forestworks ISC
INDUSTRY SKILLS COUNCIL
FOREST, WOOD, PAPER & TIMBER PRODUCTS INDUSTRY

Learning Resource for MANAGE TREE HARVESTING TO MINIMISE ENVIRONMENTAL IMPACT








ICONS

Activities and assessments are interactive – the blank boxes can be filled in with your own information.


Activity


Video

This Learning Resource has been developed to support ***FPI60111 Advanced Diploma of Forest Industry Sustainability***. It was based on the Unit of Competency ***FPICOT5209B Manage tree harvesting to minimise environmental impact***.

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June 2014

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INTRODUCTION

ABOUT YOURSELF

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USING WEBSITE LINKS

Sometimes you may click on a web link and the site will say it is not available. Please revisit the site when you are next working on your resource materials as web sites are sometimes "off line" for maintenance reasons. If the link is "not found" then track back to the home page in the link address and try and search from there.

If you are consistently unable to access a link, please search for an alternative. If the link related to an assessment or activity include the new link in your answers. Let us know of any links that do not work by completing the feedback form at the back of the resource.

HOW ARE THESE MATERIALS USED?

This learning resource has been developed as a workbook with a strong focus on the self-directed application of knowledge. It is best used in the context of the Unit of Competency it has been written against as found on page 2. Completing this workbook and all activities and formative assessments will prepare you for your final assessment.

Where a table has been provided in activities and assessments you can use Adobe forms to make notes. Click on a cell to enter text, tab to move to the next cell. The table cells do not expand as you enter text.

When viewing the text online please turn on Bookmarks in your PDF reader so you can more easily navigate through the material.

SELF-ASSESSMENT

At the end of this document there is a self-assessment checklist of the types of skills and knowledge you would be expected to have to be deemed competent in the associated Unit of Competency. At any stage you can self-assess yourself against this list and seek more information in areas you are unsure about.

On successful completion of the final assessment as agreed with your Registered Training Organisation (RTO), you can achieve competency in the related Unit of Competency.

WHAT ARE THESE LEARNING MATERIALS ABOUT?

This workbook applies to any person working in a commercial forestry enterprise which requires tree harvesting which, for the purposes of this workbook, includes the following activities:

- Felling trees and cutting felled trees into logs on defined coupes for the purposes of commercial wood production
- Extracting logs to landings or log storage areas for sorting, barking, and loading onto trucks

- Carting logs to an industrial facility for primary processing into wood products
- Road or track works required to facilitate the operation.

For the purposes of this learning resource, tree harvesting does not include the operations required to regenerate or replant harvested areas.

The scope of the workbook addresses the following requirements:

- Understanding the potential for tree harvesting to impact on various environmental values
- Acting within the legislation and environmental regulations that pertain to commercial tree harvesting
- Integrating environmental protection with operational wood production aims and the need for sustainable forest/plantation management
- Adopting a systematic approach to the planning and management of environmental protection in commercial tree harvesting operations
- Learning the measures that are taken and the techniques that are used to minimise the environmental impacts of tree harvesting.
- The workbook presumes some pre-existing knowledge and therefore does not address any of the following matters in detail:
- Various tree harvesting systems used for a variety of forest types or situations
- Relevant operational competencies and workplace OH and S requirements
- Parameters that constitute a productive forest/plantation stand suitable for harvesting
- Log grade specifications required for different wood products.

EMPLOYABILITY SKILLS

This workbook provides an opportunity to develop and apply the employability skills that are learnt throughout work and life.

The typical employability skills that would be applied in a situation related to managing tree harvesting within a commercial forestry enterprise are listed below.

In completing your daily work tasks and activities and the assessments related to this unit of resource, you must be able to demonstrate that you are applying these "employability skills":

- Analytical skills
- Organisational skills
- Communication skills (both written and verbal)
- Management skills
- Teamwork skills
- Technological skills
- Numerical and mathematical techniques.

HOW THE SKILLS LEARNED APPLY TO YOUR WORKPLACE

This resource covers the process of planning and managing commercial tree harvesting to minimise environmental impacts in a variety of settings including:

- Native forests and forestry plantations on public lands
- Native forests and wood industry plantations on private lands
- Commercial forestry plantings integrated with farming on private land.

The skills and knowledge required for competent workplace performance are to be used within the scope of the person's job and authority, and their level of responsibility. They include:

- Understanding the environmental values associated with particular workplace settings
- Knowing and understanding the environmental regulations pertaining to commercial tree harvesting operations.
- Meeting desk-top and field-based planning requirements
- Using appropriate harvesting systems that meet silvicultural, environmental, and wood production aims
- Developing and implementing risk management strategies to fit the requirements of nominated harvesting systems
- Managing specific components of tree harvesting operations, such as tree felling, log extraction, or log cartage
- Overall management or supervision of a tree harvesting operation
- Documenting and analysing the performance outcomes of tree harvesting operations with a view to informing future operations.

1. ENVIRONMENTAL REGULATIONS THAT GOVERN TREE HARVESTING

LEARNING OBJECTIVES FOR THIS SECTION

At the completion of this Section, students should have learnt:

- That the environmental impact of tree harvesting is highly regulated at national and state levels
- That there are operational planning instruments used to avoid or minimise tree harvesting impacts
- The role of forest certification in how tree harvesting is governed

TREE HARVESTING IS HIGHLY REGULATED

The conduct of tree harvesting operations in a manner that minimises environmental impacts is vital to the maintenance of forests as viable and sustainable ecosystems. Accordingly, the harvesting of native forests and plantations is arguably Australia's most highly regulated land use.

At the Federal level, there are eight Parliamentary Acts that apply to commercial tree harvesting in relation to environmental protection, indigenous cultural heritage protection, agreed forest use, and the export and import of wood products.

These Acts are supported by State legislation and associated regulations. For example, in Victoria there are 37 Parliamentary Acts and 15 Regulations that apply to commercial tree harvesting. Of these, 19 Acts and 8 sets of regulations can be regarded as addressing the environmental implications of tree harvesting.

Most of these apply to both native forests and plantations on both public and private lands, although there are exceptions, such as the Agricultural and Veterinary Chemicals (Control of Use) Act 1992, which applies primarily to plantations where agrichemicals (mostly herbicides and fertilisers) are integral to the establishment and early management of planted trees. Such chemicals are very rarely if ever used in native forests.

THE REGULATORY HIERARCHY

A hierarchy of legislation starting at the Federal level governs and regulates commercial tree harvesting. The most relevant of these are the Regional Forests Agreement Act 2002, and the Environment Protection and Biodiversity Conservation Act 1999. Underneath these there is a raft of State-based legislation.

Regional Forests Agreement Act 2002

The Regional Forests Agreement (RFA) Act relates only to native forests on public land, and sets out agreed positions between the Federal and individual State Governments on levels of forest reservation and wood production for 13 regions spread across south western WA, Victoria, Tasmania, and NSW.

An initially proposed Regional Forest Agreement for the south eastern Queensland region never eventuated after the State Government struck an agreement with the conservation movement for a phased-out end to wood production.

The RFA Act addressed the broader question of environmental protection at the regional landscape-scale by using nationally-agreed criteria to ensure creation of a comprehensive, adequate and representative (CAR) nature conservation reserve system.

Since their inception, many of the Regional Forest Agreements prepared under the Act have been overriden to varying degrees by State Governments intent on reserving more forests as national parks. However, it still remains as the overarching piece of forest management legislation in many regions.

Environment Protection and Biodiversity Conservation Act 1999

The Environment Protection and Biodiversity Conservation (EPBC) Act is the Australian Government's primary legislation for protecting environmental values at a project or development scale. As such it is applicable to both Australia's public and private lands.

It requires environmental assessments to be undertaken in relation to industrial development proposals. However, in relation to commercial tree harvesting, it recognises that the requirement for such an assessment has already been effectively met by the preparation of Comprehensive Regional Assessments which were part of the Regional Forests Agreement process.

It also recognises that State legislation already requires a detailed level of forest management planning, including operational planning down to the level of individual tree harvesting operations and considers that this meets the Act's requirements. Conservationists opposed to native forest timber production have for many years misrepresented this arrangement by claiming that timber harvesting is exempt from the EPBC Act's standard environmental regulations that govern other land uses.

State-based environmental protection legislation/regulation including Codes of Practice

State-based legislation requiring the consideration/protection of environmental values during timber production pre-dates the EPBC Act 1999, by up to 10 – 12 years in some states. In addition, State-based legislation which specifically aims to protect flora and fauna also pre-dates the RFA Act 2002.

For example in Victoria, the Flora and Fauna Guarantee Act 1988 (Vic) lists threatened and endangered species with associated Action Statements (where prepared) meant to ensure their protection and survival. Some of these relate to forest management and constrain tree harvesting to some extent.

However, the overriding influence on the control of tree harvesting to minimise environmental impacts rests with State-based forest management legislation that requires the preparation of forest management plans for State forests, and the preparation of Codes of Practices for tree harvesting operations on public lands, as well as on private lands in most states.

Codes of Practice for forestry operations (or similar instruments) have been in force in all states and territories for many years now, including 27 years in Tasmania, and 25 years in Victoria. Although their format varies between states, they typically provide mandatory minimum standards, operational prescriptions and guidelines for meeting environmental protection requirements during commercial tree harvesting operations in both native forests and plantations.

