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

# Learning Resource for IMPLEMENT SUSTAINABLE FORESTRY PRACTICES








**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 ***FPICOT5201B Implement sustainable forestry practices***.

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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 or who has responsibility for native forest or plantation management. The scope of the workbook includes the following activities:

- Developing an understanding of what sustainable forestry entails
- Learning how sustainable forestry is assessed and documented
- Gaining an appreciation of the differences in how sustainable forestry is implemented and assessed between Australian native forests and plantations

- Learning about the critical role of forest/plantation inventory and knowledge of non-wood values in implementing sustainable forestry practices
- Putting tree harvesting for wood production into perspective with regard to overall forest sustainability at the national and state-scale
- Gaining an appreciation of the responsible tree harvesting practices that contribute to forest sustainability
- Gaining an understanding of how regenerating or replanting harvested forests and plantations defines the concept of sustainable forestry and sets it apart from deforestation.

The scope of the workbook addresses the following requirements:

- Understanding the potential for tree harvesting to adversely impact on forest sustainability
- Acting within the legislation and environmental regulations that pertain to commercial tree harvesting
- Integrating environmental protection with operational wood production aims and the silvicultural requirements of sustainable forest/plantation management
- Learning the operational functions that constitute sustainable forestry practices.

The workbook presumes some pre-existing knowledge and therefore does not address any of the following in detail:

- Relevant operational competencies and workplace WH&S requirements
- Parameters that constitute a productive forest/plantation stand suitable for harvesting.

## EMPLOYABILITY SKILLS

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

The statements below list the typical employability skills that would be applied in a situation related to managing sustainable forestry enterprises.

In completing your daily work tasks and activities and the summative assessments related to this unit of competence, you must be able to demonstrate that you are applying the "employability skills" listed below to this competency.

- 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 implementing sustainable forestry practices 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

- Understanding what sustainable forestry is
- Knowledge of the internationally-agreed criteria and indicators which govern the attainment and documentation of sustainable forest management and their application in the Australian context
- Sppreciating that responsible wood production practices comprise only a minor component of the overall sustainability of Australia's forests
- Understanding the critical role of information and knowledge in effectively managing natural resources, including forests and wood
- Awareness of the measurable parameters that inform the sustainable management of native forests and plantations
- Managing tree harvesting and tree regeneration/replanting and its role in sustainable forest management
- Protecting forests and trees from unnatural agents of destruction and the importance of this to sustainable forest management.

# 1. WHAT IS SUSTAINABLE FORESTRY?

## LEARNING OUTCOME

Sustainable forestry can mean different things depending on whether it's being considered primarily from an economic, environmental or social perspective; or a combination of all three perspectives.

With regard to forestry, sustainability has traditionally been an economic concept referring to the aim of maintaining a perpetual supply of wood products. However, changing community values since the 1970s have led to it now being broadened to integrate this with social and environmental perspectives.

Accordingly, the United Nations' Food and Agriculture Organisation has, since 1993, adopted the following definition of sustainable forest management:

> *The stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems.*

Other definitions are also used. For example, the US Sustainable Forestry Initiative 2010 – 2014 Standard (January 2010) describes sustainable forestry as a practice:

> *.... to meet the needs of the present without compromising the ability of future generations to meet their own needs by practising a land stewardship ethic that integrates reforestation and the managing, growing, nurturing and harvesting of trees for useful products and ecosystem services such as the conservation of soil, air and water quality, carbon, biological diversity, wildlife and aquatic habitats, recreation, and aesthetics.*

Probably, the simplest description of sustainable forestry is that it means managing our forest resources to meet the needs we have today without reducing the capacity for future generations to also meet their needs.

For forest managers, this entails determining, in a tangible way, how to use forests today to ensure similar benefits, health and productivity in the future. To do so requires assessing and integrating a wide array of sometimes conflicting factors – commercial and non-commercial values, environmental considerations, community needs, and perhaps even global impact – to produce sound forest management plans and actions.

Because forests and societies are in constant flux, the desired outcome of sustainable forest management is never permanently fixed. What constitutes a sustainably managed forest today may change over time as public needs or values change.

This is true of Australia where the concept of sustainable forestry has a long and evolving history. As our understanding of forest ecology has increased and community attitudes have changed, management practices have also changed in order to meet sustainable timber yields while maintaining and protecting other forest values.

Accordingly, sustainable forestry necessitates the attainment of a balance between society's increasing demands for forest products and benefits, and the preservation of forest health and diversity. This balance is ultimately critical to the survival of forests, and to the prosperity of forest-dependent communities.

The following video clips show how the concept of sustainable forest management is being interpreted in the native forests of Western Australia, Sweden and Canada.

**WA Forest Products Commission: Sustainable Forest Management in Western Australia**
http://www.fpc.wa.gov.au/content_migration/environment/sustainable_forest_management.aspx (3:28 minutes)

**SL Uutbildning: Sustainable Forestry: The Swedish Model.mov (2012, You Tube)**
http://www.youtube.com/watch?v=4R3rQTksa8M (8:10 minutes)

**Naturally: wood: Managing for Sustainability in British Columbia, Canada, You Tube**
http://www.youtube.com/watch?v=OyQ9Wiy_7cM (8:01 minutes)

## Activity 1.1

Briefly describe the significance of each the following words or phrases in the context of sustainable native forest management:

- Landscape-scale
- Trade-off
- Inventory
- Regeneration
- Consultation.

# 2. CRITERIA AND INDICATORS OF SUSTAINABLE FORESTRY

## LEARNING OBJECTIVES FROM THIS SECTION

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

- What the criteria and indicators of sustainable forestry are, and how they are used
- That there are seven internationally agreed key elements of sustainable forest management
- How sustainability criteria and indicators are used in the Australian context
- About the role of forest certification as a driver of forest sustainability

## WHAT ARE CRITERIA AND INDICATORS?

Criteria and indicators provide a common understanding of what is involved in sustainable forest management, and a common framework for describing, assessing and evaluating a country's progress towards sustainable forest management. The criteria represent broad forest values, while the indicators represent measurable aspects of these criteria (Australia's State of the Forests Report 2013).

Criteria and indicators of sustainable forestry are widely used and many countries produce national reports that assess their progress toward sustainable forest management. There are nine international and regional criteria and indicators initiatives, which collectively involve more than 150 countries. Three of the more advanced initiatives are those of the Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests (also called the Montreal Process), Forests Europe, and the International Tropical Timber Organisation.

According to the United Nations' Food and Agriculture Organisation, there is a growing international consensus on the key elements of sustainable forest management. Seven common thematic areas have emerged based on the nine ongoing regional and international criteria and indicators initiatives. These seven thematic areas are:

- Extent of forest resources
- Biological diversity
- Forest health and vitality
- Productive functions and forest resources
- Protective functions of forest resources
- Socio-economic functions
- Legal, policy and institutional framework.

These themes were acknowledged by the international forest community at the fourth session of the United Nations Forum on Forests (2004) and the 16th session of the Committee on Forestry (2003). In 2007, they were enshrined in the Non-Legally Binding Instrument on All Types of Forests adopted by the UN General Assembly as a reference framework to help achieve sustainable forest management.

This consensus on common themes (or criteria) effectively provides a common, implicit definition of sustainable forest management.

## ELABORATING ON THESE COMMON THEMES

The United Nation's Food and Agriculture Organisation has drafted the following descriptions of these agreed seven key themes:

### 1. Extent of forest resources

The theme expresses an overall desire to have significant forest cover and stocking, including trees outside forests, to support the social, economic and environmental dimensions of forestry. For example, the existence and extent of specific forest types are important as a basis for conservation efforts. The theme encompasses ambitions to reduce deforestation and to restore and rehabilitate degraded forest landscapes. This theme also includes the important function of forests and trees outside forests to store carbon and thereby contribute to moderating the global climate.

### 2. Biological diversity

The theme concerns the conservation and management of biological diversity at the ecosystem (landscape), species and genetic levels. Such conservation, including to protect areas with fragile ecosystems, ensures that diversity of life is maintained, and provides opportunities to develop new products, for example medicines, in the future. Genetic improvement is also a means to improve forest productivity, for example to ensure a high wood production in intensively managed forests.

