per hectare, additional recruitment trees must be retained to bring the number up to 5 per hectare. » Where the total hollow bearing eucalypt and eucalypt recruitment trees are less than 4 trees per hectare, additional recruitment trees must be retained to bring the number up to 4 per hectare. » All roost, nest or food resource trees.
Western Hardwood	» All Old Greys. » 20 mature healthy eucalypt trees, from the oldest age classes per 5 hectares. Preference must be given to hollow bearing trees where available. » One recruitment tree must be retained for every hollow bearing tree retained up to a maximum of 10 recruitment trees per 5 hectares. Retained recruitment trees can be counted towards meeting the 20 mature healthy trees per 5 hectares. » All roost, nest or food resource trees.

Table E: Feed trees

CMAs: Border Rivers–Gwydir, Namoi	
Forest red gum – *Eucalyptus tereticornis*	Red stringybark – *E. macrorhyncha*
Narrow-leaved ironbark – *E. crebra*	White box – *E. albens*
Ferguson's ironbark – *E. fergusonii*	Yellow box – *E. melliodora*
Caley's ironbark – *E. caleyi*	Fuzzy box – *E. conica*
Grey ironbark – *E. paniculata*	Grey box – *E. molucanna*
Mugga ironbark – *E. sideroxylon*	Bloodwood species – *Corymbia* spp.
Red ironbark - *E. fibrosa*	

CMAs: Central West, Lachlan, Murrumbidgee, Murray, Lower Murray–Darling and Western	
Grey ironbark – *E. paniculata*	White stringybark – *E. globoidea*
Eurabbie – *E. bicostata*	Red stringybark – *E. macrorhyncha*
Forest red gum – *E. tereticornis*	

4.3 Minimising damage to retained trees and native vegetation

1. As far as practicable, forestry operations must not damage protected trees.
2. Without detracting from subclause (1):
   A. debris must not be heaped around protected trees
   B. machinery operations must not harm protected trees
   C. directional felling techniques must be employed to avoid (as far as is practicable) damage to protected trees.
3. In this clause **protected trees** are defined as:
   A. trees required to be retained under clause 4.2
   B. plants of the genus *Xanthorrhoea* (grass trees), genus *Allocasuarina* (forest oak) (except bull oak (*Allocasuarina luehmannii*)), and genus *Banksia*
   C. other trees that are required to be retained by this Code.

4.4 Drainage feature protection

1. Forest operations must not occur in riparian exclusion zones, other than in accordance with this clause, and except where otherwise allowed by this Code. For the purpose of this clause, riparian exclusion zones are defined as those areas within the distances specified for 'Drainage feature' as listed in Table F.
2. For the purposes of Table F, stream order is determined according to the Strahler System, using the largest scale topographic map available for that area, and as published by the NSW Government.
3. The distance specified in Table F must be measured from the top edge of each bank and away from the incised channel or, where there is no defined bank, from the edge of the channel of each specified drainage feature.

Table F: Riparian exclusion zones

Drainage feature	Riparian exclusion zone distance from drainage feature
Mapped first-order streams	10 metres
Mapped second-order streams	20 metres
Mapped third-order streams	30 metres
Mapped fourth-order streams	40 metres
Mapped fifth-order and higher streams	50 metres

4. Where harvesting is occurring adjacent to riparian exclusion zones, all tree felling should employ directional felling to minimise as far as practicable disturbance to vegetation within the riparian exclusion zone.
5. Where a tree cannot be felled into the area outside the riparian exclusion zone using directional felling, it may fall into the riparian exclusion zone provided that not more than 6 trees within any distance of 200 metres along the boundary of the riparian exclusion zone enter the riparian exclusion zone.
6. Where a tree is felled into the riparian exclusion zone, the crown must not be removed from the riparian exclusion zone and the machinery used to retrieve the log must not enter the riparian exclusion zone.
7. Rubber-tyred machinery using walkover techniques may operate in machinery exclusion zones. All other machinery must not enter unless allowed to by this Code.
8. In this clause, machinery exclusion zones are areas within 10 metres of the top edge of the bank of any unmapped drainage line.
9. Trees may be felled within machinery exclusion zones provided:
   A. felling is directed away from the drainage line
   B. any furrows resulting from log removal are treated to prevent concentration of water flow
   C. groundcover (including grasses, herbs and forest litter) is retained or artificially reinstated, similar to the surrounding area.
10. Harvesting machinery must not enter riparian exclusion zones or machinery exclusion zones other than in accordance with this clause, and clauses 4.4(7), 4.4(11) and 5.
11. New roads may be constructed and old roads re-opened within riparian exclusion zones and machinery exclusion zones provided that:
   A. the road is identified on the Forest Operation Plan
   B. the road prism crosses the riparian zones at right angles or as close to right angles as is practicable
   C. clearing and disturbance within the exclusion zone is minimised
   D. any other necessary permits have been obtained.
12. Trees may be felled within unmapped drainage depressions, and machinery may enter unmapped drainage depressions. However disturbance must be minimised by:
   A. using walkover techniques wherever possible
   B. preventing skewing of machinery tracks as much as possible
   C. operating with the blade up at all times (except during crossing construction)
   D. not snigging along drainage depressions.
13. Machinery must not operate in drainage depressions when the soil is saturated.