A key requirement of these Codes of Practice is that tree harvesting operations be properly planned as a means of ensuring minimal environmental impacts. In most cases, standard requirements have been specified for harvesting plans, and in some cases standarised plan formats have been developed.

This is meant to ensure that every operation is conducted in ways that meet the overarching requirements of forest management planning and environmental protection legislation.

The appropriate authority with responsibility for tree harvesting on public lands is the State government public land management agency. On private land, responsibility varies between states. For example, in Victoria private land tree harvesting is a local government responsibility, whereas in NSW and Tasmania it is State government responsibilty.

Table 1: Variations between State-based Codes of Practice

State	Applies to				Contains	
	1 Public Land	2 Private Land	3 Native Forest	4 Plantation	Principles goals and guidelines	*Detailed prescriptions
VIC – Code of Practice for timber production 2007	Yes	Yes	Yes	Yes	Yes	No
TAS – Forest Practices Code (2000)	Yes	Yes	Yes	Yes	Yes	Yes
NSW – Forest Practices Code Part 1: Timber harvesting in Forests NSW plantations (2005)	Yes	No	No	Yes	Yes	Yes
NSW - Plantation and Reafforestation (Code) Amendment Regulation 2010	Yes	Yes	No	Yes	Yes	No
NSW – Private Native Forestry Code for Northern NSW (reviewed 2013)	No	Yes	Yes	No	Yes	Yes
NSW – Private Native Forestry Code for Southern NSW (2008)	No	Yes	Yes	No	Yes	Yes
QLD – Plantation Code of Practice for Operations Associated with Commercial Timber Plantations on Private Land in Queensland – Draft 2010	No	Yes	No	Yes	Yes	No
WA – Code of Practice for Timber Harvesting in Western Australia (1999)	Yes	No	Yes	No	Yes	No
WA – Code of Practice for Timber Plantations in Western Australian (2006)	Yes	Yes	No	Yes	Yes	No
SA – Guidelines for Plantation Forestry in South Australia (2009)	No	Yes	No	Yes	Yes	No
NT – Northern Territory Codes of Practice for Forestry Plantations (2004)	Yes	Yes	No	Yes	Yes	No

**Where Codes don't include detailed operational prescriptions, they usually refer to associated documents containing detailed management procedures and actions*

Activity 1.1

Obtain and be familiar with the codes available for your State. Identify the key differences between the codes for each of the four tenures listed across the top of Table 1, where a code exists.

HARVESTING PLANS

Tree harvesting plans (variously called Timber Harvesting Plans, Forest Coupe Plans, or Forest Operations Plans in different states) are generally prepared to a standard format so as to ensure that all potentially relevant matters are addressed.

The harvesting plan is the basic record of the forest manager's intended activities within a given area of forest or plantation. It describes the nature of the tree harvesting operations, how and when they will be conducted, and most importantly, specifies the controls that are to be adhered to in order to avoid or minimise environmental impacts.

Harvesting plans must specify the following:

- Location of the harvesting area/s;
- Period/s during which operations are to occur;
- Estimated timber volumes to be harvested and proposed cartage route/s;
- Type/s of harvesting system to be employed, and the permitted maximum slopes; and
- The operational controls required to minimise environmental impacts.

Harvesting plans must also include a good quality map showing the area to be harvested and the location of significant environmental features and measures to be applied in protecting them.

In some states there may be a requirement to undertake flora and fauna surveys of planned harvesting coupes as part of preparing harvesting plans, so as to identify values that may need special treatment. More often the identification of special values requiring protection is based on pre-existing information from past research or field surveying, particularly on public lands where such information is typically more available.

The following video clip discusses the principles of forest management planning and operational planning in NSW private native forests, which are also broadly applicable to public and private forests and plantations in other states:

NSW Environmental Protection Agency – Private Native Forestry Technical Series: *Planning for forestry operations and long-term forest management* – a Peter Hill video on Vimeo
http://vimeo.com/60628976 (6:17 minutes)

FOREST CERTIFICATION

Forest certification aims to create a market-driven incentive for timber industries to operate in a socially and environmentally-responsible manner by developing a consumer preference for wood products carrying labels identifying them as being sourced from forests certified as being sustainably managed. In time, it is anticipated that uncertified produce from illegal or unsustainable sources will be excluded from the market.

In Australia, there are two certification schemes operating – the Forest Stewardship Council (FSC) scheme developed by the international environmental movement; and the Australian Forestry Standard (AFS) which is a national scheme developed under the auspices of the Programme for the Endorsement of Forest Certification schemes (PEFC). The PEFC is an independent, non-profit, non-government entity which acts as *'a global umbrella organisation for the assessment of and mutual recognition of national forest certification schemes in a multi-stakeholder process'.*

Despite differences in how they've been developed, both the AFS and the FSC schemes have similar approaches and requirements. Despite slight differences in terminology, both schemes follow a three-tiered approach to assessing forest management. These involve an increasing level of detail from broad principles, to management requirements, and detailed auditable assessment points.

To become certified, the forestry planning, procedures, systems and on-ground management of applicant companies or agencies must be assessed by an independent third party against the requirements of a pre-

determined standard. Upon conformity to the standard, a certificate is issued signifying that timber products are derived from sustainable sources thereby improving its market appeal.

Regular audits of certified forestry sector companies or agencies are required to ensure that their standards are being satisfactorily maintained to the level required by the certifying body.

Forest certification has no direct bearing on Australian or State government legislative and regulatory requirements which apply to tree harvesting, but it reinforces these requirements and encourages behaviour that can exceed them.

While this can be viewed as a positive, forest certification also has the potential to usurp the sovereign control of forest resources and/or forest management being exercised by jurisdictional governments. For example, the threat of witholding FSC certification from the Tasmanian hardwood timber industry was used as a lever to help force changes to Tasmania's forest policy in 2013 when approximately 500,000 hectares of State Forest was declared as new National Parks.

2. ENVIRONMENTAL VALUES IMPACTED BY TREE HARVESTING

LEARNING OBJECTIVES FOR THIS SECTION

At the completion of this Section, students should know which environmental values can be adversely impacted by tree harvesting.

KEY VALUES IMPACTED BY TREE HARVESTING

The key environmental values that can be impacted by tree harvesting are:

- Soil structure, stability and productivity
- Water quality, quantity and stream health
- Biodiversity

SOIL AND WATER VALUES

Protecting soil and water values is the most critical component of environmental protection in any tree harvesting operation irrespective of whether it is in a native forest, a plantation, or a farm planting.

Soils are the medium within which trees grow, and as such, their ongoing stability and fertility are fundamental to forest growth, health, and productivity. Soils also act as sponges that trap rainfall and slowly release it into streams that ultimately meet human water requirements.

The degradation of soil values typically has three phases:

- Firstly, the topsoil, which is the fertile upper layer of the soil, is displaced or lost to erosion ultimately leading to a reduction of tree growth at that site.
- Secondly, once erosion starts it's likely to continue and worsen.
- Thirdly, the soil is transported into nearby waterways causing water pollution and clogging stream channels and pools with sediment.

Accordingly, soil and water values are usually considered together because soil damage is the precursor to lowered water quality through erosion that channels soil sediment flow into waterways.

Stream health is a function of both water quality and quantity. While water quality can be degraded by sediment flow from eroding soils, water quantity can be reduced in catchments where tree harvesting and regeneration operations have created a proportionally significant coverage of young regrowth which grows more vigorously and transpires more water than older forests, thereby reducing the amount of water available for stream flow.

Careful planning of tree harvesting operations with respect to location, timing, proportional extent of catchment area, and operational controls is essential to minimise impacts to soil and water values.

The following video clip discusses the principles of soil and water protection in NSW native forests, which are also broadly applicable to forests and plantations in other states:

NSW Environmental Protection Agency – Private Native Forestry Technical Series: *Soil and water protection in Private Native Forestry* – a Peter Hill video on Vimeo
http://vimeo.com/60696736 (4:47 minutes)

The following video clip discusses the principles of road drainage and its importance in soil and water protection during tree harvesting operations:

NSW Environmental Protection Agency – Private Native Forestry Technical Series: *Overview of road drainage* – a Peter Hill video on Vimeo
http://vimeo.com/61222451 (3:28 minutes)

BIODIVERSITY VALUES

The need to conserve biodiversity during tree harvesting operations varies according to the workplace setting and the level of biodiversity that it supports.

Native forests generally support a wide range of indigenous flora and fauna. However, plantations (including farm plantings) are typically monocultures of just one (often exotic) tree species with little or no understorey and are usually relatively lacking in biodiversity values during their planned 10 – 40 years of growth (subject to species and targetted product markets).

Native forest tree harvesting is typically modified to take account of biodiversity requirements, particularly in public State forests managed under a 'multiple use' philosophy enshrined in forest policy and supporting legislation.

Privately-owned native forests can also have significant biodiversity values, although the imperative to take account of biodiversity is not typically as strong given the inherent rights of private property owners. Despite this, it is not uncommon for private forest owners to deploy the same biodiversity conservation strategies used in public forests, or even to exceed them.