### 3. Forest health and vitality

Forests need to be managed so that risks and impacts of unwanted disturbances are minimized, including wildfires, airborne pollution, storm felling, invasive species, pests, diseases and insects. Such disturbances may impact social, economic as well as environmental dimensions of forestry.

### 4. Productive functions of forest resources

Forests and trees outside forests provide a wide range of wood and non-wood forest products. The theme expresses the ambition to maintain a high and valuable supply of primary forest products, while at the same time ensuring that production and harvesting are sustainable and do not compromise management options of future generations.

### 5. Protective functions of forest resources

The theme addresses the role of forests and trees outside forests to help moderate soil, hydrological and aquatic systems. This includes to maintain clean water including e.g. healthy fish populations, as well as to reduce risks or impacts of floods, avalanches, erosion and droughts. Protective functions of forest resources also contribute to ecosystem conservation efforts. Protective functions of forest resources have strong cross-sectoral aspects, as the benefits to agriculture and rural livelihoods are high.

### 6. Socio-economic functions

The theme addresses the contributions of forest resources to the overall economy, for example through employment, values generated through processing and marketing of forest products and energy, trade, and investments in the forest sector. The theme also addresses the important functions of forest to host and protect sites and landscapes that have high cultural, spiritual or recreational values, and thus include aspects of land tenure, indigenous and community management systems, and traditional knowledge.

### 7. Legal, policy and institutional framework

The theme includes the legal, policy and institutional arrangements necessary to support the above six themes, including participatory decision making, governance and law enforcement, and monitoring and assessment of progress. The theme also addresses broader societal aspects, including fair and equitable use of forest

resources, science research and education, infrastructure arrangements to support the forest sector, transfer of technology and capacity building, and public information and communication.

## SUSTAINABLE FORESTRY IN THE AUSTRALIAN CONTEXT

From these broad themes, more detailed sets of criteria and indicators have emerged for practical application. For example, the Montreal Process (2009 edition) lists seven criteria and 54 indicators that can be used to assess sustainable forest management.

In Australia, the international criteria and indicators of sustainable forest management are now incorporated in key policies, plans, and reporting instruments which direct and complement forest and plantation management. This includes forestry codes of practice and the periodic state and national state of the forests reports.

Australia's Sustainable Forest Management Framework of Criteria and Indicators 2008 – Policy Guidelines [PDF 1.6MB] details the seven criteria and 44 indicators in the framework used for reporting on the state of Australia's forests. It includes the rationale for the inclusion of each indicator in the framework, within the relevant criterion. All such frameworks are developed on the premise that sustainable forest management is a process of continuous improvement.

The essential aim of sustainable forest management is to maintain the broad range of forest values in perpetuity. However, assessing progress towards this aim is difficult. Criteria and indicators are used to simplify the task by characterising the essential components of sustainable forest management. They provide a common understanding of what is meant by sustainable forest management and a common framework for describing, assessing and evaluating a country's progress towards sustainability at the national or state level.

Most methods of sustainability assessment follow a broadly similar approach involving an analytical hierarchy, in which information is organised so that each individual component contributes to the understanding of a larger theme or question (the 'criterion'). The individual components ('indicators') may then be examined in terms of their contribution to key sustainability measures. Australia's approach comprises the following criteria:

- Criterion 1. Conservation of biological diversity
- Criterion 2. Maintenance of productive capacity of forest ecosystems
- Criterion 3. Maintenance of ecosystem health and vitality
- Criterion 4. Conservation and maintenance of soil and water resources
- Criterion 5. Maintenance of forest contribution to global carbon cycles
- Criterion 6. Maintenance and enhancement of long-term multiple socioeconomic benefits to meet the needs of societies
- Criterion 7. Legal, institutional and economic framework for forest conservation and sustainable management.

These criteria are the same as those developed by the international-level Montreal Process Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests, known as the Montreal Process Working Group, which was formed in 1994 by a number of countries with temperate and boreal forests. Australia accepted the criteria developed by the Montreal Process Working Group, but adapted the indicators to better suit the country's unique forests.

## Activity 2.1

**Australia's State of the Forests Report 2013 (see the link below) exemplifies how sustainability criteria and indicators are used to monitor the nation's forest management.**
http://www.daff.gov.au/ABARES/forestsaustralia/Pages/SOFR/sofr-2013.aspx

**Visit Victoria's Code of Practice for timber production 2007 (using the link below) and briefly describe how sustainability criteria and indicators are being used to govern Victorian timber production.**
http://www.depi.vic.gov.au/__data/assets/pdf_file/0019/226036/Code_of_Practice_for_Timber_Production.pdf

## FOREST CERTIFICATION – AN EMERGING DRIVER OF SUSTAINABLE FORESTRY

The concept of forest certification was developed in the early 1990s by the international environmental movement specifically as a means of combating forest exploitation in developing countries where state environmental protection controls were being overridden by poor governance, weak management, and endemic corruption.

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.

Forest certification schemes are based on sustainability criteria supported by detailed indicators, such as those of the Montreal Process, to form the basis of assessible standards. These standards are comprised of two seperate components:

*Forest certification* – involves assessment by an independent third party of forestry planning, procedures, systems and on-ground management against the requirements of a pre-determined standard. A certificate is issued upon conformity to the standard.

*Chain of custody certification* – provides a system to track wood products from a certified forest through the processing and distribution pathway to the final user. This is also assessed and audited by a third party.

The subsequent spread of the forest certification concept into developed countries (such as Australia) where there were already strong government regulatory regimes and world's best forestry practices, has had more to do with marketing the environmental credentials of wood products and the companies that produce them.

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.

Forest certification has no direct bearing on the government legislative and regulatory requirements which apply to tree harvesting. However, forestry sector companies or agencies that attain forest certification may choose to institute more stringent environmental care strategies subject to the requirements of their certifying body in the interests of improving the marketability of their products.

While this can be viewed as a positive, forest certification also has the potential to usurp the sovereign control of forest or plantation management by national or state governments when certification standards don't align with practices that are otherwise legally allowable and comply with government regulations. For example, some critically important plantation herbicides approved and regulated for this purpose under Australian and NZ law, have long been under threat of banning by FSC standards intent on phasing-out chemical use (Tomkins, 2004). This continues today with FSC certified companies being only temporarily allowed to use herbicides such as Velpar, despite them being approved for use under national regulations (Tomkins pers comm, 2014).

As of early 2014, around 440 million hectares (or around 10%) of the world's forests and plantations had been certified in an approximately 40:60 split between FSC: PEFC national schemes.

## Activity 2.2

**Currently there are around 10.9 million hectares of native and plantation forests certified in Australia, including about 400,000 hectares certified under both the FSC and AFS schemes. By visiting the websites of the Australian Forestry Standard (http://www.forestrystandard.org.au/) and the Forest Stewardship Council (http://au.fsc.org/), try to find out how much forest and plantation is certified to each scheme and fill out this table.**

| Certified forest type | Australian Forestry Standard | Forest Stewardship Council |
|---|---|---|
| Native Forest | | |
| Plantation | | |

7 Accessed 25 May 2014

# 3. PRACTISING SUSTAINABLE FORESTRY IN THE AUSTRALIAN CONTEXT

## LEARNING OBJECTIVES FROM THIS SECTION

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

- What sustainable forestry practices are for the purposes of this workbook
- That sustainable forest management means different things in plantations and native forests
- That sustainable management of native forests is not just about wood production

## DEFINING SUSTAINABLE FORESTRY PRACTICES

For the purposes of the Advanced Diploma of Forest Industry Sustainability, sustainable forestry practices are considered here primarily from the economic perspective of using available native forests and plantations for wood production.

This involves managing a perpetual cycle of tree growth, harvest, and regrowth to ensure a stable, secure supply of wood to processing industries whilst minimising environmental impacts.

In this context, sustainable forestry practices include:

- Forest and plantation inventory to establish the extent of wood resources as well as accessing information on other values which, in combination, determines the annual harvest level needed to maintain a perpetual supply of wood into the future;
- Planning and conducting the harvesting of tree stands while minimising adverse impacts;
- Regenerating or replanting harvested areas so that they regrow into new forests or plantations; and
- Protecting wood resources from fire, pests, or diseases.