5. Construction and maintenance of forest infrastructure

5.1 Construction and maintenance of roads

1. Clearing of native vegetation for the purpose of roads, drainage structures, log landings, mill sites, snig tracks or extraction tracks must not occur except in accordance with this Code, and the clearing must be limited to the minimum extent necessary.
2. Construction of new roads and drainage feature crossings should be minimised as far as practicable, consistent with the requirements for management, harvesting and fire control in the Property Vegetation Plan area.
3. As far as practicable, roads must be located on ridgetops or just off the crest of the ridge to facilitate outfall drainage.
4. Clearing for road construction must be to the minimum extent necessary and should not be more than 3 metres from the outside edges of batters or table drains. If it is necessary to clear a wider area, a minimum of 70% groundcover must be established on all the cleared area beyond the road formation within one month of the date of construction.
5. Trees and other debris must not be stacked in landscape features referred to in Table C or riparian exclusion zones referred to in Table F.
6. Any fill batter must be stabilised and tree stumps or other woody debris must not be used to provide fill for road construction.
7. New roads must be constructed, upgraded and maintained with a maximum grade of 10 degrees. The maximum grade may be increased to 15 degrees where it would result in an improved environmental outcome or to avoid difficult ground conditions. The Forest Operation Plan must be noted.
8. Roads must be maintained according to Table G.
9. Roads must be maintained and monitored to ensure that road surfaces remain stable and drainage systems and sediment controls remain functional.
10. Soil exposure on road verges must be kept to a minimum.
11. Roads that are not required for ongoing property management must be stabilised, drained and allowed to revegetate.
12. Haulage must not be undertaken over any section of road where the surface has broken down, as evidenced by rutting greater than 150 millimetres deep for any distance exceeding 20 metres.
13. Haulage on natural surface roads must cease when there is runoff from the road surface, except for trucks that have already been loaded or partially loaded. These trucks can travel to their intended destination.
14. Where existing roads are overgrown and require re-opening, the clearing width must be minimised to the extent required to make the road suitable for traffic.
15. As far as practicable, grass cover must be maintained and disturbance to existing drainage structures must be minimised.

16. Blading-off of roads must not occur.
17. Sections of new roads may be constructed on ground slopes exceeding 25 degrees only if:
    A. there is no practical alternate route available, and
    B. the sections are designed by a suitably qualified person using currently acceptable engineering standards to ensure stability.

Table G: Maximum distance that water may travel along road surfaces, table drains, snig and extraction tracks

Road grade (degrees)	Maximum distance (metres)
0 to ≤ 3	175
> 3 to ≤ 5	100
> 5 to ≤ 8	80
> 8 to ≤ 10	60
> 10 to ≤ 15	40
> 15 to ≤ 20	25
> 20 to ≤ 25	20