It must be remembered that biodiversity conservation is a landscape-scale concept, and, given that the majority of Australia's native forests and woodlands are either already reserved or not used for any economic purpose, any individual tree harvesting operation carried out in a tiny proportion of that landscape is unlikely to have a significant impact on broader conservation values.

In addition, because harvested native forests regenerate, impacts on biodiversity are mostly temporary until revegetation encourages recolonisation by flora and fauna. Studies and observations over a long time suggest that although different species favour the early stages of regeneration, over time the same species that were formerly present in the forest prior to harvesting will recolonise the regrowth as it matures.

The exception to this is the arboreal species of mammals and birds that require larger trees with hollows that can be mostly lost in tree harvesting operations and will take over a century to regrow. Most efforts to minimise biodiversity impacts in native forest harvesting are centred on retaining some arboreal species habitat.

The following video clip discusses the principles of biodiversity conservation in NSW native forests, which are also broadly applicable to public and private forests in other states:

NSW Environmental Protection Agency – Private Native Forestry Technical Series: *Protecting Biodiversity in Private Native Forestry* – a Peter Hill video on Vimeo
http://vimeo.com/60629486 (11:09 minutes)

This next video clip discusses the principles of biodiversity conservation in blue gum plantations in WA, which are also broadly applicable to biodiversity protection associated with plantations in other states:

ANU Fenner School of Environment and Society Training Video Series: *Biodiversity and the importance of remnant vegetation in Blue Gum forestry in WA* – a Peter Hill video on Vimeo
http://vimeo.com/87143119 (6:11 minutes)

Activity 2.1

From these videos and your knowledge of tree harvesting operations, briefly outline how you think that the various activities listed below may impact on environmental values.

- Road construction to access a harvesting coupe
- Tree felling
- Log extraction (ie. transporting logs from the stump to a landing)
- Landing operations (ie. log barking, sorting, and truck loading)
- Log cartage from the forest/plantation to an industrial processing facility
- Maintenance of forest/plantation roads used for log cartage.

3. KEY DRIVERS OF ENVIRONMENTAL IMPACT

LEARNING OBJECTIVES FOR THIS SECTION

At the completion of this Section, students should have learnt:

- The key drivers of environmental impacts resulting from tree harvesting
- How these drivers influence environmental impact
- How the management of tree harvesting impacts has changed over time.

SUMMARY OF THE KEY DRIVERS

The key drivers of environmental impacts during tree harvesting operations can be considered in terms of two inter-related groupings – site conditions and operational factors:

Site conditions include:

- Slope
- Climatic conditions
- Soil type and erodibility
- Erosion hazard
- Presence of waterways
- Presence of biodiversity values
- Tree size

Operational factors include:

- Safe operating practices
- Operational planning and management
- Harvesting intensity
- Harvesting machinery
- Roads and extraction tracks

These groupings are inter-related because the operational factors are largely shaped by the site conditions and the imperative to work with them. However, an exception to this general rule can be caused by the unavailability of harvesting equipment that would otherwise be best suited to the site conditions.

SLOPE

The nature of the topography is a key determinant of the potential for tree harvesting to cause environmental impacts. The risk of adversely impacting on critical soil and water values increases directly with increasing steepness of slope, and is further magnified where these steep slopes are maintained for long lengths (as opposed to being broken-up by intermittent flatter grades).

CLIMATIC CONDITIONS

Climatic conditions that can influence the likelihood of environmental impacts are the average annual rainfall, its seasonal distribution, and the typical intensity of rainfall events.

There are two aspects to the potential influence of rainfall:

- Long term seasonal influences that are reflected in when harvesting operations can be scheduled; and
- Short term influences during the conduct of tree harvesting which can create wet conditions conducive to environmental impacts unless operations are closely monitored and controlled by temporary suspensions until drier conditions return.

SOIL TYPE AND ERODIBILITY

Soil type, including its structure, is a substantial factor in the potential for degradation of soil and water values, particularly when less stable soil types occur in concert with steep slopes.

The soil type dictates its stability ie. the strength of the bonds between soil particles which determines its capability to maintain structural strength under the weight of traffic during tree harvesting operations, and to resist erosive forces.

Soils are typically comprised of different layers which can display structural differences that may make them more or less prone to erosion. For example, **gradational soils** display only very gradual changes between the soil layers with depth – usually slightly increasing clay content and decreasing organic matter (see Figure 1).

Whereas **duplex soils** exhibit abrupt changes between the topsoil and the subsoil –usually light sandy or loamy topsoil abruptly gives way to far heavier clay subsoil at shallow depth (see Figure 2).

Topsoils are typically darker than subsoils because they contain organic matter which helps to bind soil particles together. Lighter subsoils lacking in organic matter are often more erodible.

In duplex soils, the heavy clay subsoil may be very stable but may be relatively imperveous thereby inhibiting drainage and causing topsoils to frequently become waterlogged making their structure vulnerable to collapse during tree harvesting operations. When soils become rutted and compacted they become more susceptible to water erosion.

EROSION HAZARD

Soil erosion is a natural process that is occurring constantly. However, inappropriate or poorly managed human activities can exacerbate its occurence and impact. In the context of Australian tree harvesting operations, soil degradation is typically due to erosion by water and mass movement, rather than by wind.

There are three main types of soil erosion caused by rain and water flow:

- **Sheet erosion** results in surface soil being removed in a thin layer by water moving across the soil surface. The water flow is in a sheet rather than in a channel.
- **Rill erosion** results in soil moving in small channels or "rills" due to concentrated water flow. This can be a flow on from sheet erosion where water flow becomes channelised.
- **Gully erosion** results in soil being removed in deep channels. This can follow-on from rill erosion when water movement increases in speed eventually exposing erodible subsoils to collapse.

Figure 1: A typical gradational soil (photo: G. Stewart)

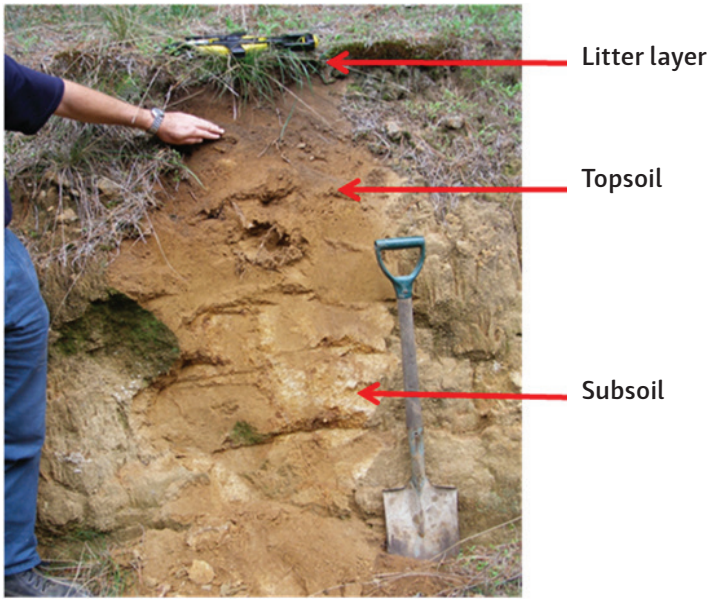
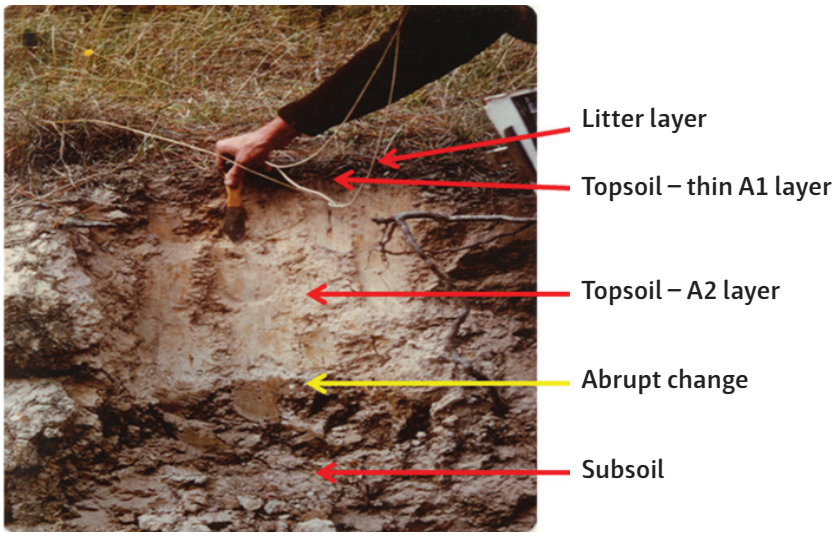


Figure 2: A typical duplex soil (photo: G. Stewart)



These types of erosion events occur in different areas of a catchment depending on the shape of the land. Sheet erosion changes to rill erosion and then to gully erosion as the water flow becomes more concentrated downslope.

Mass movement describes the process whereby large chunks of saturated soil collapse and slide downhill on steep slopes ie. landslips and slumping. Some soil types are naturally prone to mass movement, but human activity which removes ground cover and interferes with soil stability can exacerbate its occurrence.