## PUTTING NATIVE FOREST WOOD PRODUCTION INTO PERSPECTIVE

In Australia, the requirement to produce wood without compromising environmental sustainability is enshrined in the layers of government legislation and regulation which delineates public forest areas for multiple use and conservation, as well as in forest management planning, and the management of specific harvesting operations.

This, plus other land tenure and natural factors, such as topography and site productivity, dictates that most Australian native forests are unlikely to be used to produce wood. Accordingly, it can be argued that harvesting and regenerating proportionally small annual areas within a minor portion of the total forest cover has little impact on overall environmental sustainability when assessed at a landscape, state or national scale.

The Australia's State of the Forests Report 2013 (Criterion 2) regards only 5.5 million hectares (or 14%) of the nation's 39.3 million hectares of public native forest as the net available and suitable harvestable area. A much larger area of private and leasehold native forest is theoretically available for use but due to variable landowner intentions and a range of other factors, most of this is unlikely to be used.

In fact, the environmental sustainability of Australia's forests and woodlands is being primarily shaped by unnatural fire regimes and the presence of introduced pests which prey upon or compete with native species

for space, habitat or food. The question of how to address these issues is the major concern for public land managers, and to a lesser degree, the owners of private native forests and plantations.

While the management of wood production in a minor portion of the nation's forest cover is unlikely to significantly influence overall environmental sustainability, it nevertheless requires that measures be taken to minimise impacts to biodiversity, soils and water values.

Experience over a long period shows that these measures are generally sufficient to maintain most conservation values as harvested forests regenerate. Given time, there are many examples of post-harvest regrowth forests developing sufficiently high conservation values to warrant inclusion in national parks and other conservation reserves. For example, a substantial area of forest regrowth from timber harvesting conducted 60 to 80 years ago was added to Tasmania's Wilderness World Heritage Area in 2013.

## NATIVE FORESTS VS PLANTATIONS

While the principles of sustainably producing wood are essentially the same for both Australian native forests and plantations, there are different emphases placed on the various economic, environmental and social values in each instance.

Native forests are natural ecosystems with multiple and diverse environmental, social, and economic values; whereas timber plantations are artificially established tree stands with a strong economic value, but are accompanied by fewer environmental and social values.

The sustainable management of wood production in Australia's native forests is founded on:

- The need to give a high priority to protecting soil and water values that are essential for future forest health and productivity
- A recognition that is impossible for each hectare of forest to optimise all economic, social, and environmental values
- The need for a landscape-scale approach to deal with competing values such as biodiversity and wood
- A trade-off between competing values by delineating parts (or zones) of the landscape in which some values are optimised at the expense of other values that are themselves optimised elsewhere in other zones
- Creating a balance between areas zoned primarily for particular uses and values so as to ensure all economic, social and environmental values are sustained at a regional, statewide, and nationwide scale.

On the other hand, the sustainable management of Australian plantations is based on:

- The need to give a high priority to protecting soil and water values that are essential for future plantation productivity
- An economic imperative to optimise the economic value of trees to provide a financial return on the cost and effort of establishing and managing them
- A lower focus on biodiversity conservation due to a relative lack of resident flora and fauna values, apart from in adjacent unplanted areas which are not harvestable anyway
- Giving far greater weight to the economic value of wood over social values such as recreation which occassionally develops within some plantations.

In plantations, there may be occasional exceptions to the general lack of biodiversity values, such as, for example, the blue gum pulpwood plantations of south western Victoria which have been colonised recently by koalas thereby forcing changes to the way the trees are being managed.

Similarly, with regard to social values, recent initiatives such as Good Neighbour Charters and Forest Certification Schemes have in some instances heightened the consideration given to local community values and uses (such as visual amenity or recreation) by plantation owners and managers, compared to the past.

## Activity 3.1

Identify a plantation or native forest that you are familiar with and briefly describe how its sustainable management is being achieved in terms of wood, environmental, and community values.

9 Accessed 25 May 2014

# 4. KNOWLEDGE – THE FIRST STEP TO SUSTAINABILITY

## LEARNING OBJECTIVES FROM THIS SECTION

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

- The critical importance of knowing what you've got before you can hope to manage it
- The parameters which inform sustainable management of plantations and native forests
- What sustainable yield means in relation to wood production
- The significance of non-wood values in sustainable forest or plantation management

## THE IMPORTANCE OF KNOWLEDGE

It is impossible to properly manage something if you don't understand what it is or is comprised of. Accordingly, the capability to sustainably manage native forests and plantations is reliant upon knowing what characteristics and values they contain.

This information is generally obtained by undertaking an inventory. Inventory programs in Australian native forests and plantations have traditionally been focussed only on wood production capability. However in recent years, native forest inventory programs have been broadened to also capture other values.

In both native forests and plantations, the relevant parameters which inform sustainable management may include:

- Harvestable wood volume and average tree stand growth rates in the designated productive areas
- Biodiversity values – including the presence/ absence of endangered or threatened species or ecological communities
- The needs of local communities and other broader values such as water, tourism, recreation, and education;
- Carbon stocks
- Tree and ecosystem health and potential threats to health.

In plantations, the major inventory focus is typically on the harvestable wood volume and tree growth parameters which together provide the knowledge required to determine the sustainable level of annual tree harvesting, given a nominated rotation length.

The following video clip very briefly outlines the basic measurements and outputs from a typical plantation inventory program focussed on wood production:

**UPM Plantation Life: Inventories on Forest Plantations, You Tube**
http://www.youtube.com/watch?v=A-55ounz3m0 (1:07 minutes)

The following video clips respectively briefly outline the features of the broad-based national inventory of Ireland's natural forests, and outline the future of broad-based forest inventory using advanced technology:

**EPA Ireland: ForestInventory – EcoEye Series 6, You Tube**
http://www.youtube.com/watch?v=IR8CKt-CBMY (8:37 minutes)

**FPInnovations: Enhanced ForestInventory, You Tube**
http://www.youtube.com/watch?v=-VmAy6rxt-U (2:56 minutes)

## WOOD PRODUCTION – THE CONCEPT OF SUSTAINABLE YIELD

The concept of sustainable yield specifically relates to achieving a continuity of wood production by:

> *Managing a forest or plantation with the aim of achieving an approximate balance between the volume of net annual growth and the annual harvested volume of wood* (based on Davis, 1966)

This is achievable where harvesting that occurs each year is limited to a portion of the forest or plantation and is planned to match the growth occurring over the rest of the forest/plantation each year. It relies on harvested areas being immediately regenerated or replanted so that they can contribute to the annual forest/plantation growth in future years.

Where sustained yield can be determined accurately the productivity of the forest/plantation and the industries that rely on its wood resource can be maintained in perpetuity (subject to a lack of natural disasters). However, it requires detailed inventory to establish accurate area statements and tree growth rates. This requires extensive plot-based measurements of tree volume and growth parameters extrapolated to create whole of forest or plantation wood volume estimates.

Sustainable yield is a dynamic concept and there is a need for regular recalibration in response to events which impact on tree growth and resource productivity such as damaging wildfire, pest/disease infestation, changes to environmental protection regulations, or political decisions that reduce the area of forest resource available for wood production.

Calculating the sustainable yield is typically difficult in Australian native forests due to the tremendous variability in forest types and their growth and productivity. In addition, they have a considerable propensity for wood defects which can significantly reduce usable volumes, but is often difficult to accurately gauge and quantify in standing trees.

In contrast to this, plantations typically comprise only one tree species and tend to grow with far greater uniformity on any given site. However, where a plantation estate includes multiple sites of different ages spread across a large region or a state, it can also become a complicated exercise to establish the sustainable yield.

In Australia, the sustainable yield of hardwood sawlogs has been calculated for the wood production zones of multiple use public native forests (ie State forests) in each state. According to Australia's State of the Forests Report 2013, the volume of native hardwood sawlogs harvested from these forests from 1992–93 to 2010–11 was at or below the calculated sustainable yield in New South Wales, Tasmania, Victoria and Western Australia, and at or below the allowable cut in Queensland.