5.1.1 Road drainage

1. All reasonable steps must be taken to minimise soil erosion from roads. Accordingly, at least one of the following measures must be adopted, as appropriate in the circumstances:
    A. maintain vegetative cover (that is, plant material, living or dead) that protects the soil surface from erosion
    B. establish a grass cover using a sterile seed or native grass seed, where available
    C. crossfall-drain the road or track with outfall or infall drainage (preferably with the outward or inward slope being between 4% and 6%) or by shaping the road to a crown so water drains to both of its sides
    D. construct drainage structures to convey water away from the road formation (for example, cross drains, mitre drains or relief culverts).
2. Any drainage structure must be designed to convey the peak flow from a 1-in-5-year storm event.
3. Drainage structures must be established on a road if concentrated water flow on the road surface or table drains is likely to occur for distances exceeding the relevant spacing, as shown in Table G.
4. Earth windrows resulting from road construction and upgrading operations must be removed from the shoulders of all roads unless they are specifically constructed to prevent erosion of fill batters or where infall drainage is used.
5. Earth windrows from road maintenance must be cut through at regular intervals to ensure that water flow on road surfaces does not exceed the distances specified in Table G.
6. Rollover banks must have a minimum effective bank height of 15 centimetres (consolidated). Spoon drains must have a minimum effective depth of 15 centimetres.

7. Drainage structures must divert water onto a stable surface and must be kept free of debris that may impede flow of water.
8. A drop-down structure and dissipater must be installed where drains divert water over an exposed fill batter more than 1 metre high.

5.1.2 Roads crossing drainage features

1. Drainage feature crossings must be stable causeways, culverts or bridges. Existing gully stuffers may be used if they are stable, but new crossings of these types must not be constructed.
2. Crossings must be designed, constructed and maintained to minimise disturbance to the passage of fish and other aquatic fauna. They must be located and constructed to cause minimum disturbance to stream banks, stream beds and natural flows. The base of the crossing must be made of erosion-resistant material such as rock, concrete or heavy timber and must conform to the natural level of the stream bed.
3. Crossings must be constructed as close as practicable to right angles to the water flow unless an angled approach reduces soil and ground disturbance.
4. Disturbance to the bed and banks of the drainage feature during crossing construction or maintenance must be minimised. Disturbed areas must be reshaped and stabilised as soon as possible following crossing construction or maintenance.
5. Any approaches to a crossing over a drainage line must be drained, using a drainage structure, within 5 to 40 metres of the crossing. (Where this is impracticable, a drainage structure must be constructed as near as practicable to the crossing.)
6. Permanent drainage crossing structures must be designed to convey a 1-in-5-year storm event and withstand a 1-in-10-year storm event. Bridges must be designed and constructed so the natural stream flow is not restricted and erosion is minimised.
7. The surface of any crossing and the approaches on both sides of it must be made of stable material that is unlikely to be displaced during normal use of the crossing or approach, or by any flood up to and including peak flow of a 1-in-10-year storm event.
8. Causeways must be constructed of stable, non-soil material such as crushed gravel, rock, bitumen, concrete, logs or other stable material that is unlikely to produce water turbidity.
9. Construction equipment must minimise disturbance or damage to the watercourse bed and banks. Fill and construction material must not be placed into watercourses, and surplus fill must be located outside the drainage feature exclusion zone. Stream banks and bridge embankments must be protected to minimise erosion.
10. Soil stabilisation must be undertaken in all areas disturbed by construction, upgrading or maintenance, within 40 metres of either side of the crossing. These areas do not include the road surface, road drainage structures or cut batters.

5.2 Log landings, portable mill sites and snig tracks

1. Wherever practicable, log landings and portable mill sites must be located on ridge-tops or spurs.
2. Log landings and portable mill sites must be no larger than the minimum size necessary for efficient operations.
3. If topsoil is removed, it must be stockpiled and respread at completion of harvesting operations.
4. Log landings and portable mill sites must be located and constructed as far as practicable to allow effective crossfall drainage during harvesting operations.
5. Log landings and portable mill sites must not be located nearer than 40 metres where possible but a least 10 metres from a riparian exclusion zone.
6. Runoff from log landings and portable mill sites must not be directly discharged into a drainage feature.
7. Vegetation and debris from log landings and portable mill sites must not be deposited in an exclusion zone.
8. Woody waste and debris on log landings and portable mill sites must not be stacked against retained trees.
9. Bark accumulated on log landings, and sawdust on mill sites, must be progressively dispersed away from the site during harvesting operations to prevent significant accumulations.
10. On completion of operations, log landings and portable mill sites must be drained and reshaped to safely disperse runoff onto surrounding vegetation, and topsoil must be respread evenly over the landing.