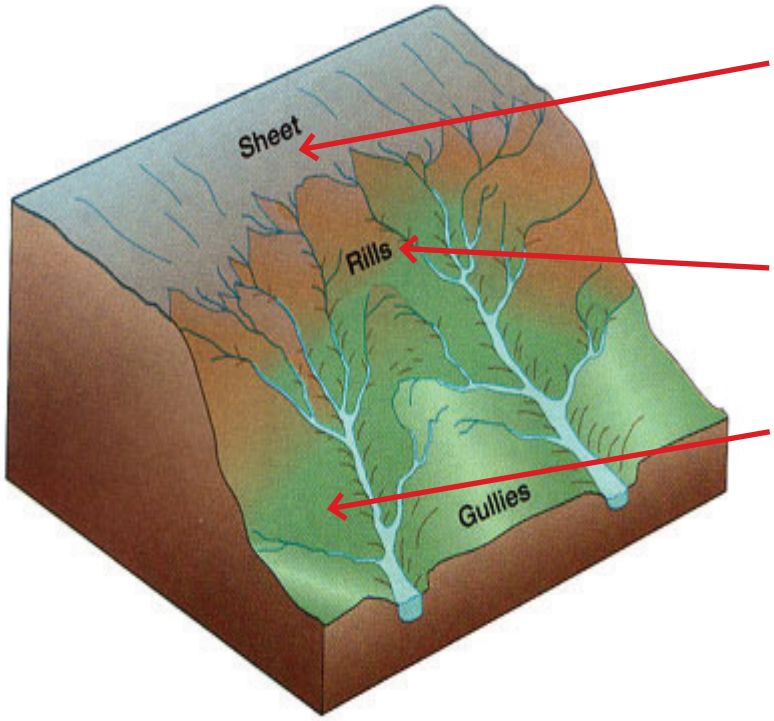
Erosion hazard is a measure of the likelihood of a soil eroding given the interaction between soil structure, slope, rainfall, and operational land use activities on a specific site. In the context of tree harvesting, erosion hazard is usually expressed in terms of water erosion, given that harvesting sites are usually relatively protected from wind.

Some general principles are that darker coloured soils with more organic matter and higher clay content are more stable and less erodible; while paler coloured soils with less clay, more sand, and low organic matter are more susceptible to erosion.

It is important to note that although sandy soil types can erode more readily, their water-borne sediment does not typically move as far as clay-based sediment. More often, it is clay soils that don't show as much visible erosion, which are the source of sediment flow into waterways.

When the soil type is coupled with slope and the intensity of tree harvesting operations, erosion hazard can be estimated. There are technical publications available in all Australian states and territories that have classified and mapped estimated soil erosion hazards across the landscape.

Figure 3: Types of water erosion (from Croke *et al*, 1992)



Sheet erosion
Surface soil removed in a thin layer by water flowing across the soil surface

Rill erosion
Soil removed in small channels due to concentrated water flow

Gully erosion
Soil removed in deep channels due to:

- Due to fast water flow
- collapse of exposed erodible subsoils

PRESENCE OF WATERWAYS

The presence or absence of waterways, and their nature (ie. permanent streams, intermittent temporary streams, or mostly dry drainage lines) has a huge influence on the potential for a tree harvesting operation to cause significantly adverse environmental impacts, irrespective of whether operations are in native forests or in plantations.

PRESENCE OF SIGNIFICANT BIODIVERSITY VALUES

The absence or presence of significant biodiversity values is also a huge determinant of the potential for operations to cause significant environmental damage. Typically native forests have far higher and more diverse biodiversity values than plantations which generally have little or no understorey and few native fauna. However, the recent development of a significant koala population within young blue gum plantations in south western Victoria shows that there can be exceptions that need to be addressed.

TREE SIZE

Tree size can also be an important influence on the likelihood of environmental impacts. Very large trees are heavier and require bigger machinery that is likely to put more pressure on soil structure and thereby increase the risk of soil degradation (such as compaction and mixing) that typically leads to erosion. In addition, the greater physical difficulty in handling bigger and heavier logs can increase the likelihood of damaging adjacent retained areas of vegetation such as stream buffers.

SAFE OPERATING PRACTICES

Adhering to safe operating practices is the essential first step to minimising environmental impacts during tree harvesting operations. All states have Operational Health & Safety requirements designed to ensure safe, efficient tree harvesting and log haulage operations. This includes accredition systems for machinery operators.

For example, Victoria has a WorkSafe Industry Standard: *Safety in Forestry Operations – Havesting and Haulage* (July 2007). See link below:

http://www.worksafe.vic.gov.au/forms-and-publications/forms-and-publications/safety-in-forest-operations-harvesting-and-haulage-industry-standard

Not adhering to these practices by, for example, operating machinery on slopes that are too steep, carries an unacceptibly high risk of exacting both human and environmental impacts.

Another aspect of safe operating practices is adhering to fire protection regulations which apply to tree harvesting. Each year a small proportion of bushfires are ignited on tree harvesting operations and an inability to quickly control these by not having the required equipment can ultimately be very damaging to the forest environment.

OPERATIONAL PLANNING AND MANAGEMENT

Operational planning and management is a critical determinant of the level of environmental impact. Operations that are poorly planned and managed are far more likely to cause significant detrimental impacts compared to operations that are, for example, scheduled and undertaken during drier seasonal conditions and where rigorous attention is paid to suspending or limiting operations during periods of wet weather. This is only one example of the superior environmental performance of well planned and managed operations.

HARVESTING INTENSITY

The intensity of tree harvesting can also play a significant role in determining environmental impacts. For example, thinning operations that remove only a proportion of the standing trees typically require less ground traffic on any part of the coupe and are therefore less likely to damage soils compared with clearfall (or final fall) operations where all trees are harvested and extracted thereby necessitating more intensive trafficking over the whole coupe.

HARVESTING MACHINERY

The type of harvesting machinery employed in a tree harvesting operation can also influence the potential for environmental impacts. For example, the use of modern rubber-tyred harvesting machinery typically has a far lower impact on soils than the heavy tracked machinery, such as large bulldozers, which were traditionally used in tree harvesting operations from the 1930s onwards.

Today's rubber-tyred forwarders or skidders typically have very large wheels that spread the weight of the machine more widely and evenly, and have the added advantage of being able to lift logs (or the ends of logs), thereby reducing soil disturbance compared with dozers that used to drag logs through the topsoil as they extracted them from the stump to the nearest landing.

Similarly, the use of excavators or forwarders that is now the norm in modern tree harvesting operations, enables logs to be lifted and placed thereby substantially reducing the need to pull, push, or winch logs across the ground as was the method used in the past, and this again reduces ground and soil disturbance.

ROADS AND EXTRACTION TRACKS

The provision of vehicle access either for log extraction or haulage has arguably the largest potential for localised soil disturbance and associated off-site impacts to water quality. For example, over 95% of the erosion associated with timber harvesting has been found to occur on or to emanate from tracks used to extract logs to landings, and roads used for log cartage from landings to processing mills.

Repeated heavy traffic on these areas can compact soil surfaces and expose sub-soils thereby reducing soil permeability and generating more run-off than undisturbed areas. This is the major cause of sediment flow into waterways and streams.

Activity 3.1

A simple indication of erosion hazard can be obtained in the field by combining various site and operational parameters and applying them to a matrix, such as the blank template below. Try to make this matrix into a usable indicator of erosion hazard for a plantation operation by filling in the blanks cells.

Some clues: For 'harvesting type', the three parameters could be final-felling (FF), first thinning (T1), and second thinning (T2) in the plantations context.

For 'reforestation' it could be to do with the techniques used to manage harvesting slash. Soil texture relates to the respective proportions of sand and clay in the top soil.

Using the matrix would entail allocating the appropriate points for each aspect of the operation and where it is due to occur. For example, a second thinning on a moderate slope on soils with particular colour and texture. Being a thinning there is no requirement for regeneration and so no need for slash disposal. The points for each aspect would then be totalled for comparison against point ranges for Low, Moderate, or High erosion hazard.

PARAMETER	POINTS 1	2	3	OPERATION SCORE
Soil colour				
Soil texture				
Harvesting type	T1	T2	FF	
Reforestation				
Slope				
			TOTAL	

Total Score: X– X (Low erosion hazard) Y – Y (Moderate hazard) Z – Z (High hazard)

Activity 3.2

The following video clip shows native forest tree harvesting operations in Tasmania's Styx River valley in the early 1940s:

http://www.youtube.com/watch?v=SW4kcuUvsJk (8:04 minutes)

Drawing on your own experience or knowledge of tree harvesting and/or the information contained in the 'operational factors' in this section, list the points of difference between 1940s and present tree harvesting operations. These may relate to OH & S and/or environmental impacts or the potential for environmental impacts.

4. MEASURES TO MINIMISE ENVIRONMENTAL IMPACTS

LEARNING OBJECTIVES FOR THIS SECTION

At the completion of this Section, students should have learnt how to apply the practical techniques that are used to minimise the impacts of tree harvesting.