The State of the Forests Report also notes that the national native forest sawlog harvest level was 17% below the calculated sustainable yield for the period 2006–11, and 6–18% below the calculated sustainable yield in each of the past four five-yearly reporting periods. This confirms that sawlog harvesting from those portions of public native forest where it is permitted is sustainable on a statewide and national basis.

Plantations are mostly privately-owned by a range of companies and individuals each with their own management intentions, plans and strategies. Accordingly, there are no accurate statewide or nationwide statements of the sustainable plantation yield, although undoubtedly the major companies managing large plantation estates would be working to sustain their productivity and would have determined the approximate annual yield from their own resource needed to do so.

## Activity 4.1

**In native forests, the calculation of statewide sustainable yield is limited to only one product (sawlogs) within just one category of land tenure (public State Forests) in which forest management plans and policies clearly delineate zones where harvesting is permitted and the conditions and regulations under which this can occur under the direction of a State Government agency.**

**Typically, statewide sustainable yields have not been determined for other wood products such as pulpwood. Nor have they been accurately determined for the private native forest estate as a whole (beyond broad guesstimates). In a few paragraphs, briefly explain why you think this may be the case.**

## Activity 4.2

**A plantation contains 150,000 $m^3$ of standing usable wood volume (at 500 $m^3$/ha) being managed on a 30-year rotation. Assuming an even spread of age classes and a consistent rate of growth across its whole area, what volume of wood and area can be sustainably harvested each year (ie. the sustainable yield)?**

### KNOWLEDGE OF BIODIVERSITY VALUES

In Australia's public native forests, information about biodiversity is typically available from state government land management agencies drawing on past field survey and research records. In private native forests, there is less likely to be specific information about biodiversity pertaining to particular areas and it may be necessary for landowners to commission flora and fauna surveys in order to understand their forest's environmental values.

Plantations are usually relatively lacking in biodiversity within the planted area itself, but there may be biodiversity values present in adjacent retained native vegetation such as internal stream buffers, or the waterways they are protecting. This could be significant given the routine use of agrichemicals for intensive weed control and fertilisation during plantation establishment, or re-establishment after harvesting.

## Activity 4.3

**For a forest or plantation that you are familiar with, would you classify the knowledge of its biodiversity values as high, medium or low, ... and why?**

### KNOWLEDGE OF COMMUNITY VALUES

In Australia's public native forests, there is likely to be knowledge about community values from recreational, tourism, and other use surveys, such as firewood collection. In private native forests, community values are typically already understood and appreciated by the owner.

Plantations are often relatively lacking in community values compared to native forests. Nevertheless, they can provide good recreational opportunities in some instances subject to owner permission.

Water is often cited as an important community value of forests and plantations. Certainly, treed catchments perform an important role in filtering and regulating run-off into streams and, in some cases, water storages. At times, forest and plantation growth has been villified as a misuse of scarce water resources even though this a natural use of rainfall.

Theoretically, plantations could directly compete for water with agriculture under irrigation regimes. However there are relatively few irrigated plantations in Australia and these are typically irrigated with waste-water as a means of municipal effluent disposal more so than a competing use of agricultural land. In accordance, their watering is often opportunistic and does not involve any requirement for sustainable use of potable water.

## Activity 4.4

**For a forest or plantation that you are familiar with, would you classify the knowledge of its community values as high, medium or low, ... and why?**

## CARBON STOCKS

With respect to practising sustainable forestry, the reasons why the carbon stocks of a forest or plantation could be measured include:

- To achieve or maintain forest certification under the Australian Forestry Standard or the Forest Stewardship Council by demonstrating that the forest or plantation is being managed in a manner that sustains or enhances its contribution to carbon cycles
- To report the greenhouse balance of a forestry investment to shareholders or other stakeholders
- To meet the recommended reporting requirements of the Australian Securities Exchange' (ASX) "to act ethically and responsibly" towards the environment

The field process of measuring carbon stocks is similar to conducting a wood volume inventory in which extensive sample plot measurements of tree growth parameters are fed into tree carbon models, with the findings then combined and averaged and ultimately extrapolated to create whole of forest or plantation estimates.

### Activity 4.5

**Does your workplace measure carbon stocks in the plantations or forests which it manages ... why or why not?**

## TREE AND ECOSYSTEM HEALTH

In some instances, knowledge of tree and ecosystem health can be an important factor in determining sustainable management strategies. For example, plantations or plantation sections which are badly afflicted with pests or disease may need to be liquidated to prevent their spread to the rest of the plantation estate.

In native forests, poor tree health could be a reason for harvesting with the intention of ultimately creating a regenerated forest that is far more vigorous and healthy. On the other hand, forests afflicted with pathogens such as *Phytophthora* or *Armillaria* may be precluded from harvesting as a means of containing their spread.

Concerted programs to measure tree and ecosystem health may occur periodically in response to observed concerns. The development and continued refinement or aerial assessment technology using LIDAR or remote-sensing satellite data can make large-scale ecosystem health assessments far easier and more cost-effective than was formerly the case.

# 5. HARVESTING TREES WHILE MINIMISING ADVERSE IMPACTS

## LEARNING OBJECTIVES FROM THIS SECTION

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

- The values that can be adversely impacted by tree harvesting
- The planning and regulatory instruments used to avoid or minimise tree harvesting impacts
- The practical operational techniques used in the field to avoid or minimise tree harvesting impacts to soils, water, and biodiversity values
- What would be needed to conduct an audit of environmental performance during tree harvesting

## THE POTENTIAL FOR ADVERSE IMPACTS FROM TREE HARVESTING

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

- Soil structure, stability and productivity
- Water quality and stream health
- Biodiversity conservation
- Cultural heritage

In accordance with Federal and State Government legislation and associated regulations (e.g. codes of practice), sustainable forestry practices include harvesting native forests and plantations in a manner that avoids or minimises impacts to these values.

The measures commonly used to minimise impacts on these values during tree harvesting operations are described in the following sub-sections.

## OPERATIONAL PLANNING AND MANAGEMENT

Operational planning and management is a critical part of minimising the environmental impact of tree harvesting because it requires supervisors of operations to identify the key environmental and cultural heritage values and compels harvesting contractors to operate in ways that take account of them.

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 among states, they typically provide mandatory minimum standards, operational prescriptions, and/or guidelines for meeting environmental and heritage protection requirements during tree harvesting operations in both native forests and plantations.

Typically, they also include a mandatory requirement for formal detailed planning for tree harvesting operations which must be approved by appropriate authorities prior to their commencement. 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.

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

addressed. This may include applicable work health and safety (WH&S) requirements, or may provide links to other regulatory instruments that deal with what is an important aspect of sustainable forestry.

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

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 in other states, although tree harvesting plans are referred to by other names:

**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)

## PROTECTING SOIL STRUCTURE AND PRODUCTIVITY

The protection of soil values is inherently linked to the protection of water quality as significant soil degradation that leads to channelised water movement and ongoing erosion is ultimately what pollutes waterways.

The strategies used to minimise soil disturbance and degradation are:

- Good operational planning
- Sensible management of harvesting infrastructure during the operation
- Rehabilitation and stabilisation of the 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 operational planning** includes locating 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 vulnerable areas.

It can also include nominating harvesting machinery and methods that are best suited to the site and its soil types, and scheduling harvesting during drier seasonal conditions as far as possible.

**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 procedes, so as to avoid the situation where long lengths of undrained track are left vulnerable to erosion. In plantations, this can include placing piles of slash at intervals along major extraction tracks to trap and disperse potentially channelised water flow.

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.

**Rehabilitation and stabilisation of the infrastructure at the completion of harvesting** involves works to effectively drain water from extraction tracks and to restore the drainage systems of log cartage roads, so as to prevent channelised 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 earth structures variously known as bars, cross drains, or cross banks that trap water flow and divert it off the track/road into adjacent harvesting slash or undisturbed vegetation where it can be effectively trapped and dissapated, thereby preventing erosion.

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

**Table 1: Victorian example of a guideline for spacing of drainage structures to prevent erosion**

| 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 |

*Source: Forest industry prescriptions for the Colac Otway Shire, Victoria, 2001*

In plantations, it can be permissable to place piles of harvesting slash, at twice the frequency required for constructed cross drains, as an alternative measure to minimise erosion potential.