5.2.1 Snig tracks and extraction tracks

1. Snig track or extraction track construction must be minimised and, as far as practicable, walkover extraction must be used and slash retained on snig and extraction tracks.
2. Soil disturbance and exposure on snig and extraction tracks must be minimised.
3. As far as practicable, snig tracks from previous operations must be used.
4. Old snig tracks or extraction tracks must not be used if they are incised and cannot be drained.
5. In re-opening old snig tracks and extraction tracks, the use of blades should be restricted to the removal of obstructions such as understorey vegetation, logs/tree heads and surface rock, and ensuring that the track is adequately drained.
6. Wherever practicable, snigging and timber extraction must be uphill.
7. Snig tracks and extraction tracks must be located where they can be drained effectively, and should be located where there is sufficient natural crossfall to remove runoff from the track surface.
8. Snig tracks and extraction tracks must not encroach on riparian exclusion zones except at designated crossings.
9. Blading-off of snig tracks and extraction tracks must not occur.

10. The grade of snig tracks must not exceed 25 degrees.
11. Where downhill snigging is necessary, snig tracks and extraction tracks must enter the log landing from beside or below. Where this is not possible, a drainage structure must be installed at the entrance to the log landing at the end of each day's operations.
12. Drainage must be effected as soon as practicable at the completion of operations on each extraction track or snig track, and in any event within two days, unless the soil is saturated.
13. Temporary drainage must be installed on any snig or extraction track that will not be used for five days or more.
14. Track drainage structures must be located, constructed and maintained to divert water onto a stable surface which can handle concentrated water flow, and which provides for efficient sediment trapping.
15. Snig tracks and extraction tracks must be located and constructed to ensure that water running along the track surface does not flow for longer than the distances specified in Table G. This could be achieved by one of the following techniques or a combination:
    A. retain the existing groundcover using walkover techniques
    B. retain or cover the track surface with slash and harvesting debris
    C. construct outfall drainage or maintain the track's outfall drainage
    D. construct track drainage structures.
16. Upon completion of operations, the following measures must be implemented:
    A. where practicable, snig tracks and extraction tracks must be reshaped, all earth windrows, wheel ruts and log furrows removed, and recoverable topsoil spread back over the track; and
    B. crossfall drainage must be reinstated on snig tracks or, where this is not sufficient to divert runoff from the track, crossbanks must be installed consistent with the spacings in Table G.
17. Crossbanks must be constructed to have a minimum effective height of 35 centimetres unconsolidated, or 25 centimetres consolidated, and as a guide should not be greater than 50 centimetres in height.
18. Crossbanks must not be constructed of bark or woody debris.

5.2.2 Snig track and extraction track crossings on drainage features

1. The location of log landings and snig/extraction tracks must be planned to minimise the number of crossings required.
2. Snig track and extraction track crossings must be stable causeways (including natural surface causeways), culverts or bridges. Existing gully stuffers may only be used if they are stable. New crossings of this type must not be constructed.
3. Machinery must not cross a drainage feature which is running water or when the soil is saturated, unless by means of a stable crossing.
4. Approaches to crossings must be as close as possible to right angles to the flow of water.

5. A crossbank must be installed on each approach, between 5 and 40 metres from the drainage feature crossing. The distance must be measured from the top of the bank of the incised channel or, where there is no defined bank, from the edge of the channel or centre of the depression. The drainage structure must divert water onto a stable surface. If such a surface is not available, sediment control measures must be used to prevent sediment entering the drainage feature.
6. Disturbance to the bed and banks of the drainage feature must be minimised, and any spoil must be removed from the drainage feature.
7. All areas disturbed during crossing construction and use, including approaches, must be rehabilitated following completion of use. Rehabilitation includes the reshaping of the crossing to conform as closely as possible to the original ground surface. If groundcover is not likely to recover naturally, sowing with a suitable sterile seed or endemic native seed/fertiliser mix must be undertaken to establish effective groundcover.

5.2.3 Wet weather limitations for snigging, log landing and portable mill operations

1. Harvesting operations must not occur when:
   A. there is runoff from the snig track surface, or
   B. soils are saturated, or
   C. soil is rutted to a depth of more than 200 millimetres below the track surface over a 20-metre section or longer.
2. Forwarders, excavators and truck-mounted loaders may be used as stationary loaders when there is runoff from the log landing.
3. All other machinery on the log landing must remain stationary when there is runoff from the log landing surface, unless the log landing is constructed of gravel or other stable material.

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