SUMMARY OF ENVIRONMENTAL CARE MEASURES

The measures commonly used to minimise environmental impacts during tree harvesting operations can be summarised as:

- Identifying waterways and applying appropriate protections
- Identifying biodiversity values and applying appropriate protections
- Identifying and, where necessary, excluding harvesting from difficult or dangerous operating environments
- Protecting soil and water values by:
  - Locating harvesting infrastructure, including roads, to avoid sensitive areas
  - Designing and constructing well-drained roads
  - Scheduling harvesting to avoid unfavourable seasonal conditions
  - Controlling harvesting to avoid operating during unsuitable weather conditions
  - Draining and rehabilitating harvesting infrastructure after use
  - Maintaining good drainage of permanent roads

WATERWAY CLASSIFICATION AND PROTECTION

The first step in protecting waterways during tree harvesting operations is to identify and classify them according to features such as:

- Channel size and the nature of their flow (ie. permanent, regularly intermittent, or very irregular only after exceptional rain events)
- The presence of riparian vegetation
- The size of their catchment
- Their position in the catchment based on whether or not they have tributaries feeding into them

The method used to classify waterways varies among the states and this can lead to variations in the levels of protection applied to them.

There may also be differences in waterway definitions and applicable levels of protection between native forests and plantations even within the same state.

There are essentially three levels of protection being applied to Australian waterways during tree harvesting operations, although not all levels may be being used in each state. They are:

- Total exclusion buffers applied to significant permanent waterways where tree felling and the entry of harvesting machinery are prohibited.

- Partial exclusion buffers applied to less significant waterways where some limited tree felling and machinery movement for log extraction may be permitted. For example, the Tasmanian Forest Practices Code (2000) allows up to 30% of the tree canopy to be removed by felling in the outer width of buffers applied to significant permanent waterways.
- Narrow filter strips or machinery exclusion zones applied to minor and usually intermittent waterways in which all trees can be felled away from the waterway but no machinery movement is permitted.

The exception to these requirements is that designated temporary crossings of minor waterways are usually permitted, and temporary crossings of more significant waterways can be permitted in some cases, even in total exclusion buffers, under the proviso that they are removed at the completion of tree harvesting.

It should be noted that not every State allows limited tree felling and/or machinery movement in waterway buffers. For example, Victoria only uses the first and third waterway protection measures specified above.

The minimum width requirement for exclusion buffers and filter strips (or machinery exclusion zones) varies between the States in accordance with differing ways of defining waterways and different nominated minimum buffer widths.

The width of waterway protection zones can also vary due to topographic circumstances such as very steep gullies where tree felling without incurring substantial damage to the buffer may be impossible. Under these circumstances, it is not uncommon for a nominated buffer width to be effectively far wider in the field due to the impractically of operating right up to its nominated boundary.

While waterway protection is also a mandatory requirement in plantation harvesting, the application of exclusion buffers can be less stringent particularly where plantations established prior to the development of Codes of Practice in the late 1980s, were planted right to the banks of significant permanent waterways on the understanding that they would be harvested in the future. Under these circumstances, plantation trees located in close proximity to waterways are generally permitted to be directionally felled away from the waterway albeit with some restrictions on access by harvesting machinery.

Activity 4.1

Consult the following Codes of Practice and note how waterway protection requirements vary amongst the States. Don't forget to look at the definitions of various types of waterways in the Codes to ensure that you are comparing apples with apples:

Tasmanian Forest Practices Code (2000)
http://www.fpa.tas.gov.au/__data/assets/pdf_file/0020/58115/Forest_Practices_Code_2000.pdf

Victoria's Code of Practice for Timber Production 2007
http://www.depi.vic.gov.au/__data/assets/pdf_file/0019/226036/Code_of_Practice_for_Timber_Production.pdf

Forest Practices Code – Part 1: Timber Harvesting in Forests NSW Plantations (2005)
www.forestrycorporation.com.au/__data/assets/pdf_file/0008/266354/forest-practices-code-part1.pdf&sa=U&ei=L_xNU5D-I4qqkgWq-oGQCw&ved=0CB4QFjAA&usg=AFQjCNEI1QUqzUde0MD7NWUId4AF-ovLOA

Private Native Forestry Code of Practice for Northern NSW (2008)
www.environment.nsw.gov.au/resources/pnf/0837copnorth.pdf&sa=U&ei=vNxNU9b_KoaAkgXttIDIDg&ved=0CCUQFjAB&usg=AFQjCNHjXfiXJivlC6zbVaOrnVMsDkNB1w

BIODIVERSITY PROTECTION

Subject to their intensity, tree harvesting operations can obviously have a significant localised impact on biodiversity in native forests, but less so in plantations where biodiversity values are typically far lower.

Native Forests

There is a two-pronged approach to conserving biodiversity during native forest tree harvesting:

- General protection measures for species richness
- Specific protection measures for particular threatened or endangered species

General protection measures commonly involve retaining suitable trees or patches of trees scattered across harvested areas to provide some on-going habitat for a range of bird and arboreal mammal species as the area regenerates. This includes retained buffers of native vegetation along waterways that serve the dual purpose of protecting water quality and conserving biodiversity.

In recent years there has been an increasing tendency to increase the width of parts of waterway buffers to gain additional biodiversity protection as a more secure strategy than leaving trees scattered across harvested areas where they are more likely to be killed by a subsequent regeneration burn or blown-over due to sudden wind exposure.

General protection measures may be varied according to the intensity of the harvesting operation. For example, a light selective harvest that leaves most trees standing may not require much to minimise biodiversity impacts, compared to a more intensive clear-fell harvest.

The following video clip discusses habitat retention during tree harvesting operations in NSW private native forests which is also broadly applicable to public and private forests in other states:

NSW Environmental Protection Agency – Private Native Forestry Technical Series: *Retained and protected trees in private native forestry* – a Peter Hill video on Vimeo
http://vimeo.com/60720428 (1:35 minutes)

The following video clip discusses the identification and protection of hollow bearing and recruitment trees during harvesting operations in NSW private native forests which is also broadly applicable to public and private forests in other states:

NSW Environmental Protection Agency – Private Native Forestry Technical Series: *Hollow bearing and recruitment trees in private native forestry* – a Peter Hill video on Vimeo
http://vimeo.com/60716117 (3:42 minutes)

Specific protection measures are related to the presence of threatened or endangered species and revolve around meeting their particular requirements, either through retaining patches of known suitable habitat, or perhaps modifying the harvesting system to retain appropriate elements of habitat. Two Victorian examples are cool temperate rainforest and known Leadbeater's Possum habitat, which are both excluded from tree harvesting and provided with a protective unharvested buffer wherever they are found. A Tasmanian example is the protection afforded to nest sites of the Wedge-tailed Eagle.

The following video clip discusses the principles of protecting threatened species during tree harvesting operations in NSW private native forests. These principles are also broadly applicable to public and private forests in other states:

NSW Environmental Protection Agency – Private Native Forestry Technical Series: *Threatened species in private native forestry* – a Peter Hill video on Vimeo
http://vimeo.com/60965213 (8:26 minutes)

The following video clip discusses the identification and protection of rainforest during tree harvesting operations in NSW private native forests which is also broadly applicable to public and private forests in some other states:

NSW Environmental Protection Agency – Private Native Forestry Technical Series: *Identifying rainforest in private native forestry* – a Peter Hill video on Vimeo
http://vimeo.com/60716120 (3:22 minutes)

In public native forests in all states, biodiversity protection strategies associated with tree harvesting operations are only a complementary measure to the far more substantial conservation outcomes being already achieved by reserving huge parts of the landscape in national parks and other conservation reserves where tree harvesting is excluded.

Fact sheets produced by the WA Forests Products Corporation and VicForests (see links below), outline the biodiversity protection measures which they employ and put them into context with the landscape-scale conservation measures being achieved in the nature conservation reserve system.

http://www.fpc.wa.gov.au/content_migration/_assets/documents/about_us/publications/swnf-4-biodiversity.pdf

http://www.vicforests.com.au/files/psmrdolaic/Protecting-Victoria's-Flora-and-Fauna-(Jan-'13).pdf

Given that multiple-use State forests, acting in concert with national parks and other reserves, are already adequately conserving biodiversity on public lands, there may be a lower imperative for private landowners to modify tree harvesting operations to conserve biodiversity. In Victoria, this is reflected in its Code of Practice for Timber Production 2007, where habitat retention measures are encouraged rather than being mandatory requirements in privately-owned forests. However, in other States, private forests may be treated little differently to public State forests in this regard.

Plantations

In plantations which have been established specifically for wood production, there is generally no mandatory requirement to reduce tree harvest productivity to protect biodiversity, but there are requirements to protect adjacent native vegetation that may be growing along waterways, in other excluded areas, and on neighbouring propertie, from any damage that could occur from harvesting the plantation. In some cases, such as on steep slopes, plantation owners often retain trees that would otherwise fall into and damage adjacent native vegetation.

On rare occasions where special biodiversity values develop within a plantation, their may be social and reputational advantages for plantation owners to minimise impacts even if it is at the expense of reduced wood production or less optimal harvest scheduling. An example of this has been the presence of an invasive koala population in 10 – 15 year old blue gum plantations in south western Victoria, where conservation efforts have been focussed on capturing and relocating animals prior to harvesting.

Where corporate plantation owners are certified to the Australian Forestry Standard or the Forests Stewardship Council, there will be a market imperative to do so in order to maintain their forest management certification.