**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)

## Activity 5.1

**From your knowledge of your organisation's activities, what soil protection measures are used in the forests or plantations that you are most familiar with?**

## PROTECTING WATER QUALITY AND STREAM HEALTH

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

- Channel size and the nature of their water flow (i.e. 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 criteria used to classify waterways vary among states and this can lead to variations among the levels of protection applied to them. For example, different definitions of 'drainage line' used in Victoria and northern NSW means that minor, usually dry, gullies that are afforded protection during tree harvesting in Victoria, require no protection in northern NSW.

There can be also differences in waterway definitions and the applicable levels of protection between native forests and plantations or even among regions in the same state.

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

- Exclusion buffers applied to significant permanent waterways where tree felling and the entry of harvesting machinery are completely prohibited
- Buffers applied to permanent waterways where limited tree felling and machinery movement is 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 flow 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 very limited temporary crossing of minor waterways is usually permitted, and temporary crossings of more significant waterways can be permitted in some cases, both under the proviso that the crossings 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 among the States in accordance with differing ways of defining waterways.

The effective width of waterway protection zones can also vary due to topographic circumstances such as very steep gullies where tree felling without substantial risk to the buffer may be virtually 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 boundary.

The protection of waterways in plantation harvesting 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 waterways on the understanding that they could be harvested in the future. Under these circumstances, plantation trees located in close proximity to waterways are generally able to be directionally-felled away from the waterway subject to restrictions on access by harvesting machinery.

The other potential source of degradation to stream health is drainage water flowing from log cartage roads. This can be avoided where roads are well sited, well designed, and constructed with adequate drainage systems that regularly direct water off the road into vegetation where sediments can be trapped or disappated rather than allowed to flow directly into waterways.

On 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 a high rainfall region in south western Victoria.  Road drainage structures include culverts, mitre drains (also known as run-offs), or cross drains, such as roll-overs.

**Table 2: Guide for maximum spacing between road drainage structures in the high rainfall region in south western Victoria**

| Soil Erodibility | Road Grade | | | | | | |
|---|---|---|---|---|---|---|---|
| | 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 |

*Source: Forest industry prescriptions for the Colac Otway Shire, Victoria, 2001*

The following online 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 effectively draining road surfaces, another critical aspect of minimising potential impacts on water quality and stream health is having well constructed and maintained road crossings 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)

## Activity 5.2

Consult the following codes of practice and note their respective waterway protection requirements, and fill out the attached table. Don't forget to look at the definitions of various types of waterways in the codes to ensure 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

| State/forest type | Protection measures | |
|---|---|---|
| | Drainage line | Permanent stream |
| Victoria – public native forest | | |
| Tasmania – public native forest | | |
| Northern NSW – private native forest | | |
| NSW – plantations | | |

## PROTECTING BIODIVERSITY

Subject to how it is done, 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 absent or far lower.

In native forests, the focus on minimising impacts to biodiversity is based on both general measures, and specific measures designed to protect significant values found to be present in a particular harvesting coupe.

General measures may vary according to the intensity of the harvesting operation. For example, a light selective harvest that leaves most trees standing may not have much impact on biodiversity, but a more intensive harvest usually requires the deliberate retention of trees to provide ongoing and future habitat.

To a large extent, biodiversity is already catered for by the retention of exclusion buffers along waterways, and there has been an increasing tendency in recent years to simply make these wider to gain additional biodiversity

protection as a more secure strategy than leaving trees scattered across harvested areas where they are likely to be killed in a subsequent regeneration burn or blown-over due to sudden exposure to wind.

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)

In addition to these general biodiversity protection strategies, there may be a need to specifically reserve areas to protect known special values, such as rainforest, or the presence of particular rare or endangered species, such as nest sites of the wedge-tailed eagle in Tasmania, or the habitat of Leadbeater's Possum in Victoria.

The following video clip discusses the principles of protecting threatened species during tree harvesting operations in private native forests in NSW. 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 private native forests in NSW, which is also broadly applicable to public and private forests in 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 minor complementary measure to the far more substantial conservation efforts already being achieved by reserving large parts of the landscape in national parks and other conservation reserves where tree harvesting is excluded, and by the effective reservation of other areas that are unsuited to tree harvesting for a variety of reasons.

The fact sheets (see links below) from the WA Forests Products Corporation and VicForests outline the biodiversity protection measures that they employ and puts these into context with the landscape-scale conservation measures being achieved in nature conservation reserves.

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 is generally a reduced 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. However, in other States, private forests may be treated little differently to public State forests in this regard.

In plantations that have been established specifically for wood production, there is generally no mandatory imperative to reduce harvest productivity to minimise biodiversity impacts, but there are requirements to protect adjacent native vegetation growing along waterways and on neighbouring lands from damage that could result from plantation harvesting.

On the rare occasions where special biodiversity values develop within the plantations themselves, there may be social and reputational advantages for plantation owners to act to minimise impacts even if it is at the expense of reduced wood production or less optimal harvest scheduling. Where corporate plantation owners or managers are certified under schemes such as the Australian Forestry Standard or the Forests Stewardship Council, there may be a market imperative to do so if it is contingent to maintaining their certification.

## Activity 5.3

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. Use the table below to 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 parameters |
|---|---|
| Eg. Timber Harvesting Plan | Does a THP exist?<br>Does it correspond to the area harvested?<br>Does it cover all the requirements set out in the Code of Practice? |
| Streamside buffer | Is it the required width?<br>Is it intact or has it been damaged by harvesting? |
| | |
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| | |

# 6. REGROWING TREES WHILE MINIMISING ADVERSE IMPACTS

## LEARNING OBJECTIVES FROM THIS SECTION

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

- That regrowing trees is the foundation of sustainable native forest and plantation management
- The steps that are required in re-establishing a harvested plantation area
- That monitoring the progress of early regrowth or replanting is critical to its ultimate survival and success

## THE IMPORTANCE OF REGROWING TREES

The regeneration or replanting of harvested forests or plantations is the cornerstone of what constitutes sustainable forestry, and is what seperates it from deforestation in which tree cover is permanently lost, either to other land uses, or just neglected and ultimately replaced by scrub, weeds or grass.

## NATIVE FORESTS

There is an inherent link between the harvesting system used and the capability to regenerate. Harvesting systems have been developed and shaped by the requirement to successfully regenerate areas after they've been harvested cognisant of the silvicultural requirements of the forest type/s in question.

For example, the clearfell-burn-and sow system used in the wet eucalypt forests of south-eastern Australia was specifically developed in the late 1950s to overcome poor or unsatisfactory regeneration of these forest types from earlier selective harvesting systems. It aimed to mimic what research indicated was the natural reliance of these forest types on intense fire to create a scorched earth seed-bed under full sunlight to stimulate the germination of seed dropped from burnt trees.

Accordingly, the capacity to successfully regenerate harvested Australian native forests requires knowledge of their silvicultural requirements and ecological niches.

Australia is home to many different forest types with varied harvesting and regeneration requirements. Typically, there is pre-existing local knowledge of what systems are needed in particular forest types based on decades of previous harvesting and regeneration experience.

It is also worth noting that regeneration is not always needed after harvesting, such as for example, when regrowth forests are thinned specifically to reduce competition and concentrate future growth onto a smaller number of the best formed trees.

Factors which determine native forest harvesting and regeneration systems include:

- **Forest type** – wet forest with dense luxuriant understorey; dry forest with more open, sparse understorey; or intermediate forest

- **Dominant tree species** – shade intolerant species requiring fire to create suitable conditions for regeneration; or shade tolerant species that can be consistently regenerated without fire
- **Seed production capability of the dominant tree species** – known consistent and prolific seeders; or known for unreliable seed production
- **Forest age and structure** – even-aged with all trees of similar size; or mixed age with young and old trees interspersed
- **Presence of regrowth** – either evenly scattered or in consolidated patches
- **Presence (or absence) of known endangered species** of flora and/or fauna requiring specific protection measures
- **Topography** – steep ground or gentle to moderate slopes which can influence the capability to safely undertake partial harvesting systems such as thinning
- **Climatic conditions** – especially extreme cold that can inhibit regeneration on exposed high altitude sites that have been intensively harvested
- **Wood products** being sought which can reflect market demand and/or forest type and productivity.

There are six methods broadly used to harvest and regenerate Australian native forests:

- **Clearfell-Burn-Sow** – where all (or almost all) trees are felled and the resultant slash is burnt to create a seedbed which is then artificially sown with previously collected seed
- **Seed Tree System** – where most trees are felled apart from evenly scattered trees retained as seed sources to naturally regenerate a burnt or mechanically disturbed seedbed. In some cases, natural seedfall from the seed-trees may need to be supplemented with artificially-sown seed to better ensure regeneration
- **Shelterwood** – a two-stage harvest whereby a partial first-cut creates gaps which regenerate without fire under the protection of the retained trees; followed by a second cut typically 10 – 20 years later to remove the originally retained trees and release the original regeneration from competition so it can fully occupy the site (see Figure 1)
- **Group selection** – a light partial harvesting technique in which small groups of trees are removed to create gaps that then regenerate with or without the need for fire (see Figure 2)
- **Single tree selection** – a very light harvesting approach whereby only scattered single trees are removed without the need for any subsequent regeneration treatment
- **Thinning** – the harvest of a specified proportion of a tree stand with the intention of improving its future productivity by removing unwanted competition and concentrating growth onto a smaller number of the best-formed trees. Again, there is no requirement for regeneration.

In these systems, efforts are typically made to retain good quality habitat trees and recruitment habitat trees particularly in the more intensive systems. In many instances, these can also play the dual role of acting as seed trees.

The following video clip outlines the thought-processes used to determine the most appropriate harvesting and regeneration approach in private native forests in NSW. This can be extrapolated to other Australian forest types where a broader range of options may be available.

**NSW Private Native Forestry Technical Series: *Principles of silviculture in private native forestry* – a Peter Hill video on Vimeo**
http://vimeo.com/60629492 (4:49 minutes)

**Figure 1: Diagramatic representation of the shelterwood system with habitat tree retention (from Campbell 1997)**

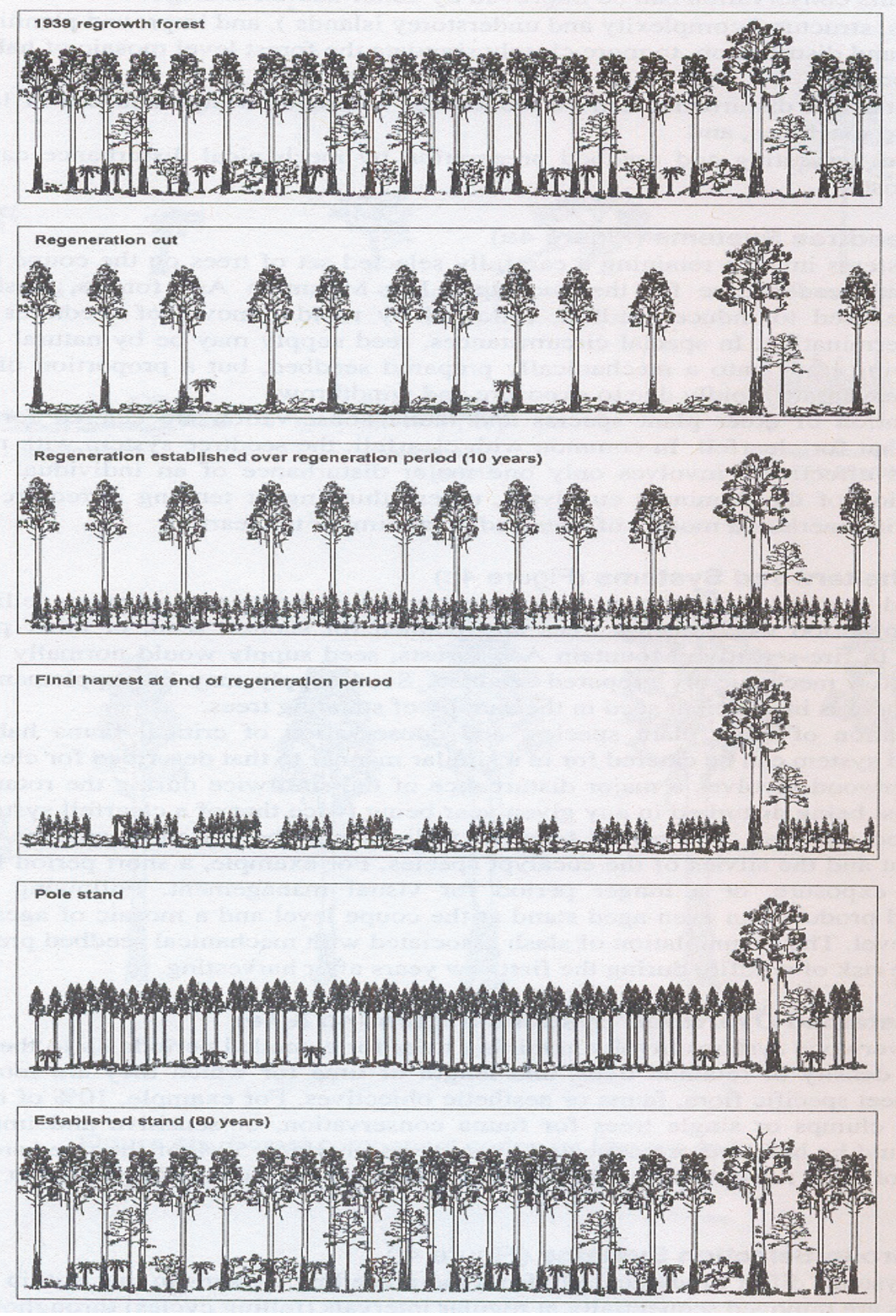
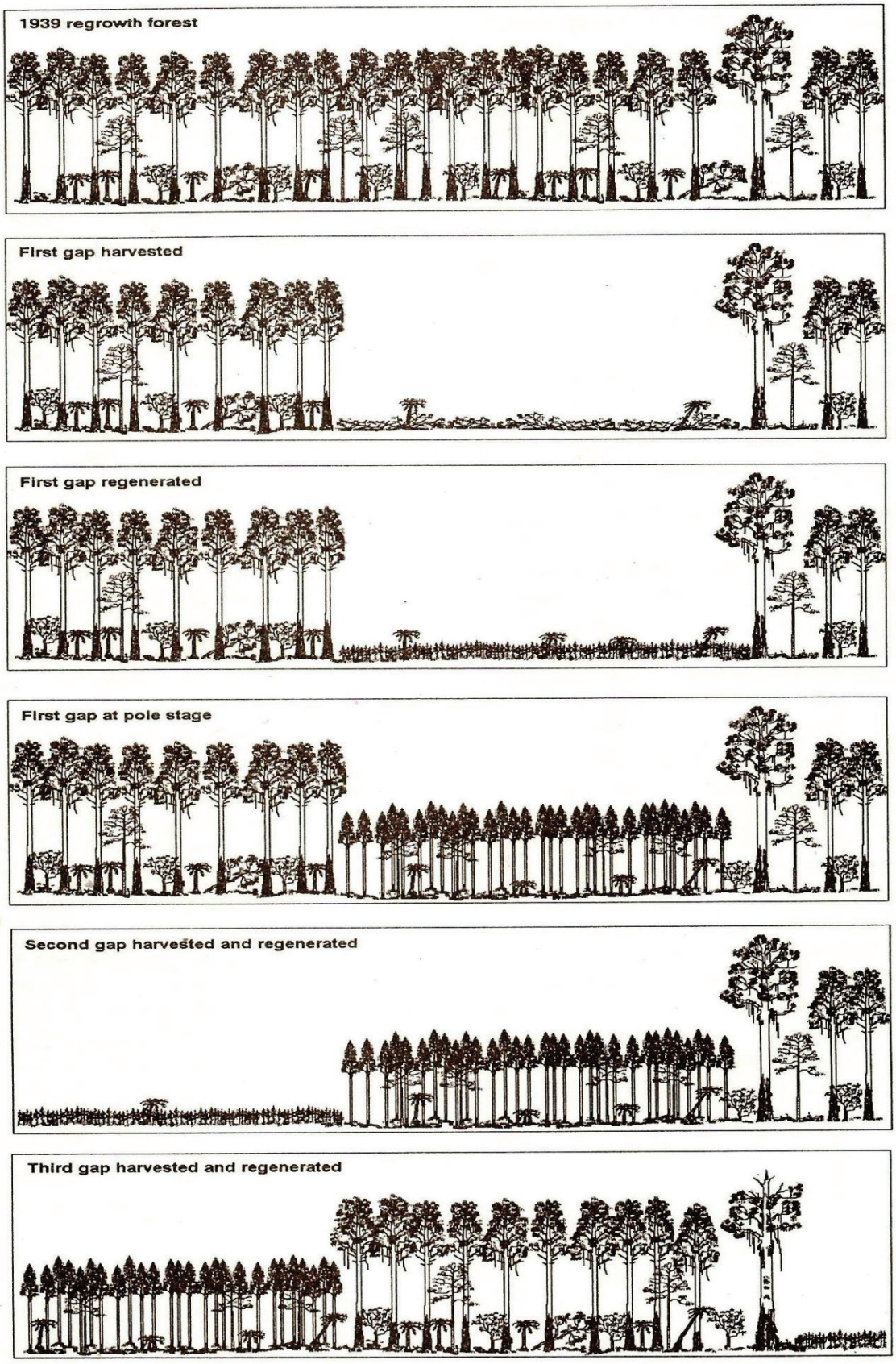