SOIL AND WATER PROTECTION

The primary focus of soil and water quality protection is on avoiding significant soil degradation that leads to ongoing erosion that channelises sediment-laden water movement and ultimately pollutes waterways.

The strategies used to minimise soil disturbance and associated degradation to water values are based on:

- Good planning and construction of harvesting infrastructure prior to the operation;
- Sensible management of harvesting infrastructure during the operation; and

- Thorough rehabilitation and stabilisation of this infrastructure at the completion of harvesting, including leaving roads in a stable condition by maintaining their drainage structures (ie. culverts, mitre drains, silt traps, etc).

Good planning includes locating operations to avoid dangerous or difficult sites, such as overly steep slopes. It also includes locating coupe infrastructure such as landings, extraction tracks, and roads as far as possible away from waterways so as to minimise the need for waterway crossings and to reduce soil disturbance close to sensitive areas. Further to this it requires good design and well constructed new infrastructure such as roads, or upgrading of pre-existing roads where necessary.

It also requires scheduling harvesting in drier seasonal conditions as far as is possible, and choosing harvesting machinery that best matches the site conditions.

Sensible management of harvesting infrastructure during the operation involves carefully monitoring conditions so as to avoid operations occurring at times when soils are more vulnerable to degradation, such as during or after wet weather or when soils are extremely dry and dusty.

This can also include actions such as progressive rehabilitation of extraction tracks as the operation proceeds using cross drains (see Figure 5), so as to avoid the situation where long lengths of undrained track are left vulnerable to erosion. In plantations and in some native forests, using slash on extraction tracks during their use protects bare ground that would otherwise be exposed and spreads machinery loads (see Figure 4), thereby largely removing the need to undertake post-use drainage and rehabilitation works.

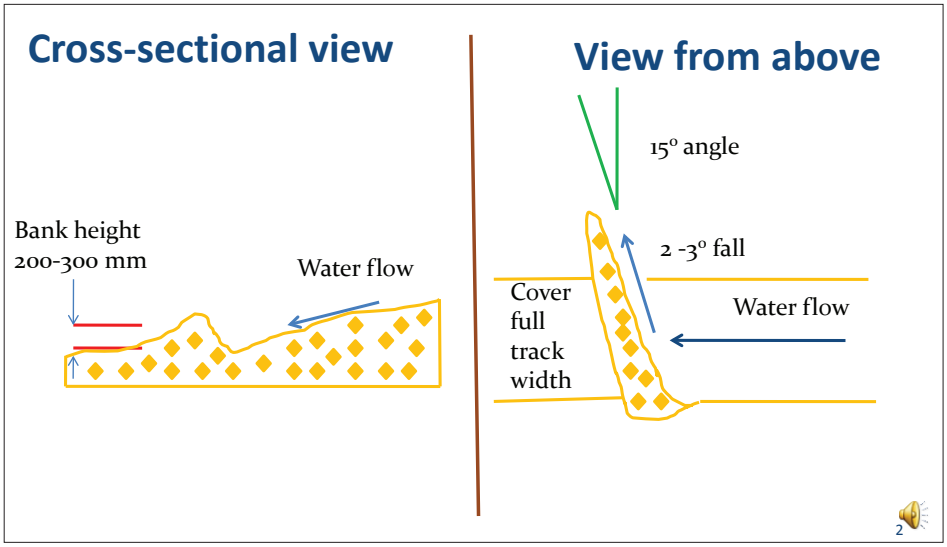
With respect to roads being used for log cartage, the same principles apply – regulating their use to avoid periods when the road surface is most vulnerable to degradation and actively maintaining road drainage structures to prevent water from pooling on the road and softening the surface thereby making it more vulnerable to damage, and ultimately to erosion.

Thorough rehabilitation and stabilisation of the infrastructure at the completion of harvesting involves works that effectively drain water from extraction tracks and to restore the drainage systems of log cartage roads, so as to prevent channelled water flow that could ultimately lead to erosion and subsequent damage to water quality in adjacent waterways.

The primary means of effectively draining and rehabilitating major extraction tracks and temporary roads is through the construction of appropriately-spaced structures variously known as bars, cross drains, or cross banks that regularly trap water flow and divert it off the track/road into adjacent harvesting debris or undisturbed vegetation where it is effectively trapped and dissipated.

Figure 4: Use of slash on a plantation extraction track to protect soil and prevent erosion
(photo: G. Stewart)

Figure 5: Cross-drain construction (supplied by G. Stewart)



The appropriate spacing for extraction track and temporary road drainage structures is determined on the basis of soil erodibility and slope, as per the example below from a high rainfall region in south western Victoria. Spacing standards may vary between states, or even between regions within states.

Table 2: Guide for extraction track drainage in high rainfall region (from Forest industry prescriptions for the Colac Otway Shire, Victoria, 2001)

	Maximum distance between cross drains based on extraction track grade					
Soil Erodibility	**0–10% 0–50**	**11–20% 5–100**	**21–30% 10–150**	**31–40% 15–200**	**41–50% 20–250**	**51–60% 25–300**
Low	125	85	60	40	20	5
Medium	110	70	45	30	15	5
High	100	60	30	20	10	Not Permitted

In some plantations, placing piles of harvesting slash at twice the frequency required for constructed cross drains, has been used as a measure to minimise erosion potential.

The following video clip discusses the construction of cross drains to prevent erosion on extraction tracks or temporary roads.

NSW Environmental Protection Agency – Private Native Forestry Technical Series: *Snig track cross bank construction in private native forestry* – a Peter Hill video on Vimeo
http://vimeo.com/60781153 (4:25 minutes)

Similarly for permanent log cartage roads, the maximum spacing between structures for effective road drainage is based on road grade and soil erosion hazard, as per the example below which is from the same region as the extraction track cross drain spacing example (see above). These road drainage structures can include culverts, mitre drains (also known as run-offs), or cross drains, such as roll-overs.

Table 3: Guide for maximum spacing between road drainage structures in high rainfall region
(from Forest industry prescriptions for the Colac Otway Shire, Victoria, 2001)

Soil	Road Grade						
Erodibility	**2%**	**4%**	**6%**	**8%**	**10%**	**12%**	**15%**
Low	250	170	130	115	100	90	60
Medium	200	150	120	105	90	80	Not permitted
High	160	130	110	95	80	65	Not permitted

The following video clips discuss the use of various road drainage structures in NSW private native forests which is also broadly applicable to public and private forests and plantations in other states:

NSW Environmental Protection Agency – Private Native Forestry Technical Series: *Mitre drains in private native forestry* – a Peter Hill video on Vimeo
http://vimeo.com/60720424 (2:08 minutes)

NSW Environmental Protection Agency – Private Native Forestry Technical Series: *Introduction to roll-overs in private native forestry* – a Peter Hill video on Vimeo
http://vimeo.com/61216305 (3:23 minutes)

NSW Environmental Protection Agency – Private Native Forestry Technical Series: *Relief pipe drainage in private native forestry* – a Peter Hill video on Vimeo
http://vimeo.com/61216306 (4:55 minutes)

Aside from drainage of the road surface, another critical aspect of minimising potential impacts on water quality is having well constructed and maintained road crossing of waterways. Poorly designed waterway crossings can end up being badly damaged by log truck traffic and subsequently washed-out in heavy rainfall events depositing substantial volumes of soil and sediment into waterways.

The following two video clips discuss the construction of road crossings of waterways using culvert pipes and bridges.

NSW Environmental Protection Agency – Private Native Forestry Technical Series: *Pipe culverts in private native forestry* – a Peter Hill video on Vimeo
http://vimeo.com/60720425 (2:18 minutes)

NSW Environmental Protection Agency – Private Native Forestry Technical Series: *Log and timber bridges in private native forestry* – a Peter Hill video on Vimeo
http://vimeo.com/60720420 (3:45 minutes)

While there is a primary focus on protecting water quality during tree harvesting operations, stream health is also a function of water quantity which can be adversely affected by over-harvesting of forested catchments thereby creating an excessive proportion of higher water use regrowth.

The protection of water quantity is addressed at higher levels of planning such as Codes of Practice or Forest Management Plans which specify limits to annual harvesting or harvesting limits over set periods such as a decade. This is meant to ensure that catchments maintain a range of different forest age classes rather than becoming dominated by young regrowth.

Activity 4.2

Imagine that you've been given the task of undertaking a post-harvesting audit of a coupe to evaluate the environmental performance of the harvesting supervisor and contractor. Using what you've learnt from this section, compile a checklist of indicators to be assessed both in the office and the field in order to complete such an audit.

Audit indicators	Assessible aspects
Eg. Timber Harvesting Plan	Does a THP exist? Does it correspond to the area harvested? Does it cover all the requirements set out in the Code of Practice?
Eg. Streamside buffer	Is it the required width? Is it intact or has it been damaged by harvesting?

5. MANAGING TREE HARVESTING TO MINIMISE IMPACTS

LEARNING OBJECTIVES FOR THIS SECTION

At the completion of this Section students should know what's required to plan, manage and learn from tree harvesting operations in relation to minimising environmental impacts and meeting sustainability indicators.

MANAGING TREE HARVESTING

Managing tree harvesting operations to minimise environmental impacts involves careful evidence-based planning, operational supervision, and monitoring.