**Figure 2: Diagramatic representation of the group selection system (from Campbell 1997)**



## Activity 6.1

Either pick one of the following NSW forest types or a forest type that you are familiar with and describe its most commonly used harvesting and regeneration system and briefly justify the reasons for its use.

- Cypress pine (*Callitris glauca*) woodlands in north central inland NSW
- River red gum (*E. camaldulensis*) mature floodplain forest in the Murray Darling Basin
- Coastal mixed species regrowth forest (silvertop, stringybark) in south eastern NSW
- Box/ironbark forest in central NSW
- Blackbutt (*E. pilularis*) regrowth forest in central coastal NSW

You can refer to the NSW Native Forest Silviculture Manual for further information:

www.forestrycorporation.com.au/__data/assets/pdf_file/0005/438404/forests-nsw-native-forest-silviculture-manual.pdf

## PLANTATIONS

Renewable plantation management also requires knowledge of the silvicultural requirements of the various exotic and native tree species that comprise Australia's plantations estate, as well as an understanding of the intensive establishment techniques used to optimise their survival and early growth.

Australia's plantations are either thinned one or more times before being clearfelled in a final harvest; or simply final felled without any previous thinning.

The choice of harvesting strategy is primarily based on the plantation type (i.e. species) and the products for which it is being grown which together determines the age when it should be final felled.

For example, hardwood (eucalypt) plantations being grown for pulpwood (i.e. woodchips) are typically just final felled every 10 – 15 years (subject to site productivity) with no intermediate thinning during their growth cycle (i.e. rotation). Whereas softwood (pine) plantations typically supply a diverse range of products to a far broader industry, and so are usually thinned one to three times to produce a variety of small log products, before being final felled for larger sawlogs and other products at around 30-years of age.

The methods of plantation re-establishment after final felling typically broadly replicate the process originally used to first establish the plantation, notwithstanding that there have been considerable technical improvements particularly to the treatment of slash and soils, the control of pests and competition, and in better targetted fertilisation programs over the past 50 years. These are greatly improving outcomes compared to those achieved when plantations were being first established, mostly from the 1960s to 80s.

## Activity 6.2

**The use of better knowledge and manipulation of these factors to improve plantation growth and productivity is exemplified in the way that the incidence of 'second-rotation decline' was addressed in Radiata Pine plantations growing in the sandy soils of Victoria's and SA's 'Green Triangle' region.**

**The traditional replanting practice following final harvesting at the end of the first rotation had been to heap and then burn the harvesting slash. What simple change to this standard practice could have overcome the observed loss of productivity in the second rotation?**

Factors that need to be considered when determinimg a program for successful plantation re-establishment are:

- **Amount of harvesting slash** – dictates the slash treatment method needed to create an accessible planting environment
- **Topography** – also a consideration in determining the slash treatment method, as well as influencing soil cultivation, weed control and fertilising methods
- **Soil type** – dictates the need for soil cultivation and the treatment method, and is a key consideration when determining a fertilisation program to boost tree growth
- **Weed species and abundance** – dictates the weed control process to free planted seedlings from early competition both in terms of agrichemical requirements and treatment method
- **Browsing animal species and abundance** – dictates the need for browsing animal control to protect planted seedlings, and the treatment method.

Planting strategies are typically based on landowner intentions with respect to land management, future products and markets, and site parameters such as soil fertility and annual average rainfall. For example, high rainfall, high soil fertility sites are often planted at higher stocking density so as to optimise the use of the available site resources, whereas drier sites may be planted at lower stocking in recognition of a lower capacity to grow numbers of sizable trees.

Landowner intentions are important. For example, while a timber industry company is obviously primarily motivated by growing wood, a small farm grower may be more motivated by tree planting to provide some future wood while complementing his agricultural ventures. Accordingly, a wide-spaced agroforestry planting may be more desirable as it can enable continued grass growth thereby allowing grazing stock to simultaneously use the planted area and derive benefit from its shelter.

The typical regime used to re-establish plantations after harvesting is:

Step 1: Treat harvesting slash to create an accessible replanting area. Typical methods include broadacre burning, mechanised slash heaping, or chopper-rolling to knock-down and crush slash.

Step 2: If necessary, undertake a soil cultivation operation.

Step 3: Treat any emerging weed or grass growth with herbicide to remove competition prior to planting.

Step 4: Plant seedlings according to the pre-determined stocking requirement. Typical stocking in southern Australia is 1000 – 1100 trees per hectare, but may be around the 1300 mark on the best sites.

Step 5: Fertilise seedlings to boost early growth and survival, as well as to get ahead of any regrowing weed or grass competition.

Step 6: If necessary, take steps to prevent animal browsing. This could include fencing, shooting, or poisoning subject to permits granted by wildlife management authorities and chemical use regulators.

Step 7: Monitor the plantation to assess plant survival and health, including evidence of browsing or excessive competition.

Step 8: If necessary, use herbicides to treat emerging weed or grass competition.

Step 9: If necessary, replant the area to replace dead trees.

Step 10: Continue to monitor the plantation until trees have clearly beaten the competition and are in good health.

Typically, the first six steps are undertaken over a 6 to 9 months period. However, it may be several years before the plantation can be considered to be growing well and free of early competition and browsing problems.

## MONITORING REGENERATION/REPLANTING SUCCESS

It is not enough to simply regenerate or replant harvested areas. The need for sustainability dictates that these operations must meet defined standards of success which entails post-treatment monitoring and, where necessary, repeated regeneration/replanting efforts until the appropriate standard is met.

In native forests, successful regeneration is typically determined by:

- Gridded plot-based assessments recorded in terms of the proportion of plots that are adequately stocked with tree seedlings from one to three years after sowing – used in Victoria and Tasmania
- Point-to-plant method for determining seedling density expressed in numbers per hectare – used in NSW
- Triangular tessellation method which measures seedling density and spatial distribution – used in WA.

By converting these different measures to a stocking density assuming a random distribution of seedlings, the various minimum standards for successful regeneration can be compared (see Table 3 below).

**Table 3: Comparison of minimum standards for successful regeneration after intensive native forest harvesting**

| State | Regeneration survey method | Converted minimum stocking for successful regeneration |
|---|---|---|
| NSW | Point- to-plant | 500 seedlings/ha |
| TAS | Quadrat plots | 500 seedlings/ha |
| VIC | Quadrat plots | 400 seedlings/ha |
| South West WA | Triangular tessellation | 1400 seedlings/ha (for Karri)<br>3250 seedlings/ha (for Jarrah) |

Under forest practices codes, sites which fail to meet these minimum standards must be re-treated to boost seedling stocking to above the minimum standard. In some states, there are also lower minimum stocking requirements that apply to defined small consolidated understocked patches which can also trigger a need for re-treatment. The following video outlines the process of regenerating harvested native forests in Victoria:

**VicForests:** ***Regrowing our natural forests after timber harvesting***
http://www.youtube.com/watch?v=h3857XjwNqI (5:07 minutes)

In plantations, establishment success is also measured by whether the planted tree stocking over the whole area meets a minimum stocking standard at some defined time after planting, and/or whether consolidated small understocked patches within the plantation meet a defined lower standard.