The ordered steps required to effectively achieve this are:

Step 1: Identify productive native forest/plantation unit proposed for harvesting from mapping or aerial photography.

Step 2: Examine proposed harvesting unit in the field to:

- Assess the overall productivity and likely wood product mix
- Assess the topographic and environmental characteristics of the unit, including their influence in determining harvesting systems, methods, extent, and timing. These parameters include slope, aspect, soil type, and the presence of waterways.
- Assess road accessibility requirements including the need for new road contruction and/or the upgrade of existing roads.
- Mark the planned boundaries of the harvesting unit, including exclusion zones such as streamside buffers or reserves, and road access requirements.

Step 3: Seek information about the presence of rare, endangered or threatened species of fauna and flora on the proposed harvesting coupe. This may include a desk-top search of existing knowledge and/or field surveys conducted specifically on the coupe.

Step 4: Prepare a harvesting plan in accordance with the operational and environmental protection requirements of the site and the requirements specified in the relevant Forest Practices Code and/or more detailed local prescriptions.

Step 5: Meet and discuss the harvesting plan in the field with the nominated harvesting contractor and (if someone else) the contractor required to upgrade or construct appropriate road access for log cartage. As a result of this meeting/s modify the plan if required, including the marked harvesting boundaries.

Step 6: Where required, undertake other consultation such as with neighbouring landholders, Local Government where log cartage is planned for Shire roads, or other stakeholders with legitimate interests. As a result of this meeting/s, modify the plan if required

Step 7: Obtain appropriate approval/s for the harvesting plan and further modify if required. With respect to operations on private lands, in some States this may require obtaining a Planning Permit from Local Government.

Step 8: Initiate the harvesting operation on-site with the harvesting contractors, including obtaining their signature on the harvesting plan to signify their acceptance of its conditions. It is normally a requirement that the harvesting contractors keep the harvesting plan on-site for the duration of the operation in most States.

Step 9: Regularly visit the operation to supervise the contractor's adherance to the plan, including respecting marked boundaries and meeting environmental protection requirements. This should also include monitoring of contractor productivity performance in terms of maximising product yields and minimising waste, such as through low stump heights or correct apportioning of logs to nominated uses and values.

It is not uncommon for planned harvesting to be amended during the operation when actual operating conditions are found to differ from planned conditions. When this occurs, contractors are required to notify supervisors to get approval to amend the plan to take account of changes. For example, the plan may require a temporary stream crossing to be removed after use, but a sudden onset of wet weather may dictate that unacceptable soil damge would be incurred in trying to meet this requirement, and an exemption from it may be more environmentally prudent.

Step 10: When harvesting is nearing completion, visit the site to reinforce the requirements for post-harvesting site rehabilitation.

Step 11: After being notified by the harvesting contractor that harvesting and site rehabilitation works have been completed, conduct a site audit to ensure that requirements have been met with regard to matters such as extraction track drainage. If work is not satisfactory, direct contractor to undertake further works before being issued with a completion notice.

The process of harvest planning will typically take several months from its initiation until the commencement of harvesting. In some cases, such as private forest and plantation harvesting in Victoria, there is a requirement that Local Government authorities are provided with harvesting plans prior to a nominated minimum period before to the commencement of harvesting.

POST-HARVEST LEARNING

There is much that can be learnt from a harvesting operation by:

- Comparing actual wood volume and product yields against that estimated during coupe planning. Such comparisons can help refine yield estimates for future operations in similar forest types or plantation ages in the same or nearby locales. This information is also essential for refining sustainability indicators such the allowable annual harvest area and/or timber volume.
- Independent auditting of the completed harvesting to assess the performance of the contractor and supervisor, particularly in terms of meeting environmental requirements. This can have a positive benefit on future outcomes by showing up areas where there is need for improvement.

Activity 5.1

A partially completed native forest Timber Harvesting Plan, including a map, is attached starting on the following page.

Using what you have learnt from this workbook and by referring to prescriptions and guidelines in Tasmania's Forest Practices Code (accessed via the link below), complete those blank sections which you believe to be relevant to the planned operation.

Tasmania's Forest Practices Code (2000)
http://www.fpa.tas.gov.au/__data/assets/pdf_file/0020/58115/Forest_Practices_Code_2000.pdf

EXAMPLE: TIMBER HARVESTING PLAN – NATIVE FOREST

General

Coupe Name	*Purple Patch 2*
Coupe Location – Map ref	*Mc Carthy 1:25,000 Mapsheet : 725304/5722224*
General Location	*Woods Rd via Christian Rd, 12 km north of Lyonville*
State Forest Block	*Lyonville State Forest*
Harvesting Supervisor	*Ben Forrest*
Date Plan prepared	*16th November 2013*

Operational features

Harvesting Contractor	*Woods ContractingPty Ltd*
Harvesting system	*Seed tree system*
Machinery to be used	*Manual felling / rubber-tyred skidder/excavator*
Planned harvesting period	*January to March 2014*
Estimated wood volumes	*2500 m3 D+ sawlog / 4500 tonnes pulp*
Log cartage contractor	*Carter and Sons Haulage Pty Ltd*
Cartage route	*Sawlog: Woods Rd – Christian Rd – Sawmill Rd* *Pulp: Woods Rd – Christian Rd – Southern Hwy – Chipper Rd*

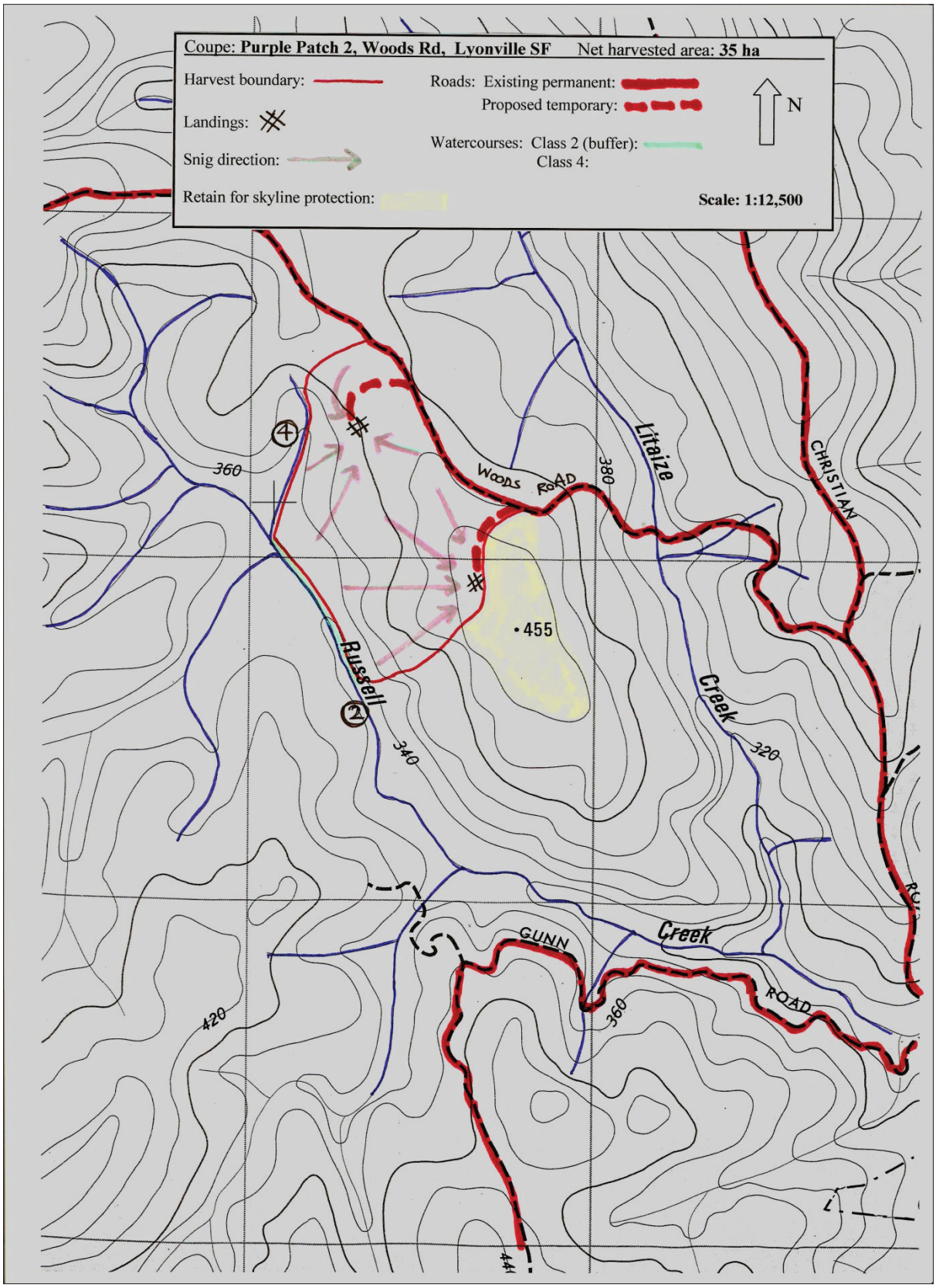
Coupe features

Coupe area	*Gross: 38 hectares Net harvested: 35 hectares*
Forest type	*High Elevation Mixed Species:* *Messmate / B Stringybark / MG Gum / Peppermint*
Elevation	*430 metres ASL*
Approx annual rainfall	*1000 mm/yr*
Topography – slope range	*Gentle – moderate slopes (5 to 15o)*
Watercourses	*Class 2 watercourse – Russell Creek* *Class 4 watercourse*
Soil type/s	*Brown sandy clay loam derived from Devonian granite*
Erosion hazard	*Moderate - High*
Silviculture/ regeneration	*Burn slash to create suitable seedbed* *Natural seed fall from retained seed trees and habitat tree, if necessary supplemented by aerial seeding*
Biodiversity – any special features	*The vulnerable Arboreal Possum occurs in this forest type* *The endangered Swamp Frog inhabits riparian vegetation in this area*