Typically plantation stocking survival is measured by a tree counting method which aims to assess a representative sample of the planted area.

The standards applied may vary among plantation owners/companies, but a typical example could be that 90% of planted seedlings must be present and healthy one year after planting. Failure to meet the designated standard would trigger a need to revisit the site and appropriately treat it for re-planting.

# 7. PROTECTING TREES FOR THE FUTURE

## LEARNING OBJECTIVES FROM THIS SECTION

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

- The importance of protecting trees to ensure sustainable forest or plantation management

## THE IMPORTANCE OF PROTECTING TREES

Sustainable forestry dictates that treed ecosystems should be protected from unnatural destructive agents that damage their health and vigour, and ultimately shorten their lives. If trees are not adequately protected forests and plantations become unsustainable.

## THE MAJOR THREATS AND HOW THEY ARE MANAGED

The overall sustainability of Australia's lands and forests is being threatened by various destructive agents that have accompanied European colonisation, and in some cases have been aided by the associated decline of traditional land management formerly practiced by indigenous Australians. These agents include:

- Unnatural fire regimes – usually as a result of a long-term lack of burning which then leads to unnaturally severe summer wildfires, but in some cases because of too frequent burning or burning at wrong times of the year
- Feral animals which prey upon native fauna (such as foxes and cats) and/or compete for food with native fauna, or damage soil and water values (pigs, deer)
- The introduction of exotic weed species (such as blackberry) which out-compete native flora and thereby reduce habitat for native fauna
- The presence and periodic spread of introduced pathogens, diseases, or insect pests.

With respect to these issues, responsible forestry practices include:

- Taking actions to restore the natural fire regime in long unburnt native forests by introducing a program of regular cool controlled burning in accordance with the best available knowledge of presumed pre-European burn intervals for the affected forest types
- Reducing the risk of unnaturally severe summer wildfires by regular and strategic prescribed burning in native forests (as per above), as well as by maintaining a well trained and equipped forestry workforce, maintaining road and track access or creating and maintaining firebreaks, developing and maintaining a vigilent approach to wildfire detection, and developing and maintaining cooperative links with other fire agencies
- Taking active steps to control feral animal populations in forests or plantations
- Taking active steps to control weed infestations in native forests and plantations, or to at least prevent them from spreading to adjacent lands
- Regular monitoring of the health of forests and plantations so as to be better placed to detect the presence of pests and diseases and then taking action to control them or to at least prevent their spread.

Unfortunately in reality, the capability to undertake these responsible practices is often hindered by a lack of resources, particularly on public lands where funding for management activities must compete with higher profile societal demands on Government budgets such as health, education, and law and order.

Corporate plantation owners may have a greater capacity to undertake meaningful efforts to address these issues, not withstanding that they have stewardship of controlled, artificial environments which typically lack the complexity of native forests and the difficulties of accessing them.

# 8. BRINGING IT ALL TOGETHER

## IMPLEMENT SUSTAINABLE FORESTRY PRACTICES

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 develop, implement and review an environmental audit for an element of a forested or wooded area, preferably one that you are wholly or partially responsible for in its management. For example, you could audit water protection or soil protection or both. If you are not in a position to do this as part of your job it is recommended that you establish an exemplar audit of a small forested area in your locality.

### Establishing the benchmarks

- Document what legislative and regulatory frameworks are used to protect soils and water
- Document what enterprise sustainability guidelines are used to manage soils and water

### Set audit criteria

The audit should provide a rating system so as to assess the success of the management of a particular defined site, taking into consideration appropriate sustainability factors such as, for example, safety, pests, fire and waste.

### Conduct audit

It is recommended that you ask a third-party person to conduct the audit against the benchmarks and criteria developed by you.

### Evaluate results

Assess the results of the audit, rank the activities and make recommendations for improved sustainable practice. Identify the one recommendation that will make the most positive impact on sustainability.

# SOURCES AND FURTHER READING

Australian Forestry Standard, Sustainable Forestry www.forestrystandard.org.au/

Australia's State of the Forests Report 2013, Department of Agriculture

http://www.daff.gov.au/ABARES/forestsaustralia/Pages/SOFR/sofr-2013.aspx

Australia's Sustainable Forest Management Framework of Criteria and Indicators 2008 – Policy Guidelines

http://www.daff.gov.au/ABARES/forestsaustralia/Documents/ciframework.pdf

Campbell (1997). Evaluation and Development of Sustainable Silvicultural Systems for Multiple Purpose Management of Mountain Ash Forests: Discussion Paper, by Rob Campbell, Centre for Forest Tree Technology, Victorian Department of Natural Resources and Environment

Crawford (2006). A review of forest certification in Australia, by H. Crawford, prepared for the Forest & Wood Products Research and Development Corporation, Project PN05.1025 (September 2006).

Davis (1966). Forest Management (2nd Edition) by Kenneth P Davis, McGraw - Hill

Forest certification in Australia, www.daff.gov.au/forestry/australias-forests/certification

Forest Europe – growing life, Ministerial Conference on the Protection of Forests in Europe

http://www.foresteurope.org/sfm_criteria

The Montreal Process Criteria and Indicators (3rd Edition – 2009)

http://www.montrealprocess.org/documents/publications/techreports/2009p_1-3.pdf

Sustainable Forest Products website developed by the World Resources Institute and the World Business Council for Sustainable Development

http://www.sustainableforestproducts.org/home

Tomkins (2004). A critique of the Forest Stewardship Council's chemical criteria for certification of plantation forestry, by IB. Tomkins, University of Melbourne, Australian Forestry, Vol 67 (1) 67-72

Tomkins pers comm (2014) Personal comments by Barry Tomkins, Green Tree Forestry Services, formerly of the University of Melbourne, Creswick campus (June, 2014)

US Sustainable Forestry Initiative, 2010-2014 Standard (January 2010) Section 2: Principles of Sustainable Forestry http://www.sfiprogram.org/

# SELF ASSESSMENT

Before "starting 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 about 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 recognise common diseases, pests and nutrition deficiencies | | | |
| Communication skills sufficient to use appropriate consultative, communication and interpersonal techniques with colleagues and others | | | |
| Literacy skills sufficient to prepare a range of reports, documentation and submissions where precise meaning is required | | | |
| Numeracy skills sufficient to analyse qualitative and quantitative information and data | | | |
| Problem solving skills sufficient to identify problems; demonstrate appropriate response procedures | | | |
| **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 implementing sustainable forestry practices | | | |
| Environmental protection requirements, including the safe disposal of waste material, the minimisation of carbon emissions, and returning the environment to its original or near to original condition on completion of activity | | | |
| Organisational and site standards, requirements, policies and procedures for implementing sustainable forestry practices | | | |

| Skills/knowledge you should have | Confident | Need Practice | What additional training do I need? |
|---|---|---|---|
| Environmental risks and hazards | | | |
| Using energy effectively and efficiently | | | |
| Using material effectively and efficiently | | | |
| Procedures for developing and implementing a range of environmental management strategies | | | |
| Energy flow and food web frameworks | | | |
| Stages of nutrient cycling | | | |
| Principles of sustainable agriculture systems | | | |
| Principles of composting and waste management | | | |
| Soil testing processes and procedures and results interpretation | | | |
| Established communication channels and protocols | | | |
| Problem identification and resolution strategies, and common fault finding techniques | | | |
| Types of tools and equipment, and procedures for their safe use and maintenance | | | |
| Appropriate mathematical procedures for estimating and measuring, including calculating time to complete tasks | | | |
| Procedures for recording and reporting 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** | ***Implement Sustainable Forestry Practices*** |
|---|---|

| **Page** | **What is in error** | **Suggested improvement** |
|---|---|---|
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| **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.

**Technical review**

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