Operational prescriptions

Seed tree retention	*Retain 6 suitable seed trees per two hectares spaced no more than 1.5 tree lengths apart*
Watercourse protection	
Soil and water quality protection – extraction tracks, temporary roads	
Soil and water quality protection – log landings	
Biodiversity protection	
Landscape protection	
Cultural heritage protection	*No cultural heritage values present*
Weather restrictions	
Fire protection restrictions	
Machinery servicing and refuelling	
Road maintenance	
Rubbish	
Boundary tracking requirements	

TIMBER HARVESTING PLAN MAP



6. BRINGING IT ALL TOGETHER

When you feel that you are getting close to being ready for assessment you should meet with your assessor to agree on:

1. the most appropriate method(s) of assessment to be used to determine competence against the Unit of Competency
2. the timing of the assessment task(s).

At AQF Level 5 it is expected that you can collect and compile a range of data types and interpret, communicate and use this data. For this reason it is strongly recommended that a holistic approach be taken to assessment.

To demonstrate competence it is recommended you evaluate a tree harvesting plan and make recommendations to the plan so as to minimise environmental impact. If you cannot access a plan then you could develop an exemplar plan based on a site in your locality.

Develop harvesting plan

If you do not have access to such a situation, you can develop a plan for an exemplar property, with case study material provided by yourself or the assessor. In either case, the completed plan would need to include the following:

1. Scope, purpose and objectives of the plan and assumptions
2. Audience and stakeholders including colleagues
3. Estimate available product
4. Impact of relevant legislation and regulations ie EPA, roads, local government planning
5. Likely issues related to environmental impacts pre, during and post harvest
6. Consultation process for internal and external stakeholders
7. Harvesting methodology to minimise environmental impacts
8. Required resources including equipment, people, budget and timelines
9. Communications plan to bring all the above together
10. Approvals required
11. Risk assessment of onsite and offsite impacts
12. Success criteria.

Manage sustainable harvesting

Using the completed plan, oversee a harvesting activity. Monitor against success indicators and ensure exceptions, issues and difficulties are recorded.

Review sustainable harvesting activity against plan

Analyse the reports against the success criteria and evaluate the effectiveness of the harvesting activity. Establish what worked well and what could be improved. Make recommendations for changes to the plan based on this information.

SOURCES AND FURTHER READING

Victoria's Code of Practice for Timber Production 2007
http://www.depi.vic.gov.au/__data/assets/pdf_file/0019/226036/Code_of_Practice_for_Timber_Production.pdf

Tasmania's Forest Practices Code (2000)
http://www.fpa.tas.gov.au/__data/assets/pdf_file/0020/58115/Forest_Practices_Code_2000.pdf

Private Native Forestry Code of Practice for Northern NSW (2008)
www.environment.nsw.gov.au/resources/pnf/0837copnorth.pdf&sa=U&ei=vNxNU9b_KoaAkgXttIDIDg&ved=0CCUQFjAB&usg=AFQjCNHjXfiXJivlC6zbVaOrnVMsDkNB1w

Sustainably Managing Private Native Forests – A Guide for Victorian Landowners, prepared by Mark Poynter on behalf of the Victorian Department of Primary Industries, Central Victorian Farm Plantations Inc, and the Joint Venture Agroforestry Project of the Rural Industries Research and Development Corporation (2008)
http://www.andrewisles.com/assets/Bookmine/p/BMImg_34191_34191_Poynter_sustain_web.jpg

Assessment of Code of Practice for Plantation Forestry: Northern Territory, prepared by Raison et al for the Department of Agriculture, Fisheries and Forestry, May 2012

Assessment of Code of Practice for Plantation Forestry: Queensland, prepared by Smethurst et al for the Department of Agriculture, Fisheries and Forestry, May 2012

Assessment of Code of Practice for Plantation Forestry: Western Australia, prepared by Smethurst et al for the Department of Agriculture, Fisheries and Forestry, May 2012

Forest Practices Code Part 1: Timber harvesting in Forests NSW plantations, published by Forests NSW, NSW Department of Primary Industries (2005)

Montreal Process Implementation Group for Australia and National Forest Inventory Steering Committee, 2013, Australia's State of the Forests Report 2013, ABARES, Canberra, December: particularly Criterion 4 "Conservation and maintenance of soil and water resources", pages 201 – 229.

Managing sediment sources and movement in forests the forest industry and water quality, by Croke et al., Cooperative Research Centre for Catchment Hydrology (1999)

SELF ASSESSMENT

Before commencing on your summative assessment take a few minutes to review this workbook and ensure you feel that you are confident about your skill levels related to this topic.

Use the table below to help you check your skills which have been taken from the *Required knowledge and Skills* section of the relevant Unit of Competency. Before commencing your final assessments it is important to review any sections in which you feel unsure. Please always ask your assessor/lecturer questions about areas you are unsure about.

In the table below, read the list of skills and knowledge you should have after completing this workbook.

1. Put a tick in the "confident" column if you can do this now and a brief comment re why you believe you have this skill.
2. Put a tick in the next column if you feel you need more practice and must review the work before completing final assessments also a brief comment as to why.
3. If you require further training, complete the third column listing what training is needed. Show this list to your supervisor or assessor and ask for more time or training before completing the summative assessments.

Skills/knowledge you should have	Confident	Need Practice	What additional training do I need?
REQUIRED SKILLS			
Technical skills sufficient to manage tree harvesting while minimising environmental impact			
Communication skills sufficient to use appropriate consultative, communication and interpersonal techniques with colleagues and others			
Literacy skills sufficient to record and report workplace information; maintain documentation; read and interpret maps; follow legislation, regulations, standards, codes of practice and safe working procedures involved in harvesting operations			
Numeracy skills sufficient to estimate and calculate volume, gross and net areas; calculate available timber			
Problem solving skills sufficient to identify problems; demonstrate appropriate response procedures			
Planning and organisational skills sufficient to organise and obtain required permits and to manage harvesting operation while minimising environmental impact; prepare and review a tree harvesting plan; implement a tree harvesting plan			
Managerial skills sufficient to manage harvesting operations			
Research skills sufficient to obtain information on tree harvesting requirements to maximise yields and minimise environmental impact and by-product			

Skills/knowledge you should have	Confident	Need Practice	What additional training do I need?
REQUIRED KNOWLEDGE			
Applicable Commonwealth, State or Territory legislation, regulations, standards, codes of practice and established safe practices relevant to the full range of processes for managing tree harvesting to minimise environmental impact			
Environmental protection requirements, including the safe disposal of waste material			
Organisational, site and management standards, requirements, policies and processes for implementing harvesting plans			
Environmental risks and hazards			
OHS in relation to harvesting operations			
OHS monitoring systems			
Applicable certification schemes such as Forest Stewardship Council, Australian Forestry Standard, ISO standards for environmental and other management systems, other identified industry standards			
Chain of custody principles and applicable systems			
Database management and document control systems			
Mathematic theory and application for calculating volume and scheduling flow			
Tree harvesting plans			
Sustainability indicators			
Coupe size (gross area estimate, net area estimate and volume estimate)			
Buffer zones, protected areas and erosion control			
Planning permits and access permission			
Performance indicators			
Established communication channels and protocols			
Problem identification and resolution			
Types of tools and equipment, and procedures for their safe use and maintenance			
Procedures for the recording, reporting and maintenance of workplace information			

FEEDBACK

This learning resource has been developed to guide you through available topical information and to set activities for you to do that help you gain knowledge and skills appropriate to your work place or situation. Your competency will be assessed through your successful completion of the activities to a satisfactory standard and submitting these for review. Please complete the following table to notify us of any errors and suggest any improvements.

Resource title	***Manage Tree Harvesting to Minimise Environmental Impact***

Page	**What is in error**	**Suggested improvement**
Is there a link to your suggested improvement?		

Additional comments

Click here to email your feedback form to ForestWorks

ACKNOWLEDGEMENTS

Preparation of this training resource has been a collaborative effort between ForestWorks and the Institute of Foresters of Australia. It is one of a set of seven as follows:

1. Manage sustainability in the workplace (assessment framework only)
2. Implement sustainable forestry practice
3. Manage tree harvesting to minimise environmental impact
4. Undertake carbon stock sampling of forests and plantations
5. Manage sustainable tree inventory
6. Promote plantations as a sustainable form of landuse
7. Build and maintain community relationships.

Project team

The project drew on the depth and breadth of technical knowledge and subject matter expertise of IFA staff, members and other experts.

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Steering committee